AN INVESTIGATION OF SOWING DATE, CULTIVAR AND DISEASE INTERACTIONS IN AUTUMN SOWN BARLEY

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SUMMARY

Yields of two barley cultivars, Sonja and Triumph, were greatest when sown in April and decreased with later sowing dates. Disease, mostly leaf rust (*Puccinia hordei*) in Sonja and scald (*Rhynchosporium secalis*) on Triumph, significantly reduced yield especially in the earlier sowings. Cultivar evaluation trials showed no cultivar consistently out yielded the others at all sites and that location and disease were the major influences on yield. Disease reduced yield significantly in three spring barleys but not in three winter barley cultivars.

INTRODUCTION

Autumn sowing of barley has not been widely practised in New Zealand despite success in other cereal growing regions. Autumn sown barley occupies 40% of the total barley area in the United Kingdom (Milbourn 1983) and more than 50% in West Germany (Gallagher 1983). Mann (1983) reported that autumn sown barley yielded on average 0.24 tonnes/hectare more than spring barley over eight years on NIAB trials without disease control and that the yield advantage relative to spring sown crops was greatest in dry seasons. Gallagher (1983) suggested that in Canterbury the avoidance of water constraints during grain filling may confer a yield advantage to autumn sown barley. Other benefits of autumn sown barley include spread of the workload throughout the season and an earlier harvest.

Little is known about crop husbandry for autumn sown barley under New Zealand conditions. Information is required on sowing date, plant density, cultivar choice and the marketability of the harvested grain. Disease is an important constraint to autumn sown barley production in England where mean yield reductions of 14% were observed with Maris Otter in three seasons trials (Palmer 1982). In New Zealand little is known of the relative importance of different diseases, the time at which these diseases may cause the greatest yield reduction, which yield components may be most affected and the best disease control systems. This paper reports preliminary results from a multidisciplinary research project the aim of which is to produce a management package for autumn sown barley based on a knowledge of biological and environmental constraints experienced in New Zealand.

MATERIALS AND METHODS

Trial 1 was established on light land at Ashley Dene Farm to investigate the effect of disease and sowing date on the yield of two barley cultivars, Triumph and Sonja. The trial was drilled on 13 April, 5 May, 5 July and 12 August into a stony Eyre silt loam. Disulfoton (Disyston 10G) at 2 kg ai/ha was included with the seed for the first two sowings to control aphids. Half of the plots were drilled with seed treated with 15 g triadimenol and 2 g fuberidazole (Baytan F17) per 100 kg seed, the remainder being untreated. Disease was controlled during the growing season in nil disease plots by applications of propiconazole (Tilt 25EC) at 125 g ai/ha at approximately 4 week intervals when disease was present. Prochloraz (Sportak 40EC) at 400 g ai/ha was used to control net blotch (*Drechslera teres*) and scald in the absence of leaf rust for the first spray on the first two sowings. Sprays were applied for all treatments using a hand held 6 m boom with hollow cone nozzles (D2-25) operating at 450 kPa and applying 300

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litres/ha. Plots (24 x 12 m) were arranged in a confounded factorial design with three replicates, each of which consisted of two blocks containing eight fully randomised plots. A buffer (24 x 6 m) drilled with Zephyr and Maris Otter separated each plot. Chlorsulfuron (Glean) was applied at 20 g ai/ha for weed control.

TABLE 1: Management of three autumn sown barley cultivar evaluation trials on different sites in Canterbury in 1983.

	Soil type	Sowing date	Mean plant No./m ²	Disease control [†]
Trial 2	light Templeton silt loam	27 May	247 ± 9	+ and –
Trial 3	very stony Eyre silt loam (Ashley Dene Farm)	26 May	268 ± 11	nil
Trial 4	medium Templeton silt loam	5 June	238 ± 8	nil

[†] disease control was achieved by prophylactic application of propiconazole. (125 g ai/ha).

Three cultivar evaluation trials were established and managed as in Table 1.

