

CONTROL OF SPECKLED LEAF BLOTCH OF WHEAT WITH FUNGICIDES

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ABSTRACT

Two field trials were conducted in autumn-sown wheat cv. Domino, which is highly susceptible to speckled leaf blotch, in Central and South Canterbury. Eighteen fungicide treatments were applied at two growth stages (tillering and ear emergence) at the manufacturer's recommended rates. Severity of speckled leaf blotch and other diseases was assessed on several occasions. Speckled leaf blotch was severe in the South Canterbury trial, but only low levels of the disease were recorded in the central Canterbury trial. Most fungicides reduced disease severity and increased yield, especially in the South Canterbury trial, where disease pressure was highest and yield increases greater than 30% were recorded. The second fungicide application appeared to provide most of the increase in yield. The increases in thousand grain weights following fungicide applications contributed approximately one-third of the total yield increases in the South Canterbury trial and half in the Central Canterbury trial.

Keywords: *Mycosphaerella graminicola*, *Septoria tritici*, disease severity, yield.

INTRODUCTION

Prior to the 1980s, speckled leaf blotch, caused by *Mycosphaerella graminicola* (Fuckel) Schroeter (anamorph *Septoria tritici* Roberge ex Desmazieres), was regarded as a major disease of wheat. Its importance decreased with the introduction of the relatively resistant cultivar Rongotea, the arrival of stripe rust (which reduced the amount of leaf area to infect and led growers to increase the use of foliar fungicides) and the move towards spring sowing. Currently, speckled leaf blotch is regarded as the most significant disease affecting winter wheat in the United Kingdom (Cook *et al.* 1999). In New Zealand it has also recently increased in importance in winter wheat grown in Canterbury and Southland. In August 1997, 12 Mid and South Canterbury winter wheat crops were monitored for disease and were all infected with speckled leaf blotch, some with high incidence levels (CromeY 1998). This increase in speckled leaf blotch is, at least in part, associated with the introduction of susceptible wheat cultivars, some of which are highly susceptible. There is little New Zealand information on the relative efficacy of existing and newly developed fungicides against speckled leaf blotch, the appropriate fungicide rates and timing, and the disease cycle under current cultivar usage and cultural practices. The research outlined here determined the relative efficacy of a range of fungicides in controlling speckled leaf blotch in Canterbury.

MATERIALS AND METHODS

Trial sites

Two field trials were conducted in autumn-sown wheat cv. Domino (highly susceptible to speckled leaf blotch) in Irwell (central Canterbury) sown on 25 May

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1998 into a Temuka clay loam and Hilton (South Canterbury) on 30 April 1998 into a Waitohi silt loam. Both trials were surrounded by commercial wheat crops and received the standard agronomic treatments of these crops, except for fungicide applications.

Experimental design

Eighteen fungicide treatments were applied, each at the relevant manufacturer's recommended rate: epoxiconazole + kresoxim-methyl (as BAS494 at 1.0 litre/ha); epoxiconazole (as Opus at 1.0 litre/ha); azoxystrobin (as Amistar at 1.0 litre/ha); carbendazim (as Bavistin FL at 0.5 litres/ha); tebuconazole (as Folicur 430 SC at 0.44 litres/ha); prochloraz (as Sportak 45 EC at 1.0 litre/ha); propiconazole (as Tilt 625 Gel at 0.2 kg/ha); prochloraz + cyproconazole (as Tiptor NF at 1.2 litres/ha); cyproconazole (as Alto 100 SL at 0.4 litres/ha); chlorothalonil (as Bravo 500 F at 1.0 litre/ha); fluquinconazole (as Flamenco at 1.25 litres/ha); propiconazole (Tilt 625 Gel at 0.2 kg/ha) for the early application with chlorothalonil (Bravo at 1.0 litre/ha) plus epoxiconazole (Opus at 1.0 litre/ha) for the late application; and six coded fungicide treatments. Each trial design was a randomised complete block, replicated five times. Four unsprayed plots were included in each block. Treatment plots (10 m x 1.3 m) were sprayed with fungicide treatments on two occasions: Irwell on 23 September 1998 (GS 22 (Tottman 1987); main shoot and two tillers) and 9 November 1998 (GS 45; boots swollen); and Hilton on 1 September 1998 (GS 23; main shoot and three tillers) and 5 November 1998 (GS 38-39; flag leaf fully emerged). Fungicide treatments were applied using a motorised back-pack sprayer with a hand-held boom fitted with XR TeeJet Nozzles (Spraying System Co. XR11002-VP) calibrated to apply 200 litres/ha.

