CONTROL OF WHEAT DISEASES IN CANTERBURY

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SUMMARY

Experiments at three sites in Central and Mid Canterbury during the 1981-82 season investigated measures for controlling disease in Rongotea wheat crops; assessed yield losses caused by diseases; and considered the economics of disease control measures. The principal disease was stripe rust (*Puccinia striiformis*) which caused yield losses up to 40% where the yield potential was high (about 8 t/ha), but the maximum loss was about 10% at the lowest yielding site (about 5 t/ha). Stripe rust was controlled economically by two fungicide applications; the first when rust was first observed in the crop and again when re-infection occurred.

INTRODUCTION

In recent years the control of diseases in wheat crops in the Canterbury region has become an important aspect of management by farmers who have been achieving high yields. However, disease control has not been a routine practice for most wheat growers. The arrival of stripe rust in 1981 and its subsequent widespread incidence in wheat crops, with the potential to cause severe yield reductions, has increased the need for routine disease control measures.

The objectives of the experiments were:

1. To investigate measures for controlling major diseases in wheat crops, principally stripe rust, but also leaf rust (*Puccinia recondita*), powdery mildew (*Erysiphe graminis*), and speckled leaf blotch (*Septoria tritici*).
2. To assess yield losses caused by the diseases.
3. To consider the economics of disease control.

METHODS

Experiments during the 1981-82 season were in paddocks of Rongotea wheat on farms at three locations in Canterbury:

1. Darfield. Templeton silt loam. Sown early May, 280 plants/m².
2. Highbank. Lyndhurst silt loam. Sown early May, 215 plants/m².
3. Methven. Mayfield silt loam. Sown early June, 220 plants/m². Irrigated.

At all sites the trial areas were subjected to the farmers' management practises, apart from the disease control treatments. All seed was treated with triadimenol + fuberidazole before sowing.

The trial areas were marked out in early spring by applying paraquat to the borders of each plot. The resulting gaps permitted easy plot identification and good access for late spray applications. The plot dimensions were 20 x 5 m. The experiments were of a randomised design with four replicates. The number of treatments differed among trials, and the treatments for each are listed in the tables.

Two fungicides, triadimefon and propiconazole, were applied at the recommended rate of 125 g/ha using a plot sprayer with a 2.5 boom equipped with disc and cone type nozzles (D2-25) operating at 300 kPa. The first application, at Feeke's Growth Stage (G.S.) 3, was timed to coincide with the usual increase of speckled leaf blotch. The second application was a G.S. 7, when stripe rust was first observed in the crops. Subsequent applications were made at G.S. 9, G.S. 10, G.S. 10.1 and /or G.S. 10.5.4 in the various experiments.

Proc. 35th N.Z. Weed and Pest Control Conf.

Captafol was applied at 1.6 kg/ha with G.S. 10.1 applications in one treatment in each experiment, where the objective was to keep plots completely disease-free, regardless of cost. Its purpose was to remove the risk of developing ears being infected by several late diseases, commonly called the ripening diseases. They occur most frequently in moist conditions.

Before harvest, ear populations were counted in all plots. A 1.6 m wide strip in the centre of each plot was threshed with a small plot harvester, and the yields recorded. Samples were retained for determinations of moisture content, 1 000 seed weight, screening percentage (using a 5½A screen) and baking score.

Yields were then adjusted to 14.5% moisture content and screenings in excess of 3% were deducted from combine yields.

RESULTS

The abnormally dry conditions during December, when grain filling occurred, caused yields at the Darfield and Highbank sites to be considerably below their estimated yield potential of 7 t/ha (Tables 1 and 2). However the yield of the crop at Methven, which was irrigated on 20 December, approached its estimated potential of 8 t/ha (Table 3).

TABLE 1: Effects of fungicide treatments on yield components and grain yield at Darfield.

