Proceedings of the New Zealand Grassland Association 52: 237-240 (1990)

Effect of a molluscicide and an insecticide on the establishment of direct-drilled ryegrass, tall fescue and phalaris

D.A. McCALLUM[1] and N.A. THOMSON[2]
Taranaki Agricultural Research Station, MAF Technology, Normanby
[2]Flock House Agricultural Centre, MAF Technology, Bulls

Abstract

The effect of a molluscicide or an insecticide on the establishment, by direct drilling of 'Grasslands Roa' tall fescue *(Festuca arundinacea* Schreb.) 'Ellett' perennial ryegrass *(Lolium perenne* L), and 'Grasslands Maru' phalaris *(Phalaris aquatica* L.) was measured in spring and autumn establishment over 2 years. In autumn after a wet summer the application of a molluscicide significantly increased seedling numbers and establishment yield for ryegrass and tall fescue. A molluscicide applied in autumn after a dry summer or in spring had no effect. Application of insecticide significantly improved the establishment of ryegrass and tall fescue in only one of the two springs and had no effect in autumn. Phalaris was the least responsive of the pasture species to either an insecticide or molluscicide. These differences observed at establishment resulting from the applications of a pesticide were not apparent in an assessment made 1 year later. For tall fescue the results recorded on seedling numbers and yield of sown species at establishment and 1 year would suggest that for this species establishment by direct drilling is not recommended.

Keywords pasture establishment, 'Grasslands Roa' tall fescue, 'Ellett' ryegrass, 'Grasslands Maru' phalaris, direct drilling, molluscicide, insecticide

Introduction

Tall fescue and phalaris have been recognised as pasture species that are tolerant to both drought and grass grub attack Kain et al. (1977). Studies in South Taranaki have show that they produce 17% and 15% more dry matter (DM) respectively than established pasture (Thompson *et al.* 1988; Judd *et* al. 1989), and consequently have been recommended for areas of low annual rainfall or where grass grub often damages pasture.

Direct-drilling into desiccated pasture is an efficient method of pasture renovation. However, the success of the practice when compared with conventional cultivation is particularly sensitive to pasture pests (Edwards 1975; Pottinger 1979). Observations of direct-drilled pastures at the Stratford Demonstration Farm and a pilot study at the Taranaki Agricultural Research Station demonstrated successful establishment of 'Ellett' ryegrass and phalaris, but failure to establish tall fescue.

Tall fescue establishes slowly (Brock 1983), and successful establishment by direct drilling will depend on effective weed and pest control. In the Taranaki trials weed control was effective and the possible failure of tall fescue to establish was thought to be due to damage by slugs or Argentine stem weevil (Pottinger 1979). This study investigated whether the application of a pesticide for either slug or insect control benefited the establishment by direct drilling of 'Ellett' ryegrass, 'Grasslands Roa' tall fescue and 'Grassland Maru' phalaris.

Methods

The study was conducted at the Taranaki Agricultural Research Station. The establishment of 'Grasslands Roa' tall fescue *(Festuca arundinacea* Schreb.) 'Grasslands Maru' phalaris *(Phalaris aquatica* L.) and 'Ellett' perennial ryegrass *(Lolium perenne* L.) were compared at sowings in spring and autumn over a 2-year period. The three species were compared with an insecticide, a molluscicide or a combination of both in a 3 x 4 factorial design trial with 4 replicates of each treatment.

Pasture was sprayed with glyphosate as Roundup at 4 l/ha and dicamba at 2 l/ha, 1 month before drilling. Four areas were drilled: 16/10/85 (spring 1985), 27/3/86 (autumn 1986), 4/11/86 (spring 1986) and 6/3/87 (autumn 1987), using a triple disc drill calibrated to sow 15 kg/ha of perennial ryegrass, 10 kg/ha of phalaris and 25 kg/ha of tall fescue. Grasses were all sown with 'Grasslands Pitau' *(Trifolium repens* L.) white clover at 3 kg/ha. Plot size was 1 drill width (2.45 x 6 m).

