Chemical Control of Seed Borne Diseases of Barley

G. J. Platz[1], S. I. Meldrum[1] and N. A. Webb[2]

[1]Hermitage Research Station, M/S 508, Yangan Road, Warwick, Queensland. 4370
[2]University of Queensland, Gatton College, Lawes, Queensland. 4343

Abstract

Many barley crops in north-eastern Australia were heavily infected by one or a combination leaf blotch diseases in 1998. Unusually wet weather promoted epidemics of net blotch (*Drechslera teres* f. *teres*), spot form of net blotch (*Drechslera teres* f. *maculata*) and spot blotch (*Bipolaris sorokiniana*) which often resulted in high levels of seed infection by these pathogens. Seed borne *D. t.* f. *teres* and *B. sorokiniana* can initiate epidemics by infection of the primary leaf via the coleoptile during seedling emergence. In addition, *B. sorokiniana* may cause blighting of seedlings or early common root rot infection.

Eleven commercial and developmental seed treatments and eleven laboratory formulations were evaluated for control of seed borne *D. teres* and *B. sorokiniana.* The addition of thiram to carboxin gave excellent control of both diseases and culminated in the granting of an emergency use permit for a formulation of these compounds. The mixture was used widely to treat barley seed for sowing in northern New South Wales and Queensland in 1999.

Introduction

Net blotches and spot blotch occurred at unprecedented levels in northern New South Wales and Queensland in 1998 and caused an estimated $50 million loss in production (Rees et al 1999). Examination of 33 seed lots from the Darling Downs showed infection levels as high as 58% for *D. teres and* 96% for *B. sorokiniana*. Often both pathogens were present.

Seed borne net form of net blotch and spot blotch may be transmitted to emerging seedlings and transmission levels as high as 80% have been reported. *B. sorokiniana* also causes common root rot and heavily infected seedlings may fail to emerge. Emergence may be reduced by as much as 50% where poor quality untreated seed is sown (Sutton and Evans, 1975).

While seed treatment is acknowledged as an effective control measure for the seed borne phase of both pathogens, there are no fungicides registered for this use in Australia. This work was undertaken to identify the most appropriate chemicals for the control of both seed borne *D. teres* and *B. sorokiniana*.

Materials and Methods

Sequential experiments were conducted in the laboratory and field evaluation is currently underway.

Experiment 1 Screening of commercial and developmental seed treatments
Experiment 2 Evaluation of mixtures of carboxin / thiram and carboxin / mancozeb.
Experiment 3 Effects of seed treatments on coleoptile length.
Experiment 4 Coleoptile lengths of barley lines.

Seed

Seed of cvs. Gilbert with 58% of grains infected with *D. teres* and Tallon with 92% of grains infected with *B. sorokiniana* were used for the experiments. No attempt was made to distinguish which form of *D. teres* was present but heavy infection of the growing seed crop by the net form of net blotch indicated that *D.t.*f. *teres* was overwhelmingly dominant. Only grains that passed over a 2.2mm screen were retained for treatment.

Fungicide Treatment

Seed was weighed into 100g lots and placed in 250ml Schott bottles. Fungicide was added taking care not to apply the chemical directly to the seed. Bottles were capped and the seed shaken manually for 60 seconds. This seed was discarded and the treatment repeated using the same bottle now coated with the desired fungicide. The second seed batch treated was used for all experiments.

Table 1. Fungicides evaluated for control of seed borne *D. teres* and *B. sorokiniana*

Seed Treatments	Active constituent of fungicide	Rate of product applied / 100kg seed
Armour C	100g/L flutriafol	100g
Baytan C	150g/L triadimenol	150ml
Baytan IM	150g/kg triadimenol+50g/kg imazalil	100g
Dithane M45	800g/kg mancozeb	100g
Dividend Star	6.3 g/L cyproconazole+30g/L difenoconazole	100g
Premis C	25g/L triticonazole	100ml
Raxil C	25g/kg tebuconazole	100ml
Vincit C	25g/L flutriafol	100g
Vincit C Plus	125g/L fenbuconazole+25g/L flutriafol	100g
Vitaflo C	400g/L carboxin	125ml
Vitaflo C	400g/L carboxin	250ml
Vitavax 200	200g/L thiram + 200g/L carboxin	250ml

Testing

Two layers of blotting paper were placed in 100mm^2 petri dishes and 10ml of distilled water added. Twenty- five seeds were spaced evenly on the grid, lids fitted and dishes sealed individually in plastic bags. There were four replications of each treatment. Dishes containing Gilbert seed were incubated at a constant 17°C (Experiment 1) and 20°C (Experiment 2) under 12 hours of light provided by cool white and near UV tubes. Tallon treatments were incubated at 25°C in the dark.