Assessments

At each trial site up to three leaves on each of 20 plants were assessed for percent leaf area infected with speckled leaf blotch and other diseases as appropriate. At Irwell, four disease assessments were conducted (22 September 1998, just prior to the first fungicide application, GS 22; 19 October 1998, GS 31; 11 November 1998, GS 49; 10 December 1998, GS 83); at Hilton there were six disease assessments (31 August 1998, immediately prior to the first fungicide application, GS 23; 22 September 1998, GS 31; 9 November 1998, GS 43; 25 November 1998, GS 61; 7 December 1998, GS 71; 17 December 1998, GS 77). The trials were mechanically harvested (Irwell on 26 January 1999 and Hilton on 13 February 1999) and the total yield (t/ha adjusted to 14% moisture) and thousand grain weight (TGW) were recorded for each plot.

Analysis

All data were statistically analysed using analysis of variance. Replicates three and four of the Hilton trial were mistakenly sprayed by the grower during a late application of epoxiconazole and hence only replicates one, two and five were used for the analyses of the final two disease assessments and yield in this trial. Data were log-transformed before analysis where appropriate.

RESULTS

Hilton trial

Speckled leaf blotch occurred early during the development of the crop. At the time of the first assessment (GS 23), 21% of assessed plants were infected with the disease, with a mean of 1.1 infected leaves per infected plant and a total of 1.2% leaf area affected. Disease severity steadily increased in the untreated plots, and at the time of the final assessment (GS 77) mean disease severity was 58% of the flag leaf area affected by the disease (Table 1).

Speckled leaf blotch severity remained low in most fungicide-treated plots at each assessment date. For instance, on 7 December 1998 speckled leaf blotch was not detected on flag leaves from five treatments, while mean disease severity in the untreated plots was 22% of leaf area affected. Even on the final assessment date mean disease severity was 2% or less of leaf area affected for seven treatments, compared with 58% in the nil fungicide treatment. At the final assessment all fungicide treatments, except chlorothalonil, had reduced ($P < 0.05$) leaf area affected by speckled

leaf blotch compared with the nil fungicide treatment (Table 1). However, the prochloraz treatment had more ($P<0.05$) disease than 14 of the other fungicide treatments.

TABLE 1: Mean speckled leaf blotch severity in the Hilton trial on five dates in wheat plots which received two applications of different fungicides or were untreated.

Fungicide treatment ¹	Mean percent leaf area affected by speckled leaf blotch					
	22 Sept lower leaves	9 Nov leaf 3	25 Nov flag leaf	7 Dec leaf 2	7 Dec flag leaf	17 Dec Flag leaf
coded-1	1.6	2.6	0.0	0.1	0.0 (0.0) ²	1.3 (0.4)
coded-2	1.6	2.0	0.0	0.1	0.0 (0.0)	1.3 (0.4)
epox' + kresox'	2.7	3.0	0.0	0.1	0.0 (0.0)	2.0 (0.4)
coded-4	2.1	4.8	0.0	0.4	0.0 (0.0)	2.0 (0.5)
azoxystrobin	2.3	3.4	0.0	0.2	1.3 (0.3)	1.3 (0.3)
epoxiconazole	2.1	5.4	0.0	0.6	0.3 (0.1)	2.0 (0.4)
coded-5	2.2	5.2	0.0	0.1	0.0 (0.0)	2.3 (0.5)
prop'/chlor' + epox'	3.5	10.4	0.0	0.6	0.7 (0.2)	2.0 (0.5)
coded-3	2.4	6.2	0.0	0.3	0.7 (0.2)	3.0 (0.6)
prochl' + cyprocon'	3.2	5.6	0.0	0.3	1.3 (0.3)	3.3 (0.6)
fluquinconazole	1.8	3.4	0.0	0.2	0.3 (0.1)	4.7 (0.7)
coded-6	3.4	4.0	0.0	1.0	1.7 (0.4)	3.3 (0.6)
cyproconazole	2.1	5.2	0.0	0.2	2.0 (0.4)	5.3 (0.8)
tebuconazole	3.0	6.4	0.5	1.9	5.0 (0.8)	5.3 (0.8)
propiconazole	2.2	6.8	0.1	1.1	2.3 (0.5)	9.7 (1.0)
carbendazim	3.9	4.2	0.1	1.5	2.7 (0.3)	11.7 (1.1)
prochloraz	3.0	10.4	0.3	1.5	6.7 (0.9)	19.0 (1.3)
chlorothalonil	6.0	15.4	3.1	9.5	14.0 (1.1)	49.0 (1.7)
nil	5.7	13.6	3.1	10.8	22.1 (1.3)	57.7 (1.7)
LSD ($P<0.05$) ³	1.87	1.36	0.89	3.54	(0.30)	(0.25)

¹Treatments are ranked in approximately increasing order of disease severity.

