NEW SEED TREATMENTS AND FOLIAR SPRAYS FOR CONTROL OF SPOT BLOTCH OF BARLEY

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SUMMARY

A survey of commercially treated barley seed samples and of barley crops in the Wairarapa in 1980-81 and 1981-82 showed that the currently used seed-treatments were giving inadequate control of foot rot and spot blotch caused by *Drechslera sorokiniana*. The experimental materials WECO 2279, prochloraz and the mixture of carboxin + prochloraz applied as seed-treatments gave superior control of the foot rot phase, while prochloraz and propiconazole applied as foliar sprays gave outstanding control of the spot blotch phase. Neither seed treatments nor foliar sprays effectively reduced infection levels in harvested grain.

INTRODUCTION

Spot blotch of barley is caused by the fungus *Cochliobolus sativus* which usually occurs as the anamorphosis (imperfect state) *Drechslera sorokiniana*. Symptoms of primary infection consist of basal browning, foot rot and dark spots or stripes on the first leaf. The pathogen is carried by seed, soil and air but seed-borne inoculum appears to be the main source of infection in New Zealand (Hampton 1979a, b). Where seed infection is heavy, stunting and death of seedlings may occur. Typical spot blotch symptoms occur only when the crop is well advanced in growth and are most conspicuous after ears have emerged. Yield losses as high as 36% have been recorded (Clark 1979). The disease may be confused with net blotch caused by *D. teres* particularly since this pathogen is generally also present in North Island crops and there is an interaction between the two (Spencer 1975). Both have been controlled satisfactorily by use of the currently registered seed-treatments (Hampton 1979b). However, more recently foot rot and spot blotch have increased in incidence being severe in some barley crops and posing a threat to barley-growing in the North Island. In an attempt to find the reasons for this increase and a solution to the problem a survey of commercially treated barley seed samples and growing crops was completed and the effectiveness of a number of seed-treatments and foliar spray formulations examined.

MATERIALS AND METHODS

In seed treatment trials two seed lines of cv. Zephyr (a & b) and one of cv. Mata were used. The treatments with the rates of application are in the accompanying tables of results. Tables 2, 3 and 4 refer to hand-sown trials, where a representative sample of barley seed consisting of 250 g was shaken with the appropriate amount of fungicide and 2.5 ml of sterile distilled water in a stoppered 500 ml conical flask on a BTL flask shaker for 15 minutes. The water was omitted in the case of the organo-mercury and untreated check. The treated seed was kept in the flasks for at least 7 days before testing to permit vapour action, if present. Four hundred seeds were plated to 2% malt extract agar containing 10 µg benomyl/ml, incubated at 15-20°C in the laboratory for up to 15 days, and irradiated with near UV to promote sporulation. The same number of seeds were sown in a mixture of sterilized Hauraki peat and perlite in the glasshouse under conditions conducive to development of primary disease symptoms. In field trials in the Wairarapa and Manawatu seed was sown in 5 m rows and the treatments were replicated 5 times and randomised, except in the 1982 field trial where there were two replicates.

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The foliar sprays were applied by a knapsack sprayer delivering 0.633 litres/minute at 100 kPa on 22 December 1980 and 2 January 1981 at Feekes G.S. 8 and 10.5 respectively. There were five replicates with each treatment randomised in each of 5 blocks. Plots were 20 x 2 m, separated by 1 m gaps. Disease assessment began at G.S. 1 (to determine the initial seed-borne inoculum) and continued at intervals to G.S. 11. In the seed treatment trials seedlings were examined for disease symptoms at intervals from emergence up to 22 days after sowing and all diseased and healthy seedlings were counted. In the foliar spray trial, disease incidence and severity was assessed on 10 tillers taken at random along a diagonal in each plot. The surveys of commercial crops were carried out as previously described (Cromeey, *et al* 1980).

RESULTS

Foot rot symptoms occurred in all Wairarapa barley crops surveyed in 1980-81 and 1981-82 and spot blotch symptoms occurred in 42% and 48% respectively. Ninety five per cent of the crops were grown from seed treated with carboxin + thiram and 5% from triadimenol + fuberidazole in both seasons. *Drechslera sorokiniana* was recovered from 40% and foot rot symptoms occurred in 60% of commercially treated barley samples (Table 1). Most barley seed samples tested immediately after harvest were infected with *D. sorokiniana*: 93% in 1981 (from a total of 14) and 77% in 1982 (total 30) while in some of the samples most of the seeds were infected.

TABLE 1: Recovery of *D. sorokiniana* from commercially treated barley seed samples and foot rot symptoms occurring in the glasshouse.

