Effect of late autumn sowing dates on ryegrass seed yields

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Abstract

Two trials evaluated the effect of autumn sowing dates on grass seed yields of perennial and hybrid ryegrass cultivars. In both trials five sowing dates were evaluated covering 100 days from 22 February to 30 May (autumn 2003) and 75 days from 1 April to 15 June (autumn 2004). Overall there was a significant (P>0.01) effect for delayed sowings to reduce seed yield. In cv "Grasslands Samson" the seed yield from February sown crop was significantly higher than March sown (1920 v 1660 kg/ha). Seed yields for sowings made in March, April and May (2003) and April, May and early June (2004) were not significantly different. In 2004 only the last sowing date (mid-June) had a lower seed yield. Treatments sown before mid-April produced herbage that could be grazed before closing, ranging from 2,700 to 5,100 kg/ha that added economic value to early sowings. Overall, the combined effect of declining seed yield and reduced herbage meant the economic cost of delayed sowing was valued at $10/ha/day.

Additional keywords: *Lolium perenne,* perennial ryegrass, economics, spring tillers.

Introduction

Autumn sowing dates for perennial and hybrid ryegrass (*Lolium perenne and L. x boucheanum*) are commonly in the period from mid March to mid April, although some growers sow later. The importance of early tillers in seed production was noted in a review on reproductive development in temperate grasses that comments "*because tillers of most perennial grasses have a juvenile phase during which they are non-receptive to inductive stimuli, and require a certain exposure to short photoperiod and/or low temperature during primary induction, a logical consequence is that only early formed tillers have the capacity to produce seed*" (Aamlid *et al.,* 1997).

Perennial ryegrass is one of the few perennial grasses that can be primary-induced as germinating seed, suggesting that there is no juvenile requirement for vernalisation to occur. However there have been few studies that have determined the contribution of spring formed tillers on seed yield. A two year survey in South Canterbury found 35% of ryegrass crops were sown after the 15th April and 15% were sown in May (unpublished data). Wheat prices are usually not announced until late autumn and in years when ryegrass prices are high and wheat prices are low the question "how late can I sow ryegrass?" is commonly asked by arable growers. Many herbage seed producers have farm enterprises that are a mix of livestock and arable crops, where herbage produced by ryegrass seed crops can benefit the livestock component. Early sowing may produce more winter/spring herbage in the period before closing, increasing livestock returns. The spring closing date is the date that livestock are removed from crops to ensure seed yield potential is not lost from livestock damaging elongating reproductive meristems.

This paper reports on trials in two successive years that assessed the impact of different autumn sowing dates on ryegrass seed yield, herbage production and economic return to provide growers with accurate information in making decisions on how late in autumn ryegrass seed crops can be sown.

Methods

The trials were sown at AgResearch Lincoln Research Farm (latitude 43°S, altitude 20 m asl) on a Wakanui silt loam, a deep fertile soil. The site was 1km from a weather station

where daily records of soil temperature and grass minimum temperatures were collected. Plots were sown with a precision cone-seed drill, with plots 3.0 m wide and 7.0 m long, replicated four times in a randomized block design. In 2003 two cultivars were sown; "Grasslands Samson" perennial ryegrass (*Lolium perenne*); and "Grasslands Supreme Plus" hybrid ryegrass (*L.* x *boucheanum*) at 8 kg/ha sowing rate. Sowing dates were: 22 February, 13 March, 14 April, 8 May and 30 May 2003; giving a spread of 100 days between the first and last sowing. In 2004 two cultivars were sown; "Grasslands Samson" perennial ryegrass; and "Grasslands Impact" hybrid ryegrass at 8 kg/ha sowing rate. Sowing dates were 1 April, 1 May, 15 May, 1 June and 15 June; giving a spread of 76 days between the first and last sowing.

The main weed problem for the trial was *Poa annua*, and the different sowing dates were sprayed with ethofumesate (Nortron) at 625 g active ingredient (ai)/ha at different dates to achieve an application at approximately the same growth stage of the crop. Broadleaf weeds were sprayed with a premix spray of Axall at 3.0 L/ha.

Plots were grazed with sheep (2003) or mown (2004) when pasture was approximately 15 cm tall. A closing date of 23 September was used as the last defoliation date for Samson and Supreme and 7 October for the later flowering Impact.

