STRATEGIES FOR CONTROLLING NET BLOTCH IN BARLEY

J.E. SHERIDAN, N. GRBAVAC and L. BALLARD*

Botany Department, Victoria University of Wellington, Wellington

**N.Z. Farmers' Fertilizer Co., Auckland*

SUMMARY

Net blotch (*Pyrenophora teres* con. stat. *Drechslera teres*) is the most important disease of barley at present in New Zealand. The main source of primary inoculum is infected seed. Other sources are feed barley crops, volunteer plants and stubble. To achieve control effective seed treatments must be used, barley must not be sown after a previous barley crop and stubble must be ploughed in or burned after harvest. Foliar sprays while giving good control during the growing season are an additional rather than a continuing means of control. Seed is generally heavily infected at harvesting despite foliar spray applications. Seed treatments and crop husbandry are key control measures.

INTRODUCTION

Barley is a very important arable crop in New Zealand with 94,000 ha grown in 1981/82 (MAF statistics 1983). The main fungal diseases are net blotch, scald, loose and covered smuts, leaf and stem rusts and mildew (Sanderson 1973; Sheridan and Grbavac 1979). Since 1974 regular surveys in the North Island have shown that net blotch is a potentially serious disease (Cromeley *et al* 1980). An epidemic occurred in 1976-77 with yield losses of over 20% (Sheridan and Grbavac 1979). In 1977 mixtures of the new systemic and protectant fungicides were introduced and net blotch became of little significance (Hampton 1980). However, in the past two seasons there have been outbreaks of net blotch on some of the newer cultivars despite normal seed treatments. Recent surveys have determined the magnitude and extent of these outbreaks and trials have tested the effectiveness of currently used seed treatments and foliar sprays for net blotch control on these newer cultivars. In this paper the sources and importance of net blotch inoculum are examined and the role of control practices (seed treatments, foliar sprays and husbandry) are discussed.

SOURCES OF INOCULUM

Seed

Hampton (1980) studied the role of seed-borne inoculum in the epidemiology of net blotch and concluded that it is the primary source of infection and that where an efficient seed treatment is applied, the disease is of little consequence. In the Wairarapa the prevalence of net blotch dropped from 100% in 1976-77 to 47% in 1977-78 (Sheridan and Grbavac 1979). It was surprising, therefore, to find in a survey of seed from the Wairarapa district in 1979 and 1980 (Chong and Sheridan 1982) that net blotch was present in all barley samples tested with a mean infection level per seed line of 35%. Seed-borne inoculum has increased in both the North and South Islands (Table 1). In field trials there has been generally a 10% transmission of inoculum i.e. if all seeds are infected 10% of those emerging will be diseased. Seeds are, therefore, a very important source of inoculum at the present time.

Barley green feed crops

Overwintering barley green feed crops provide a source of inoculum for surrounding early sown barley because the spores of *D. teres* are readily air-borne. Thus sowing barley after a winter barley green feed crop results in net blotch despite seed treatment.

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Stubble and crop debris

The perfect state of the fungus *Pyrenophora teres* develops over winter in infected stubble and releases air-borne ascospores to infect new crops. Often straw from diseased crops is left in the field over winter and this provides spores to infect the new crops. It is good practice to burn or plough in stubble so this source of inoculum should not be of much importance.

Alternative hosts

Barley grass (*Hordeum murinum*) is present in most barley growing areas in the North Island and is attacked by *D. teres*. Its role as an inoculum source has not been elucidated.

SEED TREATMENTS/CULTIVARS—THE CHANGING SCENE

Because seed is the primary source of inoculum and the majority of seed lines are now infected with *D. teres* treatment is essential. The effective organo-mercury seed treatments were banned for use in 1973 and captan-based treatments were subsequently used. These proved ineffective (Sheridan 1975; Sheridan and Spencer 1975), and net blotch developed to an epidemic in 1976-77 with yield losses of up to 35%. The first of the new systemic mixtures was used in the 1977-78 season (carboxin + thiram (Vitaflo 200) and carbendazim + mancozeb (Granosan 200)), and resulted in a dramatic reduction of net blotch severity (Sheridan and Grbavac 1979). The majority of crops for the next three years were grown from seed treated with carboxin + thiram.