²Log transformation.

³LSD is for comparison of nil treatment with fungicide treatments. Multiply by 1.26 for comparisons between the fungicide treatments.

All fungicide treatments except chlorothalonil increased ($P<0.05$) yield compared to the untreated plots (Table 2). Eight fungicide treatments resulted in yield increases of over 25%. Thousand grain weights were greater ($P<0.05$) for all treatments than the untreated except prochloraz and chlorothalonil (Table 2). Increases in mean grain weight ranged from 5% (carbendazim) to 14% (epoxiconazole + kresoxim-methyl). The average grain weight increase for effective treatments (all fungicides except prochloraz and chlorothalonil) was 9% while the average plot yield increase was 25%.

The accidental spraying of replicates three and four with a late application of epoxiconazole (in addition to treatment applications) provided the opportunity to compare the effects of fungicide timing on yield. Plots which received two fungicide applications (early and late) could be compared to ones which received a single late application or no fungicide applications. No statistical analysis was conducted on these data because of the non-random layout of plots receiving the extra application. However, comparisons of yield data suggest there were no fertility effects between replicates. Yields in plots which received the single late fungicide application were 23% greater than for untreated plots, similar to the 26% increase in plots which received two applications (early and late).

TABLE 2: Mean yields, thousand grain weights and proportional increases in these parameters relative to untreated, from wheat plots in the Hilton trial which received two applications of different fungicides or were untreated.

Fungicide treatment	Yield		Thousand grain weight	
	t/ha	% increase	g	% increase
coded-1	6.9	31	41	10
coded-2	6.7	27	41	9
epox'zole + kresoxim-methyl	6.7	29	43	14
coded-4	6.5	25	41	10
azoxystrobin	7.1	36	41	8
epoxiconazole	6.6	26	42	11
coded-5	6.7	28	42	11
prop'zole/chlor'nil + epox'zole	6.7	27	42	11
coded-3	6.6	25	41	9
prochloraz + cyproconazole	6.2	19	40	7
fluquinconazole	6.4	21	41	9
coded-6	6.9	32	41	10
cyproconazole	6.4	21	40	6
tebuconazole	6.0	15	40	7
propiconazole	6.2	18	40	6
carbendazim	6.1	17	40	5
prochloraz	6.2	18	38	1
chlorothalonil	5.5	4	38	0
nil	5.2	–	38	–
LSD (P<0.05) ¹	0.4		2	

¹LSD is for comparison of nil treatment with fungicide treatments. Multiply by 1.26 for comparisons between the fungicide treatments.

Irwell trial

Speckled leaf blotch incidence immediately prior to the first fungicide application was approximately 10% of plants infected. Epidemic development was very slow with mean disease severity reaching a maximum of 3% of leaf area affected in the nil fungicide treatment at the time of the final assessment (Table 3). At the final assessment all treatments except prochloraz and chlorothalonil had levels of speckled leaf blotch infection that were lower (P<0.05) than the untreated plots.

Low levels of leaf rust were recorded at the first two assessments, especially in untreated plots. At the final assessment (10 December 1998) moderate levels of leaf rust were observed on leaf 2 (Table 3) and lower levels were observed on flag leaves. All fungicide treatments except prochloraz and chlorothalonil (both treatments 8.2% of leaf 2 area affected) reduced (P<0.05) leaf rust severity compared with the untreated plots. Coded-6 and carbendazim provided less disease control (5.6% and 4.4% of leaf 2 area affected respectively) than the other fungicide treatments (mean of 0.8% area of leaf 2 affected).

Despite the low levels of speckled leaf blotch in the Irwell trial, all fungicide treatments except propiconazole, carbendazim, prochloraz and chlorothalonil increased (P<0.05) yield compared with untreated plots (Table 3). Only azoxystrobin increased yield by more than 20% (1.1 t/ha). All fungicides except prochloraz increased (P<0.05) thousand grain weights compared with untreated. Increases ranged between 3% (for chlorothalonil) and 10% (for epoxiconazole + kresoxim-methyl) with the mean increase across treatments (excluding prochloraz) being 8%.

TABLE 3: Mean speckled leaf blotch severity, leaf rust severity and yield in the Irwell trial from wheat plots which received two applications of different fungicides or were untreated.