Nitrogen (200 kg N/ha) was applied as urea with four applications (each of 50 kg N/ha) at three week intervals from late August to mid October. Moddus® (trinexapac ethyl) plant growth regulator was applied to all plots as a split application of 250 g ai/ha for each application in late October and 10 days later, covering the Zadocks growth stage GS32 to GS39. The split application was used to ensure different age tillers were treated at their most appropriate growth stage. A fungicide mix for rust control (epoxiconazole+azoxystrobin) was applied twice, at late head emergence and mid anthesis. Plots were irrigated (50 mm per irrigation) once in autumn and twice during late spring, at head emergence and at anthesis.

Assessments

Herbage drymatter (DM) and tiller numbers were assessed at each cutting time from 0.25m^2 quadrats cut at 5 mm above ground level. Seed yield was determined by hand harvest; cutting four samples, each 3 rows by 1.0m long (0.45m^2) from each plot. The samples were air dried in hessian sacks, threshed in a mechanical thresher, sieved and then cleaned on a 2 screen-air separator. Seed yields are machine dressed to First Generation Seed Certification standard (>98% purity). Combined data for seed yield was converted to relative seed yield (RSY) with the highest seed yield for each cultivar in each year set at 100. Herbage seed prices (net after seed cleaning) range from \$1.55 to \$1.80/kg depending on the cultivar, while herbage for grazing has a value of \$0.10 to \$0.15/kg DM. Economic assessments were based on a seed price of \$1.70/kg and herbage at \$0.125/kg DM.

Results

Average monthly 10 cm soil temperature declined each month reaching lowest values in July (Table 1). Generally the number of frosts increased in each subsequent month from March to July with a maximum number of frosts in July, 26 frosts (July 2003) and 22 frosts (July 2004) when late sown ryegrass was emerging and establishing. The lowest grass minimum temperatures were also in July, -9.1°C (2003) and -8.0°C (2004).

Table 1. Average monthly 10 cm soil temperature, number of frosts per month in the range -0.1 to -4.9°C and >5.0 °C, lowest grass minimum temperature for each month.

Year	Month	10 cm soil temperature (°C)	No. Frosts -0.1 - -4.9 (°C)	No. Frosts ≥5.0 °C	Lowest Temperature (°C)
2003	March	15.4	2	0	-3.2
	April	11.3	8	0	-4.3
	May	9.7	6	0	-3.9
	June	6.8	9	4	-7.4
	July	4.2	13	13	-9.1
	Aug	5.6	13	4	-7.9
2004	March	18.6	1	0	-0.8
	April	14.8	10	0	-2.1
	May	9.2	13	1	-6.2
	June	6.7	9	4	-8.0
	July	4.3	17	5	-6.6
	Aug	6.7	16	1	-5.9

Seed Yield

The average ryegrass seed yield for all sowing dates over two years was 1690 kg/ha. Using the combined data from the three cultivars and two years there was a significant negative effect ($P<0.01$; $R^2=0.32$) of later sowing date reducing relative seed yield (RSY); with an average daily decline in RSY of 0.14% (Figure 1). This was equivalent to a loss of 2.8 kg seed/ha/day for each day sowing was delayed in the autumn. There was no sowing date where late sowings resulted in a catastrophic yield collapse. There was no significant difference in seed yields between March and May sowings in 2003, nor between April and 1st June sowing dates in 2004 (Table 2). Seed yields of Samson sown in February were significantly higher than March sown (1920 v 1660 kg/ha). In 2004 only the last sowing date (15 June) had a significantly lower seed yield (Table 2). Seed yield of the two hybrid cultivars was more variable and while not significantly different between timings, suggested a trend towards lower seed yields from later sowings.

Table 2. Seed yield (kg/ha) for sowing dates and cultivars.

Sowing Date 2003	Samson	Supreme	Sowing Date 2004	Samson	Impact
22-Feb	1920	1834	1-Apr	1930	1850
13-Mar	1664	1734	1-May	1870	1570
14-Apr	1695	1621	15-May	1908	1520
8-May	1566	1371	1-Jun	2010	1510
30-May	1550	1781	15-Jun	1390	1510
LSD 5%	211	NS		287	NS

