The Effects of Method and Time of Sowing on Seed Production in Perennial Ryegrass [1]

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ABSTRACT

The effects of method and timing of sowing on seed yield of perennial ryegrass CV. S.24 were investigated in a series of field experiments from 1978 to 1981. Undersowing in the spring in barley resulted in similar yields to sowing direct except in 1979 when yields were reduced. Yields from autumn direct sowings when carried out before mid September were similar to undersowing and direct sowing in the spring. Sowing after mid September in most years decreased seed yield and these reductions were due to decreases in seeds per unit area.

Additional index words: **undersowing, seed yield components, lodging, tillering.**

INTRODUCTION

The most popular method of establishing ryegrass seed crops in the United Kingdom is by undersowing in spring barley (Denchfield, 1972). However, undersowing can provide a number of problems. Firstly, there is often intense competition for soil moisture, nutrients and light between the cereal crop and establishing grass. This can either result in excessive grass growth which decreases cereal yield and causes problems at cereal harvest or more often the cereal crop severely decreases the establishment and growth of the ryegrass. To some extent the adverse effects of the nurse crop can be lessened by decreasing cereal seed rates, nitrogen levels, widening cereal row width or drilling after the grass crop has emerged. But any of these methods that favor the grass seed crop are likely to decrease cereal yields.

In Holland and Denmark the majority of perennial ryegrass seed crops are direct sown in the autumn after the cereal harvest (Bawcutt and Hebblethwaite, 1978; Hebblethwaite, 1978). In recent years there has been a growing interest in autumn sowing in the United Kingdom particularly with the large increase in area of winter barley which is harvested early. Little research has been carried out in the United Kingdom comparing undersowing with autumn sowing and no work has been published defining the optimum autumn sowing date.

Trials were carried out from 1978 to 1981 to assess the effects of sowing method and time on the growth, development, seed yield components and seed yields of perennial ryegrass.

MATERIALS AND METHODS

The experiments were carried out on the University of Nottingham Experimental Farm, Sutton Bonington, Loughborough, Leics. on soil of the Astley Hall Series. All experiments were sown with basic seed of cv. S.24 at 12 kg ha^{-1} on 15 centimeter rows in plots 1.5 x 12 m. Actual sowing date treatments were within a few days of each other in each year and average time periods are given in Table 1.

Table 1. The effect of method and date of sowing on the dry seed yield t ha^{-1}, 1979 to 1981

	Year				
	1978	1979	1980	1981	Mean of 1979 to 1981
Undersown in spring barley					
March/April	--	1.9	1.3	1.4	1.5
Drilled with no cover crop					
Mid March	1.2	2.4	1.4	1.4	1.7
Mid Aug.	1.3	2.1	1.3	1.3	1.6
Early Sept.	--	2.1	0.9	1.1	1.4
Mid Sept.	1.0	1.2	1.1	1.1	1.1
Late Sept./early Oct.	--	1.2	0.9	0.9	1.0
Late Oct. Nov.	0.7	1.3	0.9	0.5	0.9
LSD (5%)	0.28	0.34	0.22	0.34	0.21
S.E.D. (21 D.F.)*	0.11	0.20	0.07	0.15	0.10
C.V. (%)	10	18	8	16	35

* 1978 (12 D.F.)
-- no treatment applied.

All experiments utilized a randomized block design replicated four times. All plots received 60 kg N ha^{-1}, 40 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} at establishment and 120 kg N ha^{-1} at spikelet initiation in the spring of the harvest year. In 1979 and 1980 ethofumesate was applied at 10 1 ha^{-1} during the autumn to control *Poa annua* and any possible *Poa trivialis*. In 1981 a mixture of half rate (5 1 ha^{-1}) ethofumesate and T C A (1.1 kg ha^{-1}) were used in order to control *Poa trivialus* and high levels of volunteer winter barley. A mixture of 2, 3, 6 TBA, dicamba, M C P A and mecoprop was applied in spring to control broadleaved

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Table 2. The effect of method and date of sowing on the seed components (mean of 1979 to 1981).