Treatment and time of application	Yield components			Grain yield (kg/ha)
	Ears/m ²	Grains/ear	1,000 seed weight (g)	
triadimenfon at G.S. 3 & 10.1*	545	23.3	41.0	5620 a
triadimefon at G.S. 7 & 10.1	607	21.7	39.7	5390 b
triadimefon at G.S. 3 & 10	573	22.2	40.5	5320 b
propiconazole at G.S. 3 & 10	570	22.2	4.07	5253 b
triadimefon at G.S. 3	561	20.4	40.8	4960 c
triadimefon at G.S. 10	611	18.8	39.3	4510 d
triadimefon at G.S. 10 & 10.5.4	582	20.5	38.5	4660 d
no fungicide	562	20.5	38.9	4470 d
C%				6.7

* Included captafol at 1.6 kg/ha at G.S. 10.1

No signs of any disease were visible in early spring when the first fungicide treatment was applied at G.S. 3. Stripe rust first appeared in these triadimenol seed-treated crops at G.S. 7, on 8, 13, and 24 October at Highbank, Darfield and Methven respectively. Re-infection occurred 4-5 weeks later, at about G.S. 10.1.

Yield losses were prevented by the fungicide treatments in all experiments. The largest losses were observed in the Methven trial (Table 3), while the differences were smallest at Highbank (Table 2).

The time and number of fungicide applications influenced the magnitude of the losses. At the Darfield site a single application at G.S. 3 was better than one at G.S. 10 (Table 1). However, in general, two applications, one when stripe rust first appeared at G.S. 7 and another when re-infection occurred at about G.S. 10.1 produced the most consistent yield responses. Fungicide applications after flowering (at G.S. 10.5.4) caused no significant yield responses (Tables 1 and 3), even though substantial stripe rust infection was visible on the glumes.

TABLE 2: Effects of fungicide treatments on yield components and grain yield at Highbank.

Treatment and time of application	Yield components			Grain yield (kg/ha)
	Ears/m ²	Grains/ear	1,000 seed weight (g)	
propiconazole at G.S. 7 & 10.1	617	22.6	33.4	4660 a
triadimefon G.S. 7 & 10.1	608	23.3	32.0	4530 b
triadimefon at G.S. 3 & 10.1	625	21.6	32.6	4410 c
triadimefon at G.S. 3 (½ rate) 6 (½ rate), 8 & 10.1	628	21.2	32.6	4340 cd
triadimefon at G.S. 3, 7 & 10.1*	639	20.8	32.5	4320 cd
no fungicide	600	22.4	31.6	4230 d
CV%				4.1

* As in Table 1.

TABLE 3: Effects of fungicide treatments on yield components and grain yield at Methven (irrigated trial).

Treatment and time of application	Yield components			Grain yield (kg/ha)
	Ears/m ²	Grains/ear	1,000 seed weight (g)	
triadimefon at G.S. 3 7 & 10.1*	630	30.0	39.5	7520 a
triadimefon at G.S. 5 (½ rate) 7 & 10.1	626	31.4	37.3	7340 b
triadimefon at G.S. 7 & 10.1	639	29.8	37.1	7070 cd
propiconazole at G.S. 7 & 10.1	646	27.6	38.5	6900 d
triadimefon at G.S. 3 & 9	654	27.4	39.5	7070 cd
triadimefon at G.S. 3, 9 & 10.5.4	642	28.8	39.1	7230 bc
no fungicide	620	20.0	34.3	4270 c
CV%				4.7

* As in Table 1.

Ear populations at harvest were not affected by stripe rust infection or the fungicide treatments (Table 1, 2 and 3). The yield losses in untreated plots were due to decreased numbers of grains per ear and 1,000 seed weights. There were up to 30% less grains per ear, and 1,000 seed weights decreased by as much as 5 g when stripe rust was not controlled (Tables 1, 2 and 3).

The results of bake tests for selected treatments are in Table 4. There were no significant differences among treatments, although mechanical dough development (MDD) test results tended to increase when diseases were controlled.

Estimates of financial returns from disease control measures at the Darfield and Methven sites are shown in Tables 5 and 6 respectively. At Darfield, two spray applications resulted in an increased net return in excess of \$100/ha. At Methven, where the yield depression was about 3 t/ha, the increased net return was about \$500/ha.

TABLE 4: Effects of selected fungicide treatments on grain quality characteristics.