TABLE 1: Percent frequency and recovery of *Drechslera teres* from barley seed samples 1976 to 1983.

	North Island				South Island	
	Wairarapa		Manawatu/ Wanganui		Frequency	Recovery
	Frequency†	Recovery††	Frequency	Recovery		
1976 ¹	—	—	100	35	49	4.4
1977 ¹	—	—	21	2	71	10
1978 ¹	—	—	6	0.1	45	5.1
1979/80 ²	100*	35*	—	—	—	—
1982	80	17	100	24	100**	56**
1983	50	6	100***	81***	—	—

¹ Data from Hampton (1980) ² Data from Chong and Sheridan (1982)

† Frequency = % of seed samples tested shown to be infected with *D. teres*.

†† Mean recovery per sample (% infected seed)

* 78% cv Zephyr ** All cv Mata *** All cv Triumph

In 1979 triadimenol + fuberidazole (Baytan F17) was registered, and in the Manawatu/Wanganui districts this seed treatment was used almost exclusively in the past two seasons. There was an upsurge in net blotch in 1981-82 in the North Island and an epidemic in the Manawatu/Wanganui districts in 1982-83. Table 2 gives data from surveys and shows the disease situation in commercial crops, seed treatments and predominant cultivars. Trials showed that triadimenol + fuberidazole seed treatment was not effective in controlling primary seed-borne infection on Mata, Triumph and some other cultivars (Sheridan and Grbavac 1983). The other registered treatments were effective but did not eliminate seed-borne infection. This situation has come about because of the introduction of many new cultivars in recent years, some of which are very susceptible to net blotch and carry high seed-borne infection. The registered seed treatments were tested originally only on Zephyr and Carlsberg but Carlsberg is no longer grown and the use of Zephyr is declining.

TABLE 2: Field survey data for the North Island 1981-82 and 1982-83.

	1981-82		1982-83	
	Wairarapa	Manawatu/ Wanganui	Wairarapa	Manawatu/ Wanganui
Net blotch severity*	3.5	7.9	0.1	12.6
Seed treatments used				
carboxin + thiram	95%	0%	84%	8%
triadimenol + fuberidazole	5%	100%	16%	92%
Predominant cultivars				
Georgie	22% †	20%	30%	5%
Goldmarker	2%	4%	25%	0%
Zephyr	24%	12%	12%	4%
Mata	5%	28%	0%	2%
Triumph	0%	36%	0%	82%
Others	47%	0%	33%	7%

* Percent mean diseased area of the top 2 leaves

† Percent of area sown

It is clear that a cultivar/fungicide interaction occurs and that there is a need for a seed treatment which will be effective on all cultivars where high seed-borne infection occurs. Among new materials tested imazalil (R 23979) and prochloraz (prochloraz bfn 8411 D) alone or in combination with other chemicals were very promising (Sheridan and Grbavac 1983).

STRATEGIES FOR CONTROL

Control strategies for net blotch in New Zealand can be determined from knowledge of the susceptibility of the cultivar sown, the time of sowing, the previous crop and management of the surrounding cropping land, the climate and the yield expected even if the disease invades the crop, together with information on effectiveness of fungicides.

TABLE 3: Effect of two applications of foliar fungicides on net blotch control and yields on Zephyr barley: Nelson 1982-83.

Treatment and rate ai/ha	Control as % of untreated					Yield as % of untreated
	Initial G.S. 3 (25)	+17* G.S. 8 (37)	+29* G.S. 10.1 (50)	+37* G.S. 10.5 (58)	+58* G.S. 11.2 (85)	
prochloraz 225 g	2.3** a	67 b	59 b	37 ab	69 bc	118 ab
prochloraz 450 g	1.5** a	71 b	80 b	67 b	81 c	139 a
triadimefon 125 g	2.2** a	67 b	26 ab	33 ab	59 b	113 b
untreated	1.9** a	4.9** a	5.4** a	3.0** a	26.2** a	100 b
cv %	50.9	57.5	69.7	34.3	30.9	11.3