	Fertile tillers m^2	Spikelets/ fertile tiller	Seeds/ spikelet tiller	Seeds/ fertile x 10^{-2}	Seeds m^2	1000 seed wt. (gm) (t ha^{-1})	Dry seed yield
Undersown in spring barley							
March/April	2569	19.6	2.04	40	1023	2.10	1.5
Drilled with no cover crop							
Mid March	2471	19.5	2.30	44	1102	2.08	1.7
Mid August	2735	20.5	1.72	36	977	2.00	1.6
Early Sept.	2437	17.8	1.90	34	829	2.04	1.4
Mid Sept.	2975	16.2	1.58	27	761	2.07	1.1
Late Sept./early Oct.	2518	14.6	1.78	26	622	2.11	1.0
Late Oct./Nov.	2538	15.2	1.56	24	619	2.12	0.9
L.S.D. (5%)	981	2.42	0.698	25.3	309.2	0.227	0.21
S.E.D. (21 D.F.)	467	1.15	0.337	12.2	149.4	0.109	0.10

weeds, the major problem in autumn sowings being *Stellaria media*.

In 1979 and 1980 each plot was prepared by plowing in the autumn followed by cultivating with spring tynes, harrowing and then rolling before sowing. Consequently, autumn sowings followed a fallow in these years. In 1981 autumn sowings followed winter barley which was harvested on 8 August. These plots were sprayed with paraquat and diquat to kill any regrowth and then immediately before sowing were spike rotary cultivated twice and then Cambridge rolled. In all years plots were Cambridge rolled after sowing. In all years spring sown treatments were defoliated at the time of combining the undersown with barley treatment.

In 1979 plots were direct combined and in 1980 and 1981 were Mayfield harvested and threshed. Details of harvesting, growth analysis, lodging scores and yield component measurement techniques used at Sutton Bonington have been previously published (Hebblethwaite and Burbridge, 1976; Hebblethwaite *et al*, 1978).

RESULTS

Seed Yield and Seed Yield Components

Undersowing in spring barley when compared to sowing with no cover crop at the same date decreased seed yield in 1979 but not in 1980 and 1981 and on average (Table 1). Sowing later than early September decreased yield in most years and on average (Table 1). Decreases in seed yield were due to reductions in seeds harvested per unit area (Table 2). In 1981 yield was not decreased until sowing was delayed to early October possibly because of the exceptionally wet and mild autumn and winter of 1980/81. In each year the decreased number of seeds per unit area was associated with a decrease in the number of spikelets per tiller, seeds per tiller and per spikelet and not with number of fertile tillers and individual seed weight (Table 2). As responses were similar in all years only average data for 1979 to 1981 are presented in Table 2.

Development

Growth stage and time of harvest at 30 to 35% moisture content (m.c.) was similar in all treatments up to sowing in late September/early October. Delaying sowing to late October/November on average delayed the time at which the crop reached 70% ear emergence, first anthesis, peak anthesis and final harvest at 30 to 35% m.c. by 14, 13, 8 and 7 days respectively.

Culm length and lodging

No differences in culm length (stem + ear) measured in the field were found until sowing was delayed until late September. For example, on 23 May 1980 the average height for sowings prior to late September was 58 cm compared to 44 and 34 cm in late September and early November sowings. By final harvest these differences were no longer evident and all treatments had reached a height of approximately 73 cm. The degree of lodging was closely related to crop height; for example, on 29 May the percentage of crop that was lodged in sowings prior to late September was similar and averaged 58% compared to 25% and 0% in the later two sowings. By anthesis on 12 June lodging percentages for these treatments were 75, 55 and 35% respectively. However, by final harvest all treatments were completely lodged. Similar results were found in 1979 and 1981 — data is therefore not presented.

Tillering

Tillering was recorded in 1979 and 1981, but as the results were similar in both years and for simplicity, data for a selective number of treatments only are presented in Figs. 1 and 2. Total number of tillers during the late autumn and winter period remained constant in all treatments but numbers were considerably lower for sowings carried out from mid September onwards (Fig. 1). Spring growth was associated with a rapid increase in the number of tillers m^{-2}, the maximum number attained being greater in the earlier sowings. Maximum number was obtained in late March in all treatments except the late October sowing where this was delayed by one month. Thereafter, when the first ears emerged, the number of tillers decreased markedly and at a similar rate in all treatments except in the late October sowing where the decrease was small. In all treatments, and particularly in the case of the mid September sowing, tiller number increased towards final harvest due to secondary

