SEED TREATMENT AND FOLIAR-APPLIED FUNGICIDES FOR CONTROL OF STRIPE RUST IN SOUTHLAND

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SUMMARY

Control of stripe rust (*Puccinia striiformis*) in wheat was studied in three spring-sown trials in Southland. Infection first appeared in late November in all trials, but developed at different rates. The cultivar Takahe was severely affected, whereas Kopara was only slightly affected. Seed treatment with triadimenol/fuberidazole reduced initial infection for 7-9 weeks after sowing, but had only a small effect on final yield. A single foliar spray on Takahe with triadimefon at GS 6-7 or GS 9-10 gave similar yield increases, but affected different yield components. Treatment at both times further improved yield.

INTRODUCTION

Stripe rust, also referred to as yellow rust, first developed in Southland wheat crops in the 1980-81 season. It was first reported in November 1980 at Gore and by late January had spread to most wheat crops.

In the Northern Hemisphere, where stripe rust occurs widely, it is regarded as the most serious rust disease of wheat as yield losses of up to 50% with susceptible cultivars have been reported (Doodson *et al* 1964; Gair *et al* 1972; King 1976). Its effect on crops is to reduce the rate of photosynthesis, increase the rate of respiration and reduce the rate of flow of food materials from the leaves. The full destructive potential of the disease is seldom reached, however, because of varying cultivar resistance and the day-to-day variations in climate which restrict the development of epidemics (Gair *et al* 1972; Rapilly 1979).

The main cultivar grown in Southland, Takahe, was found to be very susceptible and many crops suffered some yield reduction in 1980-81. If stripe rust had developed earlier in that season it is likely this cultivar would have been more seriously affected. Other cultivars grown on a minor area, such as Oroua and Kopara, exhibited some resistance.

Because stripe rust had not occurred over a full growing season and its effects on susceptible cultivars determined, the most effective control measures were unknown. The trials reported here were aimed at elucidating this problem.

MATERIALS AND METHODS

Three trials were sown in Southland with a precision cone seeder in the spring of 1981 and the details are Tables 1 and 2. Plots were 14.8 x 1.35 m. Sowing rate was 350 seeds/m² corresponding to 202 and 192 kg/ha for Takahe and Kopara respectively. A four replicate randomised block design with 16 treatments was used (Table 2). Seed treatments were at the rate of 15 + 2 g/100 kg seed for triadimenol/fuberidazole and 52 + 52 g/100 kg seed for carboxin/thiram. Foliar spraying was with triadimefon (as a 25% EC formulation) at a rate of 125 g/ha. Times of treatment were: no spray, spray at early infection (E), spray at late infection when previously treated plots were showing signs of reinfection (L) and application at both early and late times (E & L). Spray treatments were applied in 335 litres/ha with a propane powered knapsack sprayer at an operating pressure of 200 kPa using hollow cone nozzles. During the growth of the crop leaves were inspected regularly and detailed assessments conducted on four occasions.

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The green leaves of 20 tillers/plot were collected and rated for percent area infected using standard leaf area diagrams (MAF 1976). Whole plots were harvested by direct heading.

TABLE 1: Trial details.

Trial	Location	Sowing date	Spraying dates	Spraying growth stage	Harvest date
1	Chatton	7.10.81	30.11.81	G.S. 6 G.S. 10.5	24.3.82
2	Winton	13.10.81	16.12.81	G.S. 7 G.S. 10.3	26.3.82
3	Thornbury	22.10.81	13.12.81	G.S. 6 G.S. 10	13.4.82

RESULTS AND DISCUSSION

The development of stripe rust over the season at the three trial sites is outlined in Figure 1. Yield results from all sites and some components of yield from the Thornbury site are given in Table 2 and 3.

Rust development

A feature is the variation in the time of stripe rust development in the trials on untreated plots (Figure 1). Rust pustules could be found on some leaves at all sites on both cultivars by late November, but the disease subsequently increased at different

rates. At Thornbury infection rapidly developed from mid-December (GS 6, Large 1954) with all leaves infected and plants yellowing in Takahe by late December. A slower, less severe build-up occurred in Kopara. At Winton there was no rapid increase until after late December on Takahe (GS 10) and late January (GS 10.5) on Kopara, while at Chatton it was after late January (GS 10.5.2) before high levels of stripe rust developed on both cultivars. The reason for three differences is not known as the trials had a similar low level of infection in early December and weather conditions appeared similar at the sites. A contributing factor at Thornbury would have been an adjacent autumn-sown wheat crop which was severely infected during November and December.

