CYPROCONAZOLE — A NEW DMI FUNGICIDE

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SUMMARY

Cyproconazole, a new DMI fungicide, demonstrated activity against a range of diseases in arable and horticultural crops in field trials conducted in New Zealand over two seasons (1987 and 1988). At rates of 1.0-2.0 g/100 litres or 20-80 g/ha it controlled; powdery mildew in grapes, stripe rust and powdery mildew in wheat, leaf rust in barley, leaf and stem rust in ryegrass, crown rust in oats, powdery mildew in peas and squash, leafspot in strawberries and rust in garlic. Except for some leaf damage after the earliest application on grapes, there were no obvious phytotoxic reactions.

INTRODUCTION

Cyproconazole (SAN 619F), a new triazole fungicide from Sandoz Ltd. (Switzerland), is being developed in New Zealand by Nufarm Ltd under the trade name Alto (containing 100 g ai/litre). Cyproconazole is a C-14 demethylation inhibiting (DMI) fungicide with systemic, protectant, curative and eradivative activity against many Asco- and Basidiomycetes and some Deuteromycetes. Details of its chemical and physical properties and an outline of its biological activity have been reported overseas by Gisi *et al* (1986a,b). In New Zealand, Sheridan and Nendick (1988) reported protection of barley (*Hordeum vulgare*) seedlings from scald (*Rhynchosporium secalis*) when seed was treated with cyproconazole alone or in combination with carboxin + thiram.

This paper summarises data from field trials conducted in New Zealand during the 1987 and 1988 seasons evaluating cyproconazole for control of; powdery mildew (*Uncinula necator*) in grapes (*Vitis vinifera*), stripe rust (*Puccinia striiformis*) and powdery mildew (*Erysiphe graminis*) in wheat (*Triticum aestivum*), leaf rust (*Puccinia hordei*) in barley, powdery mildew (*Erysiphe polygoni*) in peas (*Pisum sativum*), crown rust (*Puccinia coronata*) in oats (*Avena sativa*), leaf rust (*Puccinia coronata*) and stem rust (*Puccinia graminis*) in ryegrass (*Lolium perenne*), rust (*Puccinia allii*) in garlic (*Allium sativum*), powdery mildew (*Sphaerotheca fuliginia*) in squash (*Cucurbita maxima*) and leaf spot (*Mycosphaerella fragariae*) in strawberries (*Fragaria ananassa*).

METHODS

Grapes

Grapes (cv. Reisling Sylvaner) grown in Blenheim were treated with a hand gun to run off, on four vines/plot, six times at 15-17 day intervals from 14 November 1988 to 17 February 1989. Leaf damage (% leaf area discoloured) was assessed on 6 December 1988. Powdery mildew infection was assessed on 20 bunches/plot randomly chosen on 12 January, 2 and 16 February 1989. On 20 March 1989 yield was assessed by picking and weighing all bunches from 2 m of row/plot.

Cereals and ryegrass

In trials in Canterbury, wheat (Trial A = cv. Oroua, Trial B = cv. Kotare), barley (Trial C = cv. Fleet), ryegrass (Trial D = cv. Prelude) and oats (Trial E = cv. Omih) were treated in 2-2.5 m x 8-10 m plots 1-2 times at 3-6 week intervals with precision backpack sprayers and hand held booms fitted with 730154 or 11002 nozzles operating at 275-300 kPa and delivering 235-300 litres/ha. Cereals were treated at growth stages 22-80 (Zadoks *et al* 1974). Disease severity (stripe rust and powdery mildew on wheat, leaf rust on barley, leaf and stem rust on ryegrass and crown rust on oats) was assessed

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on 10-20 tillers/plot randomly sampled 4-6 weeks after each application. Yield was measured from 8.44 m²/plot harvested with a Suzue mini-plot harvester (wheat, barley, oats) or 3 x 1 m² quadrats/plot hand harvested (ryegrass). Seed was threshed, dressed and weighed, weights adjusted to 14.0% grain moisture content.

Peas

Peas (cv. Pania) were sown in Canterbury in 1 m x 10 m plots on 15 October 1988. Treatments were applied during flowering on 15 December 1988 with a precision plot sprayer fitted with D2-25 disc/core type cone spray tips operating at 359 kPa and delivering 1250 litres/ha. Powdery mildew incidence (% leaves infected) was assessed on 10 plants/plot 18 days after treatment.

Squash

In a trial in Nelson, squash (cv. Supermarket) planted on 7 December 1988 were treated in 4 m x 6 m plots six times at 10-16 day intervals from 4 January 1988 to 7 March 1989 with a precision back pack sprayer and hand held boom fitted with D3-45 disc/core type cone spray tips operating at 275 kPa and delivering 800 litres/ha. Powdery mildew infection was assessed on 10 canopy and 10 immature leaves/plot on 21 March.