The insecticide chlorpyrifos was applied as Lorsban at 2 l/ha at plant emergence and then at 2 subsequent IO-day intervals. The molluscicide

metaldehyde bait (3% ai) was applied at 10 kg/ha at sowing, plant emergence and 10 days after emergence.

Plant populations were assessed by counting seedlings in 20 quadrats (20 x 20 cm)/plot. The yield of established grasses was assessed with the pasture probe (MK1 model Design Electronics Palmerston North) by measuring herbage mass before and after the first three grazings. Equations used for converting probe readings were derived from calibrations conducted weekly on the three pasture species over a 2-year period at the Taranaki Agricultural Research Station. Before the third grazing, pastures were sampled with shears to grazing height, for dissection into sown grass, legumes, weeds, dead and unsown species. Over the trial period slug and Argentine stem weevil populations were not assessed.

One year after drilling DM production and pasture composition were measured over a 10 to 15 day period after grazing. At this time pasture production was assessed with a mower and pasture composition was assessed by the method previously outlined. Information on pasture production is expressed as yield of sown species only.

In the results section, the yield of sown species will be referred to as the establishment yield and the molluscicide insecticide treatment as M x 1.

Results

Climate

The major difference in climate observed over the three seasons was the high rainfall in spring and autumn 1985-86 compared with the spring and autumn of the 1986-87 season (Table 1).

Seedling numbers

No significant interactions between pasture species and pesticide treatment were observed in either seedling numbers or establishment yield.

In all four seasons seedling numbers of tall fescue were significantly lower than of ryegrass (Table 2). In three of the four seasons, seedling numbers of phalaris at establishment were also significantly lower than those of ryegrass and similar to those of tall fescue.

In spring 1985, application of insecticide significantly increased seedling numbers; insecticide application over the other three seasons had no significant effect. The application of molluscicide significantly increased seedling numbers in autumn 1986 and again had no effect over the other three seasons.

In spring 1985, when insecticide had a major effect on seedling numbers, the effect was significant for phalaris and tall fescue; for ryegrass, a significant increase in seedling numbers was recorded only in the M x 1 treatment.

In autumn 1986, application of a molluscicide significantly increased seedling numbers for ryegrass and tall fescue, but no effect was observed for phalaris.

Table 1 Rainfall (mm) and soil temperature (10 cm °C) recorded over the trial period.

		Rainfall mm	Average soil temperature 10 cm (°C)
1985-86	Sept-Dec	460	12.3
	Jan-April	420	15.4
1986-87	Sept-Dec	280	12.5
	Jan-April	230	14.3

Table 2 Effect over four seasons of species and pesticide application on seedling numbers (no./m²) at establishment.

	Spring 1985	Autumn 1986	Spring 1986	Autumn 1987
Ryegrass				
Untreated	217	269	316	306
Molluscicide	257	512	233	286
Insecticide	285	373	286	336
M x I	301	552	287	336
Significant Contrasts	U vs M x I	U vs M U vs M x I	NS	NS
Tall fescue				
Untreated	77	17	182	215
Molluscicide	142	305	161	211
Insecticide	163	132	195	228
M x I	194	449	235	242
Significant Contrasts	U vs I U vs M x I	U vs M, U vs M x I I vs M, I vs M x I	NS	NS
Phalaris				
Untreated	122	297	208	216
Molluscicide	122	376	224	210
Insecticide	195	345	184	207
M x I	171	394	232	218
Significant Contrasts	M vs I*	NS	NS	NS
Main effects				
Species				
Ryegrass	265	427	280	311
Tall fescue	144	227	193	224
Phalaris	152	353	212	213
LSD 0.01	58	98	61	39
Pesticide				
Untreated	138	194	235	246
Molluscicide	173	398	206	236
Insecticide	214	283	222	250
M x I	222	465	251	265
LSD 0.01	67	113	NS	NS

Significant difference in main effects were all at the 1% level of significance and LSD for $P<0.01$ only are presented.