Fungicide treatment	% leaf 2 area affected (10 Dec 1998)		Yield		Thousand grain weight	
	Speckled leaf blotch	Leaf rust	t/ha	% increase	g	% increase
coded-1	0.0	0.0 (0.0) ¹	5.3	11	44	7
coded-2	0.0	1.0 (0.3)	5.5	16	44	8
epox'zole + kresoxim-methyl	0.0	0.6 (0.2)	5.3	11	45	10
coded-4	0.0	1.6 (0.3)	5.4	14	44	7
azoxystrobin	0.0	0.6 (0.2)	5.8	22	44	7
epoxiconazole	0.4	1.0 (0.2)	5.3	11	44	9
coded-5	0.0	0.0 (0.0)	5.6	19	45	10
prop'zole/chlor'nil + epox'zole	0.0	0.6 (0.2)	5.6	18	44	8
coded-3	0.0	0.2 (0.1)	5.3	11	43	5
prochloraz + cyproconazole	0.0	0.6 (0.2)	5.2	10	44	7
fluquinconazole	0.6	1.4 (0.3)	5.3	12	44	7
coded-6	0.4	5.6 (0.8)	5.3	12	43	6
cyproconazole	0.0	0.6 (0.2)	5.6	17	45	10
tebuconazole	0.0	1.2 (0.3)	5.6	17	44	8
propiconazole	0.8	1.6 (0.3)	5.1	7	43	6
carbendazim	1.2	4.4 (0.7)	5.0	6	43	4
prochloraz	2.4	8.2 (0.9)	4.7	-2	41	1
chlorothalonil	2.0	8.2 (0.9)	4.8	1	42	3
nil	3.2	9.1 (1.0)	4.7	-	41	-
LSD (P<0.05) ²	1.6	(0.22)0.5	1			

¹Log transformation.

²LSD is for comparison of nil treatment with fungicide treatments. Multiply by 1.26 for comparisons between the fungicide treatments.

DISCUSSION

Speckled leaf blotch levels differed at each site (low at Irwell and high at Hilton) which enabled fungicides to be evaluated under differing disease pressures. Most fungicides tested, including fungicides from various groups (including DMIs, strobilurins and new coded chemicals), provided effective disease control under both low and high disease pressure. This supports work conducted by other researchers, where DMI and strobilurin fungicides have provided good control of speckled leaf blotch (Cook *et al.* 1995; Jones and Bryson 1998; Cook *et al.* 1999).

Chlorothalonil provided some early protectant activity against speckled leaf blotch on flag leaves, but not lasting protection of flag leaves compared with most other fungicides tested. However, effective disease control was achieved when chlorothalonil was combined with DMI fungicides. Similar findings were reported by Cook *et al.* (1999). Prochloraz provided an intermediate level of speckled leaf blotch control. Good control was achieved with carbendazim soon after application but by the final assessment six weeks after application, speckled leaf blotch severity had increased to over 30% of that on untreated flag leaves, while for several other treatments severity remained less than 5% of the nil fungicide treatment.

Most fungicides increased yields, especially in the Hilton trial where disease pressure was high and yield increases greater than 30% were recorded. Most of this increased yield could be attributed to control of speckled leaf blotch as it was the predominant disease in that trial. The only other diseases observed were low levels of leaf and stripe rusts. The comparison of late versus early plus late fungicide applications at the Hilton trial suggests that the flag leaf (GS 38-39) fungicide application provided

the greatest increase in yield. While these results were not analysed statistically, they are supported by research of Cook *et al.* (1999). They showed that, in the United Kingdom, the greatest reduction in area under the disease progress curve (AUDPC) and highest yield increases were achieved by single spray applications (DMI fungicides) around GS 57 (ear emergence). They also showed a very strong correlation between reduced AUDPC and yield response with speckled leaf blotch control.

While increases in thousand grain weights were recorded following fungicide applications they contributed only approximately one-third to one-half of the total yield increases in the trials. This suggests that there were also large increases in numbers of harvested grains from the fungicide treatments. Since the evidence suggests the late epidemics were responsible for most of the yield increases, it is likely that this result reflects a greater number of grains reaching maturity. However, it would be necessary to measure tiller numbers to confirm that there was not also an increase in numbers of productive tillers from the fungicide treatments.

Carbendazim, which is a member of the MBC group of fungicides, provided moderate control of speckled leaf blotch in these trials. However, overseas, resistance of *S. tritici* to MBC fungicides has been reported (Metcalf *et al.* 1985) and growers should not apply this chemical more than once to a particular crop. Increased resistance to the MBC group of fungicides could quickly lead to reduced speckled leaf blotch control with this class of chemicals.

This research has identified a range of fungicides, including new coded chemicals, which offer very effective control of speckled leaf blotch under both low and high disease pressure. Further work evaluating the effects of timing of fungicide applications and fungicide mixtures under New Zealand conditions is required to develop effective management of this disease.

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