FUNGICIDE TREATMENTS FOR STRIPE RUST CONTROL IN CANTERBURY

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SUMMARY

Triadimenol 15% + fuberidazole 2% as a seed treatment and triadimefon as a foliar spray were applied to winter wheat cultivars, to investigate their effect on the development of stripe rust (*Puccinia striiformis*). Triadimenol/fuberidazole delayed the appearance of stripe rust and continued to suppress rust development up to head emergence. Triadimefon was most effective when applied prior to rust becoming established, but also gave good control of established infections. By applying triadimefon at different stages of crop development it was possible to show a positive correlation between rust-induced foliage damage and subsequent decreases in yield.

INTRODUCTION

In 1980, stripe rust appeared for the first time on wheat crops in the southern part of the South Island of New Zealand, and in some areas of Southland it developed to epidemic proportions.

Overseas, treatment of seed with the systemic fungicide triadimenol, and the foliar-applied fungicide triadimefon, has given effective control of the disease (Bayer Technical Reports; unpublished).

In anticipation of stripe rust appearing in Canterbury in 1981, trials were conducted to test the effectiveness of these fungicides under local conditions, on commonly grown cultivars.

METHOD

During the autumn of 1981, random block trials were established at 2 sites comparing triadimenol 15% + fuberidazole 2% with a treatment of carboxin 20% + thiram 20%.

The seed treatments were applied as slurries using 15 + 2 g/100 kg seed of triadimenol/fuberidazole (triad/fub) and 50 + 50 g/100 kg seed of carboxin/thiram (carb/thir).

Trial A (Darfield) was sown 15.5.81 while Trial B (Methven) was sown 24.6.81. Plots were approximately 150 m², with the treatments laid adjacent to one another within each cultivar. Growth stages (GS) were determined using a decimal key (Zadoks *et al* 1974).

Triadimefon was applied using a towed precision boom sprayer, using Tee-jet nozzles delivering 180-360 litres/ha. In all instances triadimefon was applied at a rate of 125 g/ha in a programme to show most effective application times.

Stripe rust was assessed by taking at random 25 main tillers/plot and estimating percent leaf area infected on 0-5 scale, viz; 0 = 1, 1 = 0-10%, 2 = 10-25%, 3 = 25-50%, 4 = 50-75%, 5 = 75-100%. Leaves were numbered from the top down. All percent leaf area infection data included in the tables was calculated using the method described by Townsend and Heuberger (1943). No irrigation was used, and rust in the trial developed through natural infection. Yield was determined by harvesting 33 m²/plot with a Wintersteiger plot combine.

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TABLE 1: Definition of spray timing treatments, dates and growth stages when applied.

Applied fungicide	Code	Spray application dates and growth stages	
		Darfield	Methven
Early application on appearance of rust pustules in either treatment for each cultivar	BE	25.9.81/GS 24	30.9.81/GS 23
Delayed early application, to allow establishment on leaves and infection cycling	BED	13.10.81/GS 32	14.10.81/GS 30
Early season application, (BE) followed by a late season application	BEL	25.9.81/GS 24 2.11.81/GS 47	30.9.81/GS 23 2.11.81/GS 42
Late season application only unsprayed	BL US	2.11.81/GS 47	

RESULTS**Trial A — Darfield**

Triadimefon (BE) was applied on 25.9.81 (7 days after the first observation of rust infection) and disease was assessed on 11.10.81 (Table 2).

TABLE 2: Emergence, incidence of stripe rust (126 days after sowing) and percent leaf infection 16 days after spraying (BE), GS 32.

Cultivar	Seed Treatment	Emergence* and Incidence*	Spray Treatment	% Plants Infected	%Leaf area infected**			
					L1	L2	L3	L4
Rongotea	triad/fub carb/thir	248/0 226/0.4	BE	0 0.4	0 0	0 0.2	0 18	0 26
	traid/fub carb/thir		US		0 0.8	0 1.3	0 39	0 65
Hilgendorf	triad/fub carb/thir	214/0 199/0.7	BE	0 0.7	0 0	0 0	0 3	0 9
	triad/fub carb/thir		US		2.8 8.7	6.2 35	25 49	64 76
Kopara	triad/fub carb/thir	208/0 197/0.9	BE	0 0.9	0 0	0 0	0 0	0 0
	triad/fub carb/thir		US		0 0	0 0	2 14	3 31

* Emergence = plants/m²; Incidence = No. plants/m row infected (126 days after sowing (GS 22) 25 points/plot.