Assessment

Seeds were examined after six days (Gilbert) and four days (Tallon). Shoots were snipped from germinated seeds which were then individually scanned for the presence of conidia using a steromicroscope at X64 magnification. Seeds were counted as infected when conidia on conidiophores were seen on the seed. Percentage infected seeds were recorded and data analysed by analysis of variance.

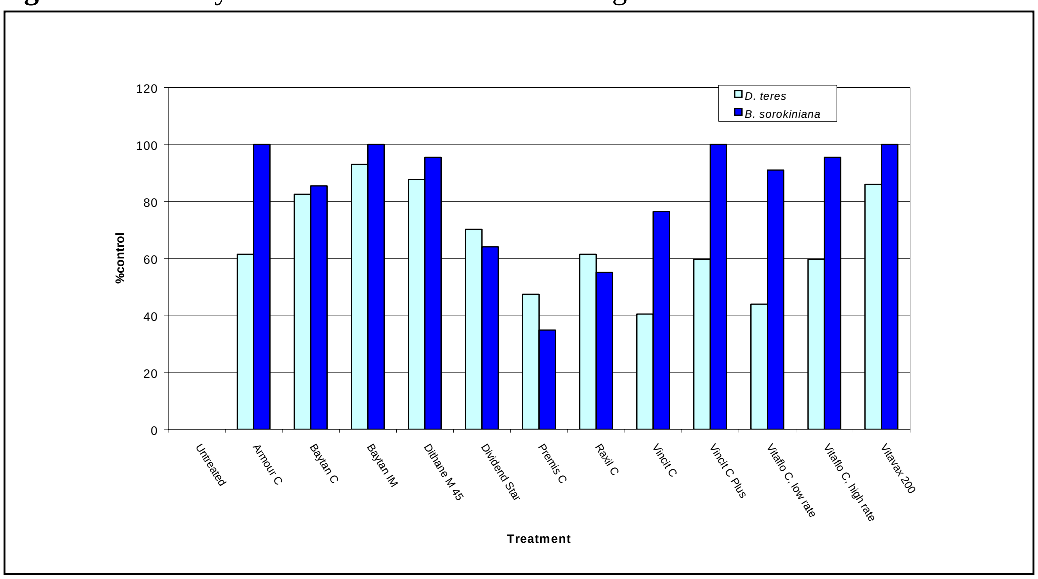
Coleoptile length

A fine sand /peat (50:50 by volume) medium was spread 40mm deep in polystyrene boxes. A groove 3mm deep was pressed into the medium and seeds placed crease down along the grooves. Seeds were then covered with a further 10mm of medium, watered to field capacity and the boxes sealed. Boxes were immediately placed in a growth room at 15°C in continuous dark. Coleoptiles were measured after 14 days.

Results

Experiment 1 Baytan C, Vitavax 200, Dithane M45 and Baytan IM gave superior control of *D. teres* yet were not significantly different from each other (Figure 1). Vitavax 200, Armour C, Vincit C Plus and Baytan IM all gave 100 per cent control of *B. sorokiniana* with Dithane M45 and Vitaflo C providing 95% control. Only Vitavax 200 and Baytan IM gave effective control of both pathogens. Baytan IM demonstrated some phytoxicity in this experiment with delayed germination and disfigured coleoptiles; suggesting Vitavax 200 had a commercial advantage.

Figure 1. Efficacy of seed treatments in controlling *D. teres* and *B. sorokiniana*.



Experiment 2 As there were no commercial quantities of Vitavax 200 in Australia, mixtures of thiram and carboxin were compared for control of the target pathogens. Combinations of Dithane M45 and carboxin were also compared. All formulations containing mancozeb gave perfect control of *B. sorokiniana* and near perfect control of *D. teres*. The best control with thiram / carboxin formulations was achieved at rates of 50 and 100g of thiram and 100g of carboxin.