Strawberries

Second year strawberries (cv. Pajaro) grown in Nelson were treated in 5m x 2 row plots with a precision back pack sprayer and hand held boom on 25 August and 12 September 1988 using 730-154 nozzles at 275 kPa delivering 300 litres/ha and on 26 September and 6 October 1988 using D3-45 disc/core type cone spray tips at 275 kPa delivering 1066 litres/ha. Leafspot infection was assessed on the second and third youngest leaves of 10 plants/plot on 27 October 1988.

Garlic

Treatments were applied to garlic (cv. Marlborough White) grown in Blenheim, on 15 December 1987 in 5m x 2 m plots with a precision plot sprayer fitted with 730154 nozzles at 275 kPa delivering 300 litres/ha. Rust infection was assessed on the top five leaves of five plants/plot on 31 December 1987.

All trials were of a randomised complete block design with plots replicated three (garlic) or four (other crops) times. Statistical analysis was by analysis of variance with mean separation by Duncans New Multiple Range test ($P < 0.05$), transformations being applied as required. Details of chemicals and rates used are included in Tables 1-4.

RESULTS AND DISCUSSION

Grapes

Cyproconazole at 1.0-2.0 g/100 litres gave good control of powdery mildew on Reisling Sylvaner grapes with levels of control similar to that obtained in the standard treatment, fenarimol at 2.4 g/100 litres (Table 1). Some leaf browning was seen on 6 December (after the first application at flower bud) and a leaf damage assessment (Table 1) showed that cyproconazole at 1.0-2.0 g/100 litres did not cause significantly worse leaf damage than fenarimol. No leaf damage was seen following later applications and no damage was seen on the fruit. Another trial with the same treatments was conducted in the same season on Palomino grapes in Blenheim. Similar control of powdery mildew was obtained, but less leaf damage was evident on this variety after the first application.

Cereals

On cv. Oroua wheat, cyproconazole at 20-80 g/ha gave good control of stripe rust (Table 2, Trial A) with control similar to that in the standard treatment, 125 g/ha propiconazole. Similar results were obtained in the same season with the same treatments in three other trials on wheat (cv. Oroua and Rongotea) grown in Canterbury and Southland. Good control of powdery mildew in cv. Kotare wheat (Table 2, Trial B) was obtained with 40-80 g/ha cyproconazole and 750 g/ha fenpropimorph (the standard treatment).

Cyproconazole at 20-60 g/ha gave good control of leaf rust on cv. Fleet barley (Table 2, Trial C), and at 40-60 g/ha it reduced leaf rust severity more than the standard treatment, 125 g/ha propiconazole. Similar results were obtained with the same

TABLE 1: Powdery mildew incidence and severity, % leaf damage and yield in grapes.

Treatment	Rate g ai/100 litres	Mean ¹ % p.mildew		% leaf damage (6.12.88)	Yield kg/2 m row
		inc	sev		
untreated		100 a ²	74.8 a	0.3 b	2.6 b
cyproconazole	1.0	20.8 b	5.2 b	22.3 a	8.8 a
cyproconazole	1.5	10.8 bc	1.3 b	19.0 a	10.9 a
cyproconazole	2.0	2.1 c	0.4 b	45.0 a	9.7 a
fenarimol	2.4	23.3 b	3.9 b	37.5 a	10.0 a
cv%		33.5	17.1	49.2	18.6

inc = incidence (mean % bunches infected)

sev = severity (mean % mildew/bunch)

¹ = mean of three assessments (12.1.89, 2.2.89, 16.2.89)² = means followed by the same letter are not significantly different (P<0.05, Duncan's New Multiple Range Test)**TABLE 2: Stripe rust and powdery mildew severity in wheat, leaf rust severity in barley, and wheat and barley seed yield in Trials A, B and C.**

Treatment	Rate g ai/ha	Mean ¹ disease severity			Yield (T/ha)		
		s. rust	p.mildew	l.rust	wheat	wheat	barley
		A	B	C	A	B	C
untreated		10.84 a ²	14.47 a	66.0 a	2.63 b	3.51	1.47 c
cyproconazole	20	0.86 b	—	13.0 bc	5.68 a	—	2.60 ab
cyproconazole	40	0.55 b	1.60 b	9.2 cd	6.37 a	3.53	2.84 a
cyproconazole	60	0.17 b	1.23 b	5.7 d	5.85 a	3.89	3.03 a
cyproconazole	80	0.10 b	1.30 b	—	5.77 a	4.06	—
propiconazole	125	0.24 b	—	24.5 b	5.89 a	—	2.18 b
fenpropimorph	750	—	1.28 b	—	—	3.98	—
cv%		35.93	8.27	14.68	7.75	9.78 NS	12.84
transformation			SQRT	LOG10			

¹ = mean of 1 or 2 assessments² = see Table 1.Severity = mean % leaf area infected (stripe rust and powdery mildew)
mean no. rust pustules/leaf (leaf rust).