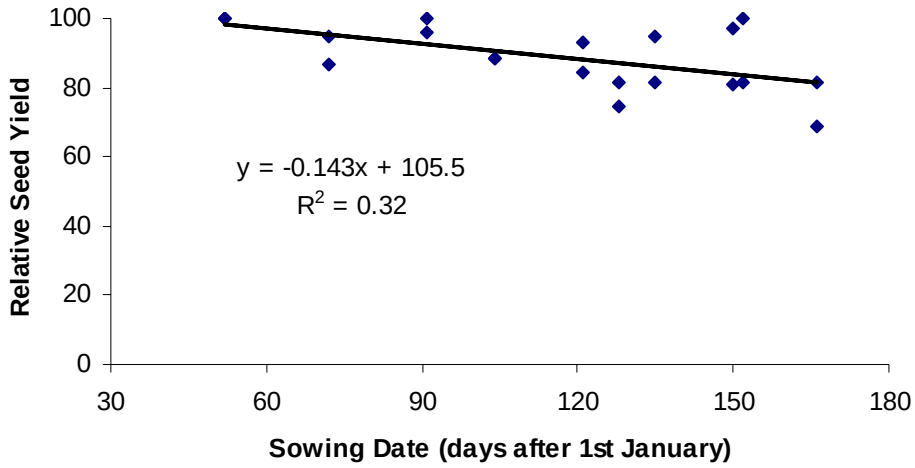

Figure 1. Relationship between relative seed yield and sowing date, combined data from two years and three cultivars

Herbage yield

Early sown (February) crops were grazed at the beginning and end of winter (Table 3). Crops sown from mid March to mid April were defoliated twice in 2004 but only once in 2003. Samson and Supreme sown after mid April did not produce herbage for grazing. The later flowering Impact sown on the 1 April was defoliated three times while plots sown a month later on 1 May were defoliated once (Table 3). Herbage yields in 2003 from the earliest sowing date ranged from 4810 and 5560 kg DM/ha for Samson and Supreme respectively. The total herbage produced declined on average by 64 kg DM/ha for each days delay in sowing (Figure 2).

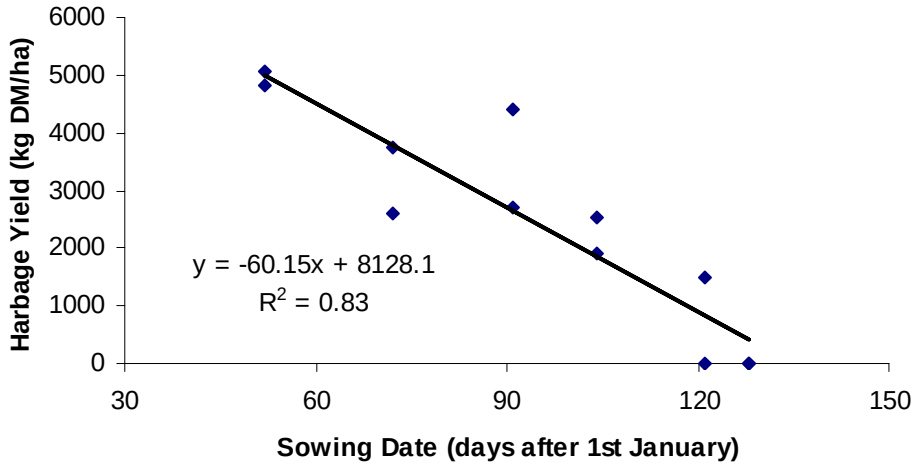

Figure 2. Relationship between total accumulated herbage yield (from sowing to spring closing) and sowing date.

Table 3. Herbage yield at each grazing date and accumulated yield for each sowing date (kg DM/ha).

	Grazing dates cv "Samson" 2003				Grazing dates cv "Supreme" 2003			
Sowing Date 2003	30-May	26-Aug	23-Sep	Total	30-May	26-Aug	23-Sep	Total
22-Feb	2540	2270	0	4810	2850	2210	0	5060
13-Mar	0	2590	0	2590	0	3730	0	3730
14-Apr	0	0	1920	1920	0	0	2520	2520
8-May	0	0	0	0	0	0	0	0
30-May	0	0	0	0	0	0	0	0
		cv "Samson" 2004				cv "Impact" 2004		
2004	23 Aug	23 Sep	7 Oct	Total	23 Aug	23 Sep	7 Oct	Total
1-Apr	770	1930	0	2700	1210	2090	1140	4440
1-May	0	0	0	0	0	0	1480	1480
15-May	0	0	0	0	0	0	0	0

Economic Impact

The effect of later sowing date on gross economic return was calculated to decline at $10.57/ha/day (Figure 3). Of the two components of income, economic loss from reduced herbage for grazing contributed 70% of the loss, while declining seed yield contributed 30%.