Disease was assessed in all trials as the percentage green leaf area (GLA) on 10 plants sampled randomly from each plot every 2 weeks. Percentage GLA is the proportion of the leaf which is green, i.e. not including senescent tissue and disease pustules or lesions with associated chlorosis and necrosis. A disease index was calculated by the formula (GLA healthy - GLA diseased)/GLA healthy expressed as a percentage, on a per plant basis for all leaves that were green.

At harvest, 10 quadrat samples (0.1m²) were collected from each plot, bulked and analysed for yield and yield components. Yield was expressed as grammes dry matter per square metre (g DM/m²). The data were analysed using ANOVA and means tested for significance using least significant difference (LSD) paired comparisons.

RESULTS

The greatest yields were produced from the first sowing date of both cultivars in trial 1 (Table 2). Disease reduced yield significantly in the first three Triumph sowings, and in all but the third sowing of Sonja. In Triumph, where disease-induced yield depressions were greater than Sonja, the significant yield decreases were attributable to smaller grains in the first three sowings and fewer grains per ear in the first two (Table 3). There were no significant differences in the numbers of ears/m². In Sonja, grain number/ear was again the component most severely affected by disease, with ear number/m² being significantly reduced in the final sowing and grain size in the second sowing. Sonja was mostly infected by leaf rust and Triumph by scald which reflected the relative susceptibilities of these cultivars to the two diseases. Early in the season, there were low severities of net blotch and powdery mildew (*Erysiphe graminis*) but these had little effect on GLA. Disease development as measured by disease index for three of those treatments with significant yield reductions is shown in Figure 1. In the first sowing date, the disease epidemic on Sonja was less severe than that on Triumph from growth stage (GS) 27 to 73 (Zadoks *et al* 1974) but a late epidemic of leaf rust on Sonja gave both cultivars a similar disease index by GS 78. The differences in disease index at early growth stages were attributable to scald on Triumph during the conducive conditions of winter and early spring. Triumph plots sown on 5 May were less severely infected by scald at equivalent growth stages during most of the season than those sown on 13 April.

TABLE 2: Effect of sowing date, cultivar and disease on the yield (g DM/m²) of autumn sown barley on light Eyre soils in 1983 (trial 1).

Sowing date	Cultivar			
	Sonja		Triumph	
	+ disease	-disease	+ disease	-disease
13 April	305	418***	342	529***
5 May	303	376*	283	427***
5 July	299	296	289	365*
12 August	194	269*	308	272

CV(%) = 11

*, ** and *** Significantly different from diseased at P = 0.05 (LSD = 57.9), P = 0.01 (LSD = 78.3) and P = 0.001 (LSD = 104.2).

For paired comparisons within one level of disease LSD's at P = 0.05, 0.01 and 0.001 are 56.4, 76.2 and 101.4 respectively.

TABLE 3: Effect of disease on the yield components of four autumn sowings of Triumph barley in 1983 (trial 1).

Sowing date	Disease	Yield Components		
		Ears/m ²	Grain No./ear	Grain weight (mg)
13 April	+	818	16.6	25.3
	-	845	19.7**	31.8***
5 May	+	611	15.8	29.4
	-	659	19.3**	33.8***
5 July	+	571	17.2	29.5
	-	612	18.4	32.5*
12 August	+	502	17.8	34.5
	-	474	17.5	32.6
LSD 5%		66.1	2.06	2.31
LSD 1%		89.2	2.79	3.13
LSD 0.1%		118.8	3.71	4.16
(for comparison within one sowing date)				
C.V. (%)		10	6.7	3.8

Yields for the six cultivars from trial 2 (Table 4) ranged from 521 to 778 g DM/m², equivalent to 6.1 to 9.0 t/ha at 14% moisture content. In the absence of disease control the yield of Illia was greater than all other cultivars and those of Priver, Koru, and Sonja were significantly greater than Kym and Triumph. When fungicides were applied the yields of Kym, Koru and Triumph were significantly greater than the diseased plots as indicated by low Yield delivery index values (Priestley 1983) (Table 4). On an infertile site (trial 3) yields, in the absence of disease control, ranged from 231 g DM/m² for Sonja to 321 for Koru (Table 5). On a medium Templeton silt loam site (trial 4) yields did not differ significantly and ranged from 607 g DM/m² for Triumph to 705 g DM/m² for Sonja.