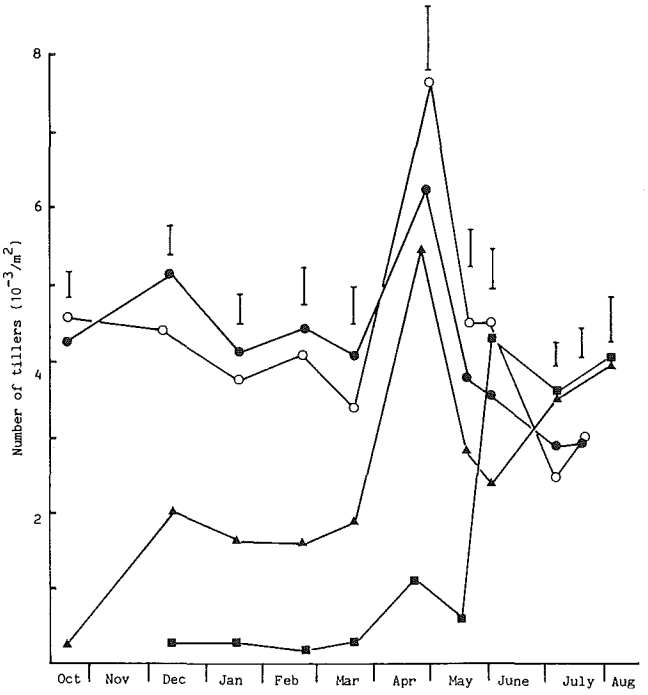


Fig. 1. The effect of sowing method and date on the total number of tillers. ○, March/April; ▲, Mid-September; ■, Late October/November; ●, Undersown in spring barley in March/April.

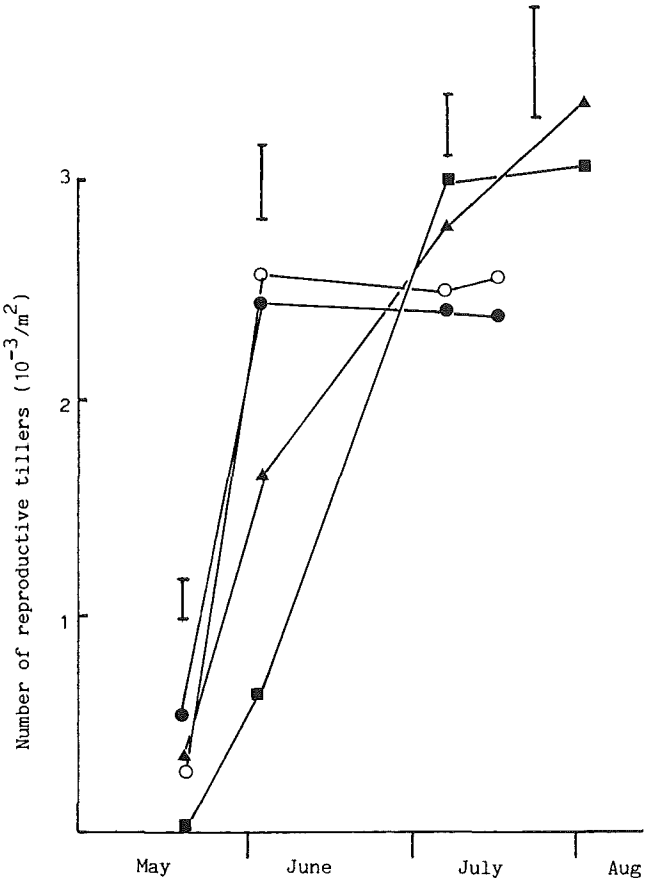


Fig. 2. The effect of sowing method and date on the number of reproductive tillers. ○, March/April; ▲, Mid-September; ■, Late October/November; ●, Undersown in spring barley in March/April.

vegetative tiller growth. By final harvest there was no difference in tiller number between treatments.

Delaying the time of sowing delayed ear emergence and the time the crop reached maximum emergence (Fig. 2). March direct and undersown treatments reached maximum emergence in early June but emergence continued in mid March and October sowings until final harvest (Fig. 2).

Total dry matter accumulation

In all treatments no dry matter was accumulated during the winter period (Fig. 3). In late March rapid dry matter accumulation took place in all treatments except in the late October sowing where this increase was delayed until May (Fig. 3). Sowing in mid September and late October decreased crop dry weight at all sampling dates up to mid May. However, by early July there was no significant difference between treatments in crop dry weight (Fig. 3).