** 4 leaves/main tiller — excluding top leaf, leaf 1 being the next leaf down.

In the absence of an early (BE) application, triad/fub as a seed treatment markedly reduced rust infection in all cultivars; compared to the carb/thir treatment.

Early spraying (BE) prevented the establishment of rust in all triad/fub treatments, although in the week between initial detection and application (BE), rapid development of rust had occurred in the carb/thir plots.

In the 23 days between first and second assessments at GS 32, leaf infection increased substantially with newly emerged leaves becoming infected rapidly. Rongotea and Kopara carb/thir (US) treated plots had become heavily infected on the lower two leaves, in contrast with the triad/fub (US) treated plots, where development of rust was almost totally suppressed.

No rust developed in the triad/fub (BE) plots until GS 43, a period of approximately 1 month during which time high inoculum pressure from nearby unsprayed plots existed. Fresh sporulation had occurred in the carb/thir (BE) plots, and by GS 47 rust was well distributed within the plots.

Due to hot and dry conditions, leaf senescence progressed quickly, and in the case of Hilgendorf, complete loss of the leaf area was only prevented by a late spray of triadimefon (BEL and BL) (Table 3).

TABLE 3: Percent leaf infection at GS 47, 9 days after spraying (BE and BL), percent green leaf area at GS 73 and yield (14% moisture)

Seed Treatment	Spray Treatment	Rongotea		Hilgendorf		Kopara	
		% LA infected*	Yield t/ha	% LA infected	Yield t/ha	% LA infected	Yield t/ha
triad/fub carb/thir	BEL	3.4	(74)†	10.3	(63)	4.8	(79)
		19.6	(73)	46.0	(47)	21.0	(73)
triad/fub carb/thir	BE	3.2	(66)	20.8	(0)	14.6	(58)
		11.9	(61)	47.5	(0)	25.3	(59)
triad/fub carb/thir	BED	3.6	(66)	21.0	(0)	6.3	(68)
		13.3	(67)	30.2	(0)	17.1	(57)
triad/fub carb/thir	BL	25.1	(63)	44.3	(46)	23.0	(73)
		25.2	(61)	40.3	(48)	35.7	(55)
triad/fub carb/thir	US	33.0	(28)	44.5	(0)	37.9	(23)
		35.5	(36)	50.2	(0)	39.8	(28)

* mean leaf area infected on Flag and four lower main tiller leaves.

† Figures in brackets represent mean percent green leaf area on flag, leaf 2 and leaf 3 at GS 73.

The disease assessment at 180 days after sowing (Table 3) showed that large differences existed in leaf infection between seed treatments when early sprays were applied. In the absence of early sprays, no such differences existed. It would appear that the later season development of rust was dependent on spore production prior to stem extension growth, this being a function of the rust infection at that time (see Table 2). This observation was supported by aerial infra-red photographs of the trial area taken on 11.11.81 which clearly showed localisation of infected areas to those plots not receiving protection from either triad/fub as a seed treatment and/or an early (BE or BED) triadimefon application.

Lower early season leaf infection in triad/fub treatments was reflected in yield, suggesting a beneficial influence on early determined yield components (Table 3). Triadimefon applied as a single spray treatment gave a greater yield response when applied to triad/fub treatments in each cultivar. All cultivars demonstrated a positive yield response to a second triadimefon application, with differences in early season disease control from triad/fub separating yields within cultivars. Kopara displayed the

highest level of tolerance to rust, yield loss 26%, compared with yield losses of 46% and 66% for Rongotea and Hilgendorf respectively.

Trial B — Methven

Triad/fub seed treatment reduced both the numbers of plants infected and leaf area infected, compared to carb/thir. In the carb/thir (US) plots, rust developed rapidly, with new foliage being infected soon after emergence (Table 4). Triadimefon (BE) gave effective control of rust, with no 'healthy' pustules on any foliage 2 weeks after application.