Treatment contrasts were all significant $P<0.01$ except for one * $P<0.05$

Establishment yield

In all seasons, the establishment yield of tall fescue was significantly lower than that of ryegrass and phalaris (Table 3). In spring 1986, the establishment

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Keywords pasture establishment, 'Grasslands Roa' tall fescue, 'Ellett' ryegrass, 'Grasslands Maru' phalaris, direct drilling, molluscicide, insecticide

Introduction

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Tall fescue establishes slowly (Brock 1983), and successful establishment by direct drilling will depend on effective weed and pest control. In the Taranaki trials weed control was effective and the possible failure of tall fescue to establish was thought to be due to damage by slugs or Argentine stem weevil (Pottinger 1979). This study investigated whether the application of a pesticide for either slug or insect control benefited the establishment by direct drilling of 'Ellett' ryegrass, 'Grasslands Roa' tall fescue and 'Grassland Maru' phalaris.

Methods

The study was conducted at the Taranaki Agricultural Research Station. The establishment of 'Grasslands Roa' tall fescue (*Festuca arundinacea* Schreb.) 'Grasslands Maru' phalaris (*Phalaris aquatica* L.) and 'Ellett' perennial ryegrass (*Lolium perenne* L.) were compared at sowings in spring and autumn over a 2-year period. The three species were compared with an insecticide, a molluscicide or a combination of both in a 3 x 4 factorial design trial with 4 replicates of each treatment.

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The insecticide chlorpyrifos was applied as Lorsban at 2 l/ha at plant emergence and then at 2 subsequent 10-day intervals. The molluscicide

Table 3 Effect over four seasons of species and pesticide application on the establishment yield (kg DM/ha).

	Spring 1985	Autumn 1986	Spring 1986	Autumn 1987
Ryegrass				
Untreated	4930	2490	2910	6910
Molluscicide	4340	4620	2810	6950
Insecticide	5210	2060	2950	7490
M x I	5330	4360	3070	7490
Significant Contrasts	U vs M, M vs I M vx M x I	U vs M, U vs M x I I vx M x I, I vs M	NS	NS
Tall fescue				
Untreated	750	100	210	1740
Molluscicide	300	800	140	1450
Insecticide	700	110	250	1943
M x I	710	920	190	1952
Significant Contrasts	NS	NS	NS	NS
Phalaris				
Untreated	3430	2930	5140	3610
Molluscicide	3530	3750	4690	3960
Insecticide	3560	3210	4420	3080
M x I	3780	2970	5370	3300
Significant Contrasts	NS	NS	NS	NS
Main effects				
Species				
Ryegrass	4950	3380	2930	7140
Tall fescue	620	480	200	1770
Phalaris	3580	3220	4900	3490
LSD 0.01	440	550	570	730
Pesticide				
Untreated	3030	1840	2750	4090
Molluscicide	2720	3060	2543	4120
Insecticide	3160	1790	2440	4080
M x I	3270	2750	2880	4250
LSD 0.05	380	470	NS	NS
0.01	NS	630		

Where differences were significant the values for LSD $P<0.05$ and LSD $P<0.01$ are presented. Treatment contrasts were all significant $P<0.01$.

yield of phalaris was significantly higher than that of ryegrass, although in 1987 the reverse effect was observed.

In only one of the four seasons was there a significant increase in establishment yield above the yield of untreated to applying a pesticide, with ryegrass the only species in which a significant effect was observed. In autumn 1986, application of a molluscicide significantly increased establishment yield. For tall fescue, in spring 1985 the application of a molluscicide depressed establishment yields non significantly and in autumn 1986 there was a marked trend for application of a molluscicide to increase establishment yield. Phalaris was unaffected by the pesticide treatment in any season.

Subsequent yield

The effects of species and pesticide treatment 1 year after establishment are shown only as main effects in Table 4. In all four seasons, tall fescue yielded significantly less than ryegrass; in spring 1985 and autumn 1986 phalaris also yielded less than ryegrass, but in the subsequent two seasons the yield of phalaris was significantly higher than that of tall fescue and similar to that of ryegrass. One year after establishment there were no significant effects of pesticide treatment.