Weeds

In 1981 autumn sowing followed a winter barley crop (see Materials and Methods) and in spite of herbicide application (ethofumesate plus T C A), this resulted in high populations and consequently dry weights of winter barley volunteers and *Poa trivialus* particularly in the late sown treatments (Fig. 3). The barley was almost completely eaten by birds before harvest particularly in the November sown treatment but the *Poa* grew considerably just before harvest as the ryegrass senesced and this could have caused harvesting problems. The effect of the volunteer barley on seed yield was assessed on the mid September sown treatment by

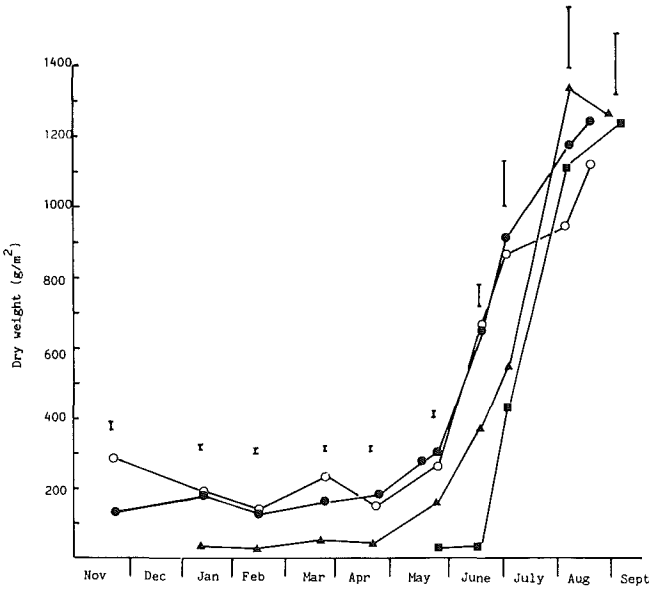


Fig. 3. The effect of sowing method and date on the total crop dry weight. ○, March/April; ▲, Mid-September; ■, Late October/November; ●, Undersown in spring barley in March/April.

hand rogueing an area 2 m^2 on 21 April and harvesting separately. Interestingly, there was no significant difference in seed yields between the two areas and this may have been because rogueing was too late and possibly caused some crop damage.

In all years, populations of *Stellaria media* were higher in autumn sown plots but this was easily controlled by hormone herbicide (see Materials and Methods).

DISCUSSION

These results show that undersowing in spring barley is a satisfactory method of establishing ryegrass seed crops in most years and similar results have been found by other workers (Roberts, 1958; Kellner *et al*, 1967; Nordestgaard, 1981). However, this work shows that growers wishing to change from spring to winter barley will not suffer a yield reduction by direct sowing perennial ryegrass after the barley unless they sow later than the first week of September. Work in Denmark on early and medium early perennial ryegrass has shown that any delay in sowing after the end of August will decrease yields (Nordestgaard, 1981). Consequently growers sowing perennial ryegrass after winter barley should sow as soon as possible after the barley harvest.

In years with mild winters reasonable seed yields can be obtained from sowings in late September and early October. Nevertheless, it is important to remember that the farm field situation is not likely to be as precise as that found in experimental plots. Similar results have been found by workers from a series of trials at the National Institute of Agricultural Botany, Cambridge (A.W. Evans, Personal communication).

Decreases in yield for late sowings were due to decreases in ear size and seed set and not fertile tiller numbers. A number of workers have shown that ear size (spikelet numbers) decreases the later the date of origin of the shoot (Ryle, 1964; Hill and Watkin, 1975; Hebblethwaite and Clemence, 1982). This decrease in spikelets was found to be correlated with a decrease in the number of unexpanded leaf primordia accumulated at the shoot apex before induction (Ryle, 1966). Late sowings would therefore have accumulated a lower number of leaf primordia before induction than early sowings.

Autumn sowings, particularly when late, were shown to have problems in relation to volunteer winter barley. Recent survey work on farms (N.I.A.B., unpublished) has shown that spring sown grass seed crops have less cereal volunteers on average than autumn sowings. Cereal volunteers even at fairly low populations have been found to decrease seed yields (Wright and Hebblethwaite, 1983). Further work is therefore needed on chemical control of cereal volunteers in autumn sown ryegrass seed crops.

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