Triadimefon (BED) was applied 2 weeks later at which time infection foci were marked with pegs. These infection foci comprised plants with very high levels of leaf area infected, while plants adjacent (within 1-2 m) were not infected.

TABLE 4: Percentage incidence and leaf area infected 12 days after spraying (BE). Growth stage 24.

Cultivar	Seed	Emergence No./m ²	Spray Treatment	% Plants Infected	%Leaf area infected	
					Leaf 1	Leaf 2
Rongotea	triad/fub	202	BE	0	0	0
	carb/thir	208		T	T	T
	triad/fub		US	0.8	0	8.0
	carb/thir			8.4	7.5	20.5
Kopara	triad/fub	195	BE	0	0	0
	carb/thir	204		T	T	T
	triad/fub		US	0.4	0	1.5
	carb/thir			7.4	5.7	18.8

T = trace

During the 3 weeks after BED, the striped arrangement of pustules developed in unsprayed plots. Seed treatment effect was apparent, with < 50% infection present in triad/fub, compared to carb/thir. The localised development of rust in the BED plots was still evident, with renewal of sporulation within infection foci and peripheral areas. However, development of rust on plants not infected prior to BED was delayed for a further 8-10 days.

Plant senescence was hastened due to drought effects in Canterbury, although having most effect where early establishment of rust had occurred. Although Kopara appeared to have less healthy leaf area compared to Rongotea, the damage was not comparable, being manifest as a leaf flecking unassociated with free sporulation. This is thought to be an agronomic reaction due to partial resistance developing as the plant matures (Gaunt pers comm). This may have had a less severe effect on yield, as there was less rupturing of the leaf epidermal tissues, typically associated with the production of uredinia. Thus the disease-induced 'flecking', and possibly carbohydrate loss associated with spore production would not substantially contribute to loss of leaf turgidity. This may have allowed Kopara to tolerate drought conditions better than a potentially higher yielding cultivar exhibiting a typical reaction to rust.

In Kopara, large differences in yield (Table 5) between seed treatments in each spray treatment category may be attributable to disease susceptibility during tillering, when large differences in leaf infection were recorded in unsprayed plots (Table 4). Overriding late season influences tend to be absent, probably attributable to relationship between increasing resistance and plant maturation. This is consistent with the result obtained in Trial A.

Rongotea did not yield as well, with seed treatment and early spray differences which may have affected yield being negated through later season infection. Yield losses were 57% and 47% respectively for Kopara and Rongotea.

TABLE 5: Percent leaf infection at GS 42, 11 days after spraying (BEL), percent green leaf area at GS 77 and yield.

Seed Treatment	Spray Treatment	Rongotea		Yield t/ha	Kopara	
		% LA Infected*			% LA Infected*	Yield t/ha
triad/fub carb/thir	BEL	2.4	(89)†	3.5	2.5	(78) 4.6
		5.1	(73)	2.9	4.7	(63) 2.8
triad/fub carb/thir	BE	1.8	(48)	2.8	4.5	(40) 4.1
		9.6	(31)	2.2	9.8	(36) 2.7
triad/fub carb/thir	BED	2.3	(56)	2.7	2.0	(35) 4.0
		3.5	(37)	2.3	7.1	(35) 2.6
triad/fub carb/thir	US	10.8	(36)	2.2	13.7	(36) 3.5
		42.1	(35)	1.8	34.6	(30) 2.0

* mean leaf area infected on leaf 2, 3 and 4

† figures in brackets represent percentage green leaf area on flag + leaves 2 and 3 at GS 77.

CONCLUSION

Stripe rust may reduce yields on susceptible varieties in excess of 50%, with differences in infection severity during seedling and tillering growth stages having a direct influence. Triadimenol/fuberidazole seed treatment delayed both the initial infection compared to carboxin/thiram, and development of rust up to head emergence. Triadimenol/fuberidazole seed treatment is a useful adjunct to foliar treatment with triadimefon, with both products giving effective control of stripe rust.

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