Treatment and Year	No. samples examined	<i>D. sorokiniana</i>		Foot rot symptoms	
		No.	Infection range (%)	No.	Infection range (%)
carboxin + thiram 1980	10	2*	0.5 — 50.8	4*	0.3 — 15.7
carboxin + thiram 1981	9	2	2.0 — 2.8	8	0.3 — 1.7
triadimenol + fuberidazole 1980	4	4	0.3 — 3.5	3	0.3 — 1.3
triadimenol + fuberidazole 1981	7	4	0.5 — 5.8	3	0.8 — 1.3
total	30	12	0.3 — 50.8	18	0.3 — 15.7
No. certified	14	6	0.3 — 5.8	4	0.3 — 1.8

* Number of samples with infection present.

The effects of the currently registered seed treatments on recovery of *D. sorokiniana* and on disease symptoms are shown in Table 2. All were less effective on cv Mata than cv Zephyr in glasshouse trials and only carbendazim + mancozeb gave control approaching that of organo-mercury on cv Mata in field trials. In laboratory tests a high infection with *D. sorokiniana* was found in both seed lines of cv Zephyr and a low infection in cv Mata. The latter was probably due to the masking effect of an accompanying high infection with *D. teres* and this could explain the anomaly between laboratory and glasshouse trials. During the 6 month period between testing in 1981 and 1982 a considerable reduction in infection occurred in both cultivars due to loss of viability of *D. sorokiniana*.

The effects of the new experimental materials are shown in Table 3. WECO 2279, prochloraz and the mixture of carboxin + prochloraz were the most effective on both cultivars. Table 4, where control is expressed as a percentage of the untreated check, shows that WECO 2279 and prochloraz were also the most effective in the Manawatu trial — the mixture was not tested. No treatment was consistently as effective as organo-mercury. Germination and emergence was not adversely affected by any treatment.

TABLE 2: The effect of currently registered seed-treatments on recovery of *D. sorokiniana* from barley seeds and on disease symptoms.

Treatment and rate /100 kg seed	Recovery (%)			Diseased plants (%)					
	Lab. Tests*			Glasshouse*			Field* (Wairarapa)		
	1980	1981	1982	1980	1981	1982	1980	1981	1982**
Cultivar Zephyr	(a)	(b)	(b)	(a)	(b)	(b)	(a)	(b)	(b)
carboxin + thiram 50 g + 50 g	6.8	0.3	.0	25.9	1.8	3.4	0.8	1.6	0.0
carbendazim + mancozeb 30 g + 120 g	57.0	-	4.0	10.3	-	1.1	0.9	-	0.1
triadimenol + fuberidazole 15 g + 2 g	52.8	31.0	5.5	10.7	4.1	0.5	0.3	0.3	0.0
organo-mercury*** 2.2 g	-	1.0	0.0	-	1.3	0.3	-	0.5	0.0
untreated	97.8	74.3	45.4	64.8	54.0	18.3	2.1	3.2	1.2
Cultivar Mata									
carboxin + thiram 50 g + 50 g	-	0.0	0.0	-	3.6	6.2	-	1.0	0.5
carbendazim + mancozeb 30 g + 120 g	-	-	0.0	-	-	4.6	-	-	0.1
triadimenol + fuberidazole 15 g + 2 g	-	1.0	0.5	-	2.6	3.9	-	0.9	0.3
organo-mercury** 2.2 g	-	0.0	0.0	-	0.0	0.3	-	0.3	0.1
untreated	-	1.3	0.5	-	17.4	17.1	-	2.6	0.8

* Sown or tested Oct/Nov. 1980 and 1981; April 1982.

** Two replicates only

*** 1% mercury as phenyl mercury acetate and ethyl mercury chloride.

TABLE 3: The effect of experimental seed-treatments on recovery of *D. sorokiniana* from barley seeds and on disease symptoms.

Treatment and rate /100 kg seed	Recovery (%)			Diseased Plants (%)					
	Lab. Tests			Glasshouse			Field (Wairarapa)		
	cv. Zephyr	Mata		cv. Zephyr	Mata		cv. Zephyr	Mata	
	1980	1981	1981	1980	1981	1981	1980	1981	1981
untreated	97.8	74.3	1.25	64.8	54.0	17.4	2.1	3.2	2.6
TCMTB 30 g	5.8	10.0	0.0	26.2	25.0	4.8	0.4	1.9	2.7
furmecycloz 100 g	-	52.0	0.3	-	45.1	4.4	-	2.9	1.8
U 150315 30 g + 6 g + 3 g	-	2.5	0.0	-	8.8	3.4	-	1.7	2.2
prochloraz 25 g	-	0.0	0.0	-	11.5	0.0	-	1.2	0.3
iprodione 100 g	0.8	-	-	1.3	-	-	0.3	-	-
RH 2161 48 g	11.8	-	-	0.3	-	-	0.6	-	-
WECO 2279*	0.3	1.5	0.0	0.0	2.1	0.5	0.3	0.3	0.8
carboxin + thiram + RH 2161 25 g + 25 g + 24 g	2.3	-	-	1.8	-	-	0.2	-	-
carboxin + prochloraz 50 g + 12.5 g	-	4.8	0.0	-	0.0	0.5	-	0.1	0.0
furmecycloz + thiram 100 g + 12.5 g	-	1.2	0.0	-	-	-	-	0.6**	0.4**

* 50 g in 1980; 10 g in 1981.