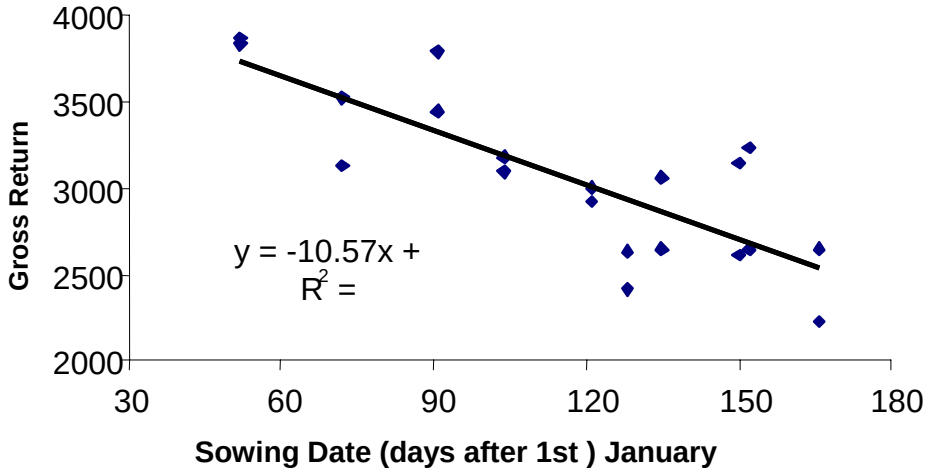

Figure 3. Relationship between gross return and sowing dates (based on seed price of $1.70/kg and herbage at $0.125/kg DM).

Autumn v Spring tillers

In these trials the number of vegetative tillers at closing on 23 September was compared with the number of reproductive tillers (seed heads) present after anthesis. Samson sowings made after the 8 May had

fewer vegetative tillers at closing than the number of reproductive heads present before harvest (Table 2). These seed heads were produced from tillers emerging after the 23 September. Spring tillers emerging after 23 September contributed to between 59 and 64% of reproductive head number for sowings made between 30 May and 15 June (Table 2). The calculated seed yield per head (seed yield/head density) was not reduced by later sowing dates (Table 2).

Table 2. Vegetative tiller density at closing (23 September) and reproductive tiller density post-anthesis; percent reproductive heads from spring emerged tillers and dressed seed yield (SY) per head for Samson perennial ryegrass at five sowing dates.

		tillers/m^2			
Year	Sowing Date	closing	harvest	% heads from spring tillers	SY (mg/head)
2003	22-Feb	4510	2020	--	95
	13-Mar	4780	2050	--	81
	14-Apr	3150	1900	--	89
	8-May	1920	1540	--	102
	30-May	640	1750	64	89
2004	1-Apr	3430	2510	--	77
	1-May	2080	1940	--	97
	15-May	1550	1890	18	101
	1-Jun	890	2170	59	93
	15-Jun	550	1370	59	105

Discussion

Sowing date on farms is influenced by a number of factors but it is often difficult for growers to achieve early sowing dates. In many years harvests can be delayed by poor weather, while the trend towards autumn sowing of milling wheat increases cultivation pressure in autumn. Stale-seedbeds in autumn following the previous crop allows better control of crop volunteers. Ryegrass seed exported to Australia must be free of cereal seed and ryegrass often follows wheat in rotations, requiring a stale-seedbed approach with a delay in sowing.

Not all arable farms have a livestock component. On these farms sowing in April will ensure that there is no need to defoliate crops in the spring. However on mixed-crop farms livestock makes a significant contribution to farm income and sowing ryegrass early will provide additional feed for the winter/early spring period when forage growth rates are lowest. However, autumn grass weeds, especially *Poa annua,* are a major potential problem with early sowings and extra costs for ethofumesate herbicide necessary, while late sowings may not require herbicides to control *Poa*.

Previous studies on sowing dates (Hill and Watkin, 1975a, 1975b) in a North Island environment with warmer winters emphasised the importance of early formed tillers and their contribution to seed yield. Vernalisation in ryegrass occurs at temperatures below 10 ^{o}C (Langer, 1972). In Canterbury cool nights capable of providing 12 hours per day of vernalisation continue throughout spring. Tillers not emerged in late September have probably been formed during winter and may well be vernalised before emergence.

In these trials we have demonstrated that late autumn sowings of ryegrass are possible; although there is a negative linear decline in potential income. These late sowings emerged and established even with frequent overnight ground frosts from –5 ^{o}C to –9 ^{o}C during the first eight weeks after sowing. While late sowings have potentially lower incomes from the loss of grazing and a possible trend of declining seed yields, there was no date that suggested a catastrophic drop would occur.

Acknowledgements

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