SITE	Treatment	MDD *test	Protein content (%)	Flour extraction (g/250 g)
Darfield	no fungicide	12	8.4	153
	triadimefon at G.S. 3 & 10	12	9.0	158
	propiconazole at G.S. 3 & 10	14	8.8	159
	triadimefon at G.S. 7 & 10.1	15	8.9	161
	triadimefon at G.S. 3 & 7	14	8.1	161
	triadimefon at G.S. 3 & 10.1	14	8.1	161
Highbank	no fungicide	18	10.9	146
	triadimefon at G.S. 7 & 10.1	20	11.7	149
Methven	no fungicide	15	10.7	170
	triadimefon at G.S. 3, 7 & 10.1	18	10.5	170

* MDD = mechanical dough development.

TABLE 5: Estimates of financial returns from fungicide treatments at Darfield.

Treatment	Treatment cost ¹ (\$/ha)	Extra return from ² treatment (\$/ha)	Nett return from treatment (\$/ha)
triadimefon at G.S. 3, 7 & 10.1	130	234	104
triadimefon at G.S. 7 & 10.1	70	187	117
triadimefon at G.S. 3 & 10	70	173	103
propiconazole at G.S. 3 & 10	70	158	88
triadimefon at G.S. 3	35	98	63
triadimefon at G.S. 10	35	7	-28
triadimefon at G.S. 10 & 10.5.4	70	37	-33

- Cost used in calculations:—

triadimefon at 125 mls/ha	= \$25/ha.
captafol at 1.6 kg/ha	= \$25/ha.
propiconazole at 125 mlg/ha	= \$25/ha.
	(assumed).
application cost	= \$10/ha.
- Wheat price of \$203/t.

TABLE 6: Estimates of financial returns from fungicide treatments at Methven.

Treatment	Treatment cost ¹ (\$/ha)	Extra return from ² treatment (\$/ha)	Nett return from treatment (\$/ha)
triadimefon at G.S. 3, 7 & 10.1	130	660	530
triadimefon at G.S. 5 (½ rate) 7 & 10.1	88	624	536
triadimefon at G.S. 7 & 10.1	70	569	499
propiconazole at G.S. 7 & 10.1	70	534	464
triadimefon at G.S. 3 & 9	70	569	499
triadimefon at G.S. 3, 9 & 10.5.4	105	601	496

1 & 2 as in Table 5.

DISCUSSION

A two spray programme adequately controlled stripe rust and other diseases, and reduced the chances of a yield depression. The optimum times for the two fungicide applications were when stripe rust was first observed in the crop, usually at about G.S. 7, and when re-infection occurred, about G.S. 10.1.

An early spray application at G.S. 3, about two moths before stripe rust was first observed in control plots, was also beneficial, particularly at the high-yielding Methven site. The single application at G.S. 3 in the Darfield trial was better than the single one at G.S. 10, even though stripe rust infection was severe in the latter case. These observations suggest that in medium or high yield potential situations it could be beneficial to apply fungicide at an early stage, before stripe rust is first observed on the plants. However, very late applications, after flowering appear unwarranted.

Yield losses caused by stripe rust varied among the trial sites, ranging from up to about 40% (3.2 t/ha) at Methven to almost 10% (0.5 t/ha) at Highbank. Losses were greatest where the yield potential, determined by site, management, and climatic factors, was highest.

The financial calculations showed that two spray applications produced good returns on money spent on fungicide and its application at the medium and high yielding sites (Darfield and Methven). At Methven, three applications were marginally better. However, at Highbank, where yields were lowest, the economics of spraying twice were probably marginal.

There was little difference in the effect of the two fungicides, triadimefon and propiconazole, on disease control or grain yield. No economic comparison was possible because propiconazole is a new product and is not yet commercially available.

ACKNOWLEDGEMENTS

I wish to thank S. White, A. Grant and M. Grogan of Advisory Services Division, MAF and G. Hurrell of Research Division of MAF for their valuable assistance with spraying and harvesting; G. Gough, A. Lill and G. Robertson for access to their wheat crops; and D. Wilson of Crop Research Division of DSIR for his technical assistance and analysis of the data.