** Sown late: untreated 6.4% for Zephyr and 1.4% for Mata.
Dates of sowing/testing were the same as in Table 2.

The effects of the four formulations applied as foliar sprays on spot blotch development are shown in Table 5. Prochloraz and propiconazole gave outstanding control being significantly better than triadimefon at the last assessment.

A laboratory test showed the mean level of infection of harvested grain grown from seeds treated with the currently registered materials was higher than from untreated seed. Foliar sprays applied at G.S. 8 and 10.5 (Feekes scale) had little effect on infection levels of *D. sorokiniana* in seed at harvest (Table 5).

TABLE 4: Percent control of the primary phase of spot blotch of barley given by seed-treatments.

	Glasshouse		Field			
	Zephyr	Mata	Wairarapa		Manawatu	
	Zephyr	Mata	Zephyr	Mata	Zephyr	Mata
Registered products						
carboxin + thiram	80*	72**	70*	51**	83	59
carbendazim + mancozeb	89**	73	74**	87	-	-
triadimenol + fuberidazole	91*	81**	92*	62**	94	25
Organo-mercury	99	100	92**	89**	100	96
Experimental products						
TCMTB	57**	73**	61**	0	94	75
furmecyclox	17	75	10	31	51	23
U150315	84	80	47	16	87	74
prochloraz	79	100	63	88	96	84
iprodione	98	-	87	-	-	-
RH 2161	99	-	70	-	-	-
WECO 2279	96	97	90	71	96	80
carboxin + thiram + RH 2161	97	-	93	-	-	-
carboxin + prochloraz	100	96	84	100	-	-
furmecyclox + thiram	-	-	91	71	-	-

* mean of 3 season's trials

** mean of 2 season's trials

TABLE 5: The effect of foliar sprays applied at G.S. 8 and G.S. 10.5 on control of spot blotch and recovery of *D. sorokiniana* from harvested grain.

Treatment and rate/ha	Spot blotch			Spot blotch			<i>D. sorokiniana</i> Recovery (%)
	Mean Incidence (%)			Mean Severity (%)			
	G.S 8	G.S. 10.5	G.S. 11.1	G.S. 10.5	G.S. 11.1	G.S. 11.1-11.2	
WECO 2279 20% EC 100 g	3.6	70	98	0.7	3.2	28.0 B	47.6
prochloraz 40% EC 500 g	4.2	50	80	0.1	0.1	2.4 D	40.0
propiconazole 10% EC 125 g	1.8	48	80	0.1	0.5	3.7 D	35.3
triadimefon 25% EC 125 g	3.6	52	98	0.4	1.4	10.7 C	42.7
untreated	2.8	80	100	2.0	8.9	42.8 A	64.7

DISCUSSION

Foot rot and spot blotch caused by *Drechslera sorokiniana* have recently become a serious threat to barley growing in the North Island. Most seed samples are infected some with high levels. Since Hampton (1979b) reported effective control of the

pathogen on seed by carboxin + thiram and carbendazim + mancozeb, the situation has changed and none of the currently registered systemic-based fungicides are giving adequate control. In the present studies, using an organo-mercury fungicide as a standard, the experimental seed treatments WECO 2279 and prochloraz gave good control of the primary seed-borne phase. These have the added advantage of giving good control of net blotch caused by *D. teres* and do not appear to be influenced by cultivar. The same applied to the mixture of carboxin + prochloraz. The mixture carboxin + thiram + RH 2161 gave good control of both diseases in one trial but it was not tested on any of the newer cultivars. However, Luz and Vieira (1982) in Brazil and Edgington (1980) in Canada report promising results on local cultivars with RH 2161 alone or in combination with carboxin.

Luz and Vieira (1982) obtained good control with nuarimol and moderate control with triadimefon in laboratory and glasshouse tests. Nuarimol has not yet been tested in New Zealand.

Prochloraz and propiconazole as foliar sprays gave outstanding control of the spot blotch phase of the disease being significantly better than triadimefon. However, WECO 2279 gave little control when applied as a foliar spray: the reason is unknown. When the trial was repeated in 1981-82 spot blotch did not develop presumably due to unsuitable weather conditions although the seed was heavily infected and spot blotch developed in the same line sown in the Manawatu. *Drechslera sorokiniana* appears to die out rapidly on storage of infected seed. Further studies on the epidemiology of spot blotch and longevity of the pathogen are needed. Seed treatments and foliar sprays have little effect on infection levels in grain harvested from treated crops. Yield increases were not assessed due to lack of a suitable harvester in 1981.

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