Experiment 3 Vincit C, Premis C and Vincit C Plus did not affect coleoptile length but Raxil C, Baytan IM, Armour C, Baytan C and Dividend Star all significantly reduced coleoptile length. In contrast, Vitaflo, Vitavax 200 and Dithane M45 increased coleoptile length significantly above the untreated control (Table II).

Experiment 4 The popular northern varieties Skiff, Tallon, Lindwall and Grimmett had the shortest coleoptiles of 11 lines tested (Table II). Grimmett was significantly shorter than Tallon and Lindwall, which were significantly shorter than all other lines tested.

Discussion

Fungicides varied widely in their efficacy against *D. teres* and *B. sorokiniana* and their effects on coleoptile length. Baytan IM and Vitavax 200 gave superior control of both pathogens yet the former reduced coleoptile length of Tallon by over 15% indicating its potential to cause emergence problems.

Vitaflo C is used widely as a smuticide and demonstrated a high degree of efficacy in controlling *B. sorokiniana*. It was only partially effective against *D. teres*; however the addition of thiram (in Vitavax 200) increased the level of control of *D. teres* from 44% to 86% and from 91% to 100% for *B.sorokiniana*. A mixture of carboxin and thiram was shown to provide excellent control of seed borne net blotch in New Zealand (Arnst et al.1978) and its positive effect on seedling growth indicated it would be a suitable mixture for treating seed for sowing in the Northern Region in 1999.

At the recommended rate, Vitavax 200 is equivalent to 50g of thiram + 50g of carboxin per 100 kg of seed. This mixture gave good control of both pathogens but by doubling the rate of carboxin, the level of control of *D. teres* increased by over 16% and provided absolute control of *B. sorokiniana*. Doubling the rate of thiram did not significantly improve efficacy.

Admixtures with mancozeb gave complete control of both pathogens in experiment 2; but problems with poor emergence of cereals in the past (Kollmorgen and Ballinger, 1975) discouraged further work with this product. There was no evidence of phytoxicity from mancozeb during the course of this work.

Table 2. Effects of seed treatment and genotype on coleoptile length.

Seed treatment	Length (mm)		Genotype	Length (mm)	
Vitaflo C (high)	73.8	a	B% 1302	85.8	a
Vitavax 200	72.3	a	Schooner	80.0	ab
Vitaflo C (low)	70.4	ab	Tantangara	80.0	ab
Dithane M45	68.8	bc	Gilbert	79.0	ab
Vincit C	65.1	cd	Cameo/Koru 85	78.0	b
Premis C	64.3	d	Kaputar	76.3	b
Vincit C Plus	63.2	d	Gairdner	75.7	b
Untreated	62.6	d	Skiff	75.2	b
Raxil C	58.5	e	Tallon	64.6	c
Baytan IM	53.0	f	Lindwall	63.5	c
Armour C	49.2	g	Grimmett	52.3	d
Baytan C	48.8	g			
Dividend Star	44.2	h			
LSD P<0.05	3.89			6.86	

Most triazole fungicides reduced coleoptile length by between 7% and 30% and indicated that under less favourable conditions emergence may be affected. Of the triazoles tested only Vincit C, Vincit C Plus and Premis C did not reduce coleoptile length significantly. In addition, experiment 4 demonstrated wide variation in coleoptile lengths between genotypes. Skiff, Tallon, Lindwall and Grimmett are major varieties in the Northern Region and these had the shortest coleoptiles of eleven lines examined. The use of triazole based seed treatments on varieties with inherently short coleoptiles is likely to exacerbate emergence problems.

From the work conducted, it was concluded that the most appropriate seed treatment for control of seed borne *D. teres* and *B. sorokiniana* was a mixture of thiram and carboxin at rates equivalent to 50g and 100g respectively per 100 kg of seed. Application for an emergency use permit was made to the National Registration Authority and was granted in March, 1999.

Acknowledgments

We gratefully acknowledge GRDC and GRF for funding to conduct this research and the chemical companies who provided fungicides.

References

Arnst, B.J., Sheridan, J.E. and Grbavac N (1978) NZ J Ag. Res. 21:697-701.

Kollmorgen, J.F. and Ballinger, D.J. (1975) Aust. J. Exp.& An. Husb, 15:700-704.

Rees, R.G., Strong, W.M. and Neale, T.J. (1999). Report to the GRDC Northern Panel.

Sutton, J.C. and Evans, I.R. (1974) Ontario Ministry of Agriculture and Food. Agdex 114/632.