TABLE 4: Effect of disease on the yield of six cultivars of autumn sown barley grown on a light Templeton silt loam site in 1983 (trial 2).

Cultivar	Yield (g DM/m ²)		Yield delivery index†
	+ disease	-disease	
Illia	743	764	97.2
Priver	645	697	92.5
Koru	635	778*	81.6
Sonja	632	655	96.7
Kym	531	730**	72.7
Triumph	521	677*	76.9
CV(%) = 10			

† Yield delivery index = (yield with disease/yield without disease) x 100 (Priestley 1983).

* and ** Significantly different from diseased at P=0.05 (LSD = 119.2) and P=0.01 (LSD = 159.5).

For paired comparisons within one level of disease LSD's at P=0.05 and P=0.01 are 96.1 and 128.6 respectively.

TABLE 5: Yields of six autumn sown barley cultivars in the absence of disease control on a very stony Eyre silt loam (trial 3) and a medium Templeton silt loam (trial 4) site in 1983.

Cultivar	Yield (g DM/m ²)	
	Trial 3	Trial 4
Koru	321	703
Priver	283	657
Kym	258	630
Illia	254	682
Triumph	253	607
Sonja	231	705
LSD 5%	48.9	113.7
CV (%)	13.6	13.7

DISCUSSION

Scald and leaf rust were the dominant diseases in these trials with autumn sown barley. In trial 1 there were greater yields with early sowing for both cultivars especially when diseases were controlled. It is likely that the yield advantage at the earlier sowing dates relative to spring sowing at the traditional time (September/October) would be even greater. Yield was significantly reduced in cultivars susceptible to leaf rust (Sonja) and scald (Triumph) indicating that control of these diseases may be an important factor in crop management. Control measures may also be necessary for barley yellow

dwarf virus and early preparation of the ground for April — May sowings may necessitate some loss of autumn feed for animals in mixed farming systems.

Fig. 1: Disease development for autumn sown barley grown on a very stony Eyre silt loam in Canterbury in 1983.

The yield in three cultivar evaluation trials varied markedly from site to site, and no cultivar yielded best at all locations. For all cultivars greatest yield was from the treated plots in trial 2 where yields ranged from 655 to 778 g DM/m². The greatest yield (Koru) was equivalent to 9.0 t/ha at 14% moisture content. This yield was significantly greater than those of Triumph and Sonja but not Illia, Priver or Kym. Thus, with disease control at a location with moderate scald and leaf rust severity, both winter and spring barleys had high yield potentials. In comparison cultivars were ranked differently in plots not receiving prophylactic disease control. Illia, with a yield delivery index of 97% yielded better than all other cultivars. This type of analysis enables growers, merchants and advisers to select cultivars on the basis of both yield potential at given site and sensitivity of yield to disease. At the two other locations, both without disease control, cultivar ranking was affected by the presence of disease and at one site (Ashley Dene) by low nutrient status of the soil.

There was a close relationship between disease susceptibility (yield delivery index) and type of barley in trial 2. Winter barley cultivars were shown to be resistant to scald and resistant or moderately resistant to leaf rust. In contrast, most spring barleys were susceptible to scald and had varying levels of resistance to leaf rust. Thus spring barleys sown in winter are less attractive because of potential disease control costs. The grower also chooses cultivars on the basis of marketability for malting or feed purposes. At present no winter barley is acceptable as malting quality grain. Thus, the options for a grower are to grow winter barley cultivars for feed with nil or low disease control costs and a low market price, or to grow spring barley cultivars with high disease control costs but also with a high market value. It must be emphasised that a prophylactic disease control programme of seed treatment and up to four sprays was used as a basis for the estimates of YDI. Thus susceptible cultivars may not yield as well using a less frequent

spray schedule. The economics of disease control were not investigated in this programme. The need to control disease may change in the next few seasons. A winter or spring barley with good disease resistance to scald and leaf rust and acceptable for malting would clearly be a valuable commodity.

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