Discussion

Although rainfall differed between the two springs (Table 1), it is felt that this would not have had a significant effect on moisture levels within the pastures due to normally high moisture levels in spring occurring as a carry over from winter. Slugs are active and feed at any time of the year when temperature and moisture conditions are suitable (Barker & Pottinger 1980). Slugs have been reported to affect the establishment of direct-drilled white clover and ryegrass (Ferguson 1983). They are most active when the soil is wet and atmosphere is humid. From this, it would be assumed that a problem with slugs could have possibly occurred in autumn 1986 and in spring of both years. Molluscicide had no effect in either springs, but in autumn 1986 the application of a molluscicide increased both seedling numbers and establishment yield. This effect was much more apparent for ryegrass and tall fescue than for phalaris. Barker *et al.* (1983) found that slugs preferentially fed on white clover compared with ryegrass, tall fescue and *Phalaris tuberosa*, the last named being more acceptable than ryegrass and tall fescue. In this trial, no response to the application of a molluscicide was recorded with phalaris, suggesting that it may be less acceptable to slugs, which is in contrast to other published work.

The application of an insecticide at establishment could have influenced the population of a number of pasture pests such as Argentine stem weevil, springtails, grass grub and porina (Pottinger 1979).

Table 4 Effect of four seasons on species and pesticide application in the yield of sown species one year after establishment (kg DM/ha). Main effects only.

	Spring 1985	Autumn 1986	Spring 1986	Autumn 1987
Ryegrass	263	278	578	395
Tall fescue	123	131	136	135
Phalaris	155	156	406	322
Sig	**	**	**	*
LSD 0.05	34	44	276	194
LSD 0.01	46	59	372	
Untreated	174	199	372	392
Molluscicide	202	201	379	267
Insecticide	164	150	387	246
M x I	181	204	354	226
Significant	NS	*	NS	NS
LSD 0.05		51		
LSD 0.01				

Significance: *$P<0.05$ **$P<0.01$

As no measurements of pasture pests were made in the trial, no specific effects of insecticide can be commented on. In spring and autumn 1986, a significant effect of applying an insecticide or a molluscicide and insecticide together on seedling numbers was recorded. This effect, however, was not reflected in the establishment yield of sown species.

Under similar conditions, tall fescue did not establish as well as ryegrass. The slower establishment of tall fescue had been well documented by Brock (1983). However, in this trial, plant numbers and the establishment yield of tall fescue was reflected in a significantly poorer yield 12 months after establishment (Table 4). This suggests that some factor other than pasture pests affects the establishment of tall fescue when direct drilled. In three of the four establishment periods, seedling numbers at establishment of phalaris were similar to those of tall fescue and significantly fewer than those of ryegrass. However, establishment yield of phalaris was significantly greater than for tall fescue in each of the four seasons. This trend was again apparent 1 year after establishment. The yield of phalaris 1 year after establishment was never superior to that of ryegrass, suggesting that direct-drilled phalaris may not establish as well as ryegrass. Overall, ryegrass seedling numbers, establishment yield and yield one year after establishment were superior, but appeared to be influenced more by a pesticide applied at establishment than either tall fescue or phalaris.

The yield of sown species recorded 1 year after establishment was low due to the short regrowth period allowed. These results did, however, reflect the difference between species observed in the establishment period. The significant effects of pesticide on establishment observed in spring '85 and autumn '86 were not reflected in the yield of sown species 1 year later. This indicated that the highly significant effects observed at establishment were transient and the application of a pesticide at establishment may not effect the long term productivity of direct-drilled pastures. This conclusion is drawn from a measurement made over a short period 1 year after sowing and may not truly reflect the effects of a pesticide applied at the time of establishment by direct drilling. Ferguson & Barratt (1983), Ferguson (1984) and Charlton (1978) also recorded significant losses in seedling numbers and establishment yield due to slugs. However, these trials were short term and the long term effects on pasture productivity were not measured.

Conclusion

From the information recorded over the establishment period, the following conclusions can be drawn.

(1) When direct drilling in autumn following a wet summer the application of a molluscicide is recommended when sowing either tall fescue or ryegrass.
(2) The establishment of phalaris by direct drilling was not affected by the application of a pesticide.
(3) The establishment of tall fescue by direct drilling is much more difficult than either ryegrass or phalaris, and direct drilling would not be a recommended method of establishment.
(4) The effects observed from the application of a pesticide at establishment were not apparent one year later.

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