Spray treatments

Significant yield responses (Table 2) were recorded only with spray treatments on Takahe and Kopara at Thornbury and on Takahe at Winton. At these sites Takahe with a single foliar spray applied either early or late gave a similar yield response but this was not as great as the double spray treatment where sprays were applied at both times. At Thornbury, on Kopara, a single spray applied either early or late gave a similar yield response to the double spray treatment.

The effect on two important yield components, grains per head and grain weight was demonstrated in these trials. At Thornbury on Takahe where high rust levels occurred early in crop development, the early spray treatment (GS 6) increased the number of grains per head and grain weight (Table 3). When both an early and a late spray (GS 10) were applied grain weight was significantly increased further ($P < 0.05$). A late spray only gave an intermediate result. With Kopara, which was only moderately affected, no differences in grains per head occurred but a significant improvement in grain weight with late spraying was recorded (Table 3).

TABLE 2: Grain yields from trials at Chatton, Winton and Thornbury.

Cultivar	Seed treatment	Spray treatment	Yield t/ha		
			Chatton	Winton	Thornbury
Kopara	triadimenol/ fuberidazole	O	6.63	4.08	5.06
		E	6.42	4.41	5.60
		L	6.37	4.76	5.67
		E & L	6.58	4.40	5.86
Kopara	carboxin/ thiram	O	5.99	4.68	5.01
		E	6.44	4.90	5.59
		L	5.77	4.51	5.01
		E & L	5.87	4.95	5.50
		LSD 5%	0.89	0.78	0.47
		LSD 1%			0.64
		CV %	8	12	6
Takahe	triadimenol/ fuberidazole	O	6.69	3.67	2.50
		E	7.26	4.44	3.88
		L	7.79	4.32	4.05
		E & L	8.31	5.85	5.62
Takahe	carboxin/ thiram	O	7.09	3.45	2.15
		E	8.00	4.19	3.54
		L	7.44	4.57	3.76
		E & L	7.97	5.09	5.52
		LSD 5%	1.83	0.58	0.54
		LSD 1%		0.77	0.73
		CV %	14	9	9

At Winton where stripe rust development was later than at Thornbury only Takahe grain weight was improved by both early (GS 7) and late (GS 10.3) spraying.

These results suggest that with a susceptible cultivar such as Takahe, the earlier in the plants development phase that stripe rust occurs, the more severe its effect. The occurrence of high levels of leaf infection over the spikelet formation period has the effect of reducing the number of grains per head while later infection reduces grain size. Very late infections such as occurred at Chatton had no effect on these yield components or on yield. The no spray Takahe treatments at Thornbury and Winton had a high percentage of pinched grain and were of unacceptable milling standard. This contrasts with the double spray treatments which had a normal grain size and were suitable for milling. It was also shown that the late spray applied after ear emergence (GS 10.1) reduced the amount of infection in the heads. It is not known from these trials whether head infection had a damaging effect on grain filling.

Seed treatment

Seed treatment with triadimenol/fuberidazole, compared with carboxin/thiram, increased yields of both Takahe and Kopara significantly ($P < 0.05$) at Thornbury where very high levels of infection developed. After infection was first observed in late November there was a slower initial build-up of stripe rust in triadimenol/fuberidazole plots. This effect could be seen until mid-December after which high levels of stripe rust developed which swamped initial protection. The yield improvement from triadimenol/fuberidazole treatment could not be attributed to increase in grains per head or grain weight but there may have increased tillers/m², a yield component which was not measured. Since all plots had one or other seed treatment, it is not known whether carboxin/thiram gave any improvement over no seed treatment at all. Up to mid-December a similar reduction in stripe rust through application of triadimenol/fuberidazole was observed at the other two sites.

TABLE 3: Mean grains per head and thousand grain weights for Takahe and Kopara at Thornbury.

Spray treatment	Takahe		Kopara	
	Grains /head	Thousand Grain wt (g)	Grains /head	Thousand Grain wt (g)
No spray	15.1 c	24.5 d	28.2 a	38.9 b
Early spray	21.9 a	32.0 c	29.0 a	39.0 b
Late spray	19.0 b	36.8 b	28.9 a	40.1 a
Early + late spray	21.5 a	40.8 a	30.2 a	42.6 a

CONCLUSIONS

These are:—

- Initial stripe rust infections occurred in late November on both cultivars at all sites, but developed at a different rate at each site.
- Takahe was much more susceptible than Kopara.
- Seed treatment with triadimenol/fuberidazole gave some early protection but inconsistent yield responses.
- Early and late spraying on Takahe with triadimefon gave similar large yield increases under conditions of medium to high infection but affected different yield components.
- A combination of early and late spraying of Takahe resulted in the prevention of highly significant yield losses (41-62%).
- With Kopara, only small yield responses occurred following spraying even under high rust levels. At Thornbury yield loss prevented was 15%.

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