NS = no significant difference between treatment means.

treatments on cv. Triumph in Canterbury in 1988, and in 1987 on an experimental cultivar in Canterbury and on cv. Goldmarker in Blenheim. Cyproconazole at 20-60 g/ha also gave good control of crown rust in cv. Omihi oats (Table 3, Trial E) with similar crown rust severity to the standard treatment, 125 g/ha propiconazole. No damage was seen from cyproconazole treatments on the wheat, barley or oats.

Ryegrass

Good control of leaf rust in cv. Prelude ryegrass was given by 20-60 g/ha cyproconazole in Trial D (Table 3), although stem rust severity was significantly higher at 20 g/ha cyproconazole than at 40-60 g/ha cyproconazole or 125 g/ha propiconazole (the standard treatment). Similar results against leaf rust were obtained in a trial the previous season on cv. Barry ryegrass. No damage was seen on the ryegrass from cyproconazole treatments. In another trial on cv. Ellett ryegrass in Canterbury in 1987, the endophyte (*Acremonium lolii*) level in seedlings grown from seed harvested from plots treated with 80 g/ha cyproconazole was not affected (80% compared to 75% from untreated).

Peas

Cyproconazole at 40, 60 and 80 g/ha demonstrated significant activity against powdery mildew on peas, reducing disease incidence on the leaves to 48, 33 and 33%

TABLE 3: Leaf and stem rust severity in ryegrass, crown rust severity in oats, and ryegrass and oat seed yield in Trials D and E.

Treatment	Rate g ai/ha	Mean ¹ disease severity			Yield (kg/ha)	
		l.rust D	st.rust D	c.rust E	ryegrass D	oats E
untreated		9.74 a ²	6.11 a	45.5 a	305 b	3913
cyproconazole	20	0.92 b	3.52 b	3.0 b	—	4030
cyproconazole	40	0.32 bc	1.62 c	1.0 b	1361 a	4000
cyproconazole	60	0.05 c	1.24 c	0.7 b	1512 a	4036
propiconazole	125	0.19 bc	1.69 c	4.1 b	1367 a	3876
cv %		9.97	12.83	5.84	7.31	5.69 NS
transformation		SQRT		SQRT		

¹ = cv mean of 1 or 2 assessments² = see Table 1.

Severity = mean no. rust pustules/leaf (leaf and crown rust)

= mean score, on a 0-10 scale (stem rust)

NS = no significant differences between treatment means

(respectively) from 80% in untreated. The two standard treatments in the trial (1200 g/ha sulphur and 250 g/ha benomyl) did not significantly reduce powdery mildew incidence. Other DMI fungicides were used in this trial and the best of these recorded similar powdery mildew incidence to cyproconazole, but the identity of these treatments was confidential. Powdery mildew did not infect the peas until flowering and, whilst incidence was high in untreated, it did not develop as severely as expected. There was no significant response in seed yield to mildew control in this trial.

Garlic, squash and strawberries

In a severely infected garlic crop, cyproconazole applied at rates of 20, 40 and 80 g/ha significantly reduced the number of rust pustules/leaf 16 days after treatment to 34, 26 and 13 (respectively) from 106 in untreated. Propiconazole at 125 g/ha reduced the number of pustules/leaf to 41, which was significantly different to untreated but not to cyproconazole.

Good control of powdery mildew on squash was obtained with 50-75 g/ha cyproconazole (Table 4). Similar powdery mildew incidence and severity was recorded in the standard treatment, 150 g/ha pyrazophos.

TABLE 4: Incidence and severity of powdery mildew in squash, and leafspot in strawberries.

Treatment	Rate g ai/ha	squash powdery mildew		strawberry leafspot	
		incidence	severity	incidence	severity
untreated		78.8 a ¹	36.9 a	100.0 a	45.7 a
cyproconazole	25	43.8 b	4.1 bc	33.7 c	1.1 bc
cyproconazole	37.5	30.0 c	3.1 c	6.2 d	0.1 c
cyproconazole	50	3.8 d	0.3 d	1.2 d	0.0 c
cyproconazole	75	8.8 d	0.4 d	0.0 d	0.0 c
pyrazophos	150	8.8 d	1.4 cd	—	—
bitertanol	250	—	—	75.0 b	3.8 b
cv		25.5	6.3	14.2	6.5
transformation			SQRT		SQRT

¹ = see Table 1.

incidence = mean % leaves infected

severity = mean % leaf area infected (squash)

= mean no. spots/leaf (strawberries)

Cyproconazole at 25-75 g/ha gave good control of leafspot on strawberries (Table 4). Leafspot incidence and severity was significantly lower in the 37.5-75 g/ha cyproconazole treatments than in the standard treatment, 250 g/ha bitertanol.

No crop damage was evident in the trials on peas, garlic, squash and strawberries.

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