↓ Spray application

* Days after 1st spray application

** Percent mean diseased area of the top 3 leaves (up to G.S. 10.1) or flag leaf only (G.S. 10.5 and G.S. 11.2)

triadimefon (Bayleton 25 WP) prochloraz (Sportak 45 EC)

Seed treatment to eliminate the seed-borne infection is possible, but even if clean seed is sown in contaminated ground, or at a time of the year when secondary inoculum is prolific, the disease can invade the crop before Feekes G.S. 3 (Zadoks 25). In a seed treatment trial, cv Zephyr was sown in late summer (24 February 1983) in Nelson. The seed line contained 35% seed-borne infection. Despite effective seed treatment, the crop was heavily infected with net blotch 21 days after planting; 79-83% of seedlings were infected irrespective of seed treatment. Secondary infection from nearby infected crops and infected soil debris had annulled the effects of seed treatment.

Foliar sprays of prochloraz (Sportak 45 EC) and propiconazole (Tilt 250 EC) have held the disease in check and increased yields in some cultivars of barley in North Island trials. In Nelson trials, foliar treatments of prochloraz applied early to spring sown barley in a replicated plot trial, held the disease in check. The barley plants grew rapidly out-stripping the disease until flag leaf emergence. A second spray applied to protect the flag leaf gave more lasting control (Table 3). However, after the early treatment application at the trial site, untreated plots provided copious secondary inoculum that would not be present in a large sprayed crop area. In the crop situation, an early fungicide treatment applied along with the herbicide, could help control disease originating from stubble or seed-borne infection.

In the past, yield increases of around 20% were experienced when the non-systemic fungicide, mancozeb, was applied at ear emergence (Hampton pers comm). High yield increases were obtained for prochloraz and propiconazole treated barley (see Tables 3 and 4). These yield increases may not be entirely due to disease control because some systemic fungicides appear to have a tonic effect. This has also been observed by overseas workers recently (Cook 1981; Priestley 1981; Griffiths 1981).

TABLE 4: The effect of two applications of foliar fungicides on net blotch control, yield and seed infection on cv Zephyr barley: Wairarapa 1981-82.

Treatment and rate ai/ha	% control G.S. 11.1 (75)	Yield as % of untreated	% recovery of <i>D. teres</i> in harvested seed
imazalil 62.5 (Weco 5%)	4	98	38
prochloraz 563 g (Sportak 45 EC)	51	142	38
propiconazole 125 g (Tilt 250 EC)	24	121	39
triadimefon 125 g (Bayleton 250 EC)	22	111	35
untreated	47*	100	43

* Percent mean diseased area of the top 3 leaves

A trial in the Wairarapa (Table 4) showed that foliar control of net blotch at heading did not produce disease-free seed and there was still a need for seed treatment. These are results of a randomised block trial where two treatments were made at 14 day intervals — the first at Feekes G.S. 10.1 (Zadoks 50) and the second at G.S. 11.1 (73). Best control and highest yield was obtained with prochloraz, yet seed infection was still high.

The cost of applying foliar sprays to crops reduces the profit to the farmer unless there is a substantial increase in yield. The high increases in yield reported in this paper, after spraying infected barley, show that up to two applications may be justified depending on the cultivar infected, the fungicide chosen and the severity of the inoculum pressure. Where possible foliar treatments should be avoided by sowing barley early in the season, into clean land, and using an effective seed treatment to eliminate seed-borne inoculum.

DISCUSSION AND CONCLUSIONS

At present most barley seed lines are infected. Seed is an important source of inoculum so an effective seed treatment must be applied to reduce seedling net blotch infection. Care must be taken in choosing the treatment fungicide particularly where levels of seed-borne inoculum are high. Cvs Mata and Triumph do not respond to triadimenol + fuberidazole and should not be treated with this fungicide. Carboxin + thiram and carbendazin + mancozeb are satisfactory.

Cultivars, therefore, differ in their response to commercially available fungicides. The new products imazalil and prochloraz are not apparently cultivar specific and can be used on seed lines of all cultivars with high seed infection levels. Preferably, they should be applied along with a systemic chemical which controls loose smut.

Where an outbreak of net blotch occurs in a crop a foliar fungicide should be applied without delay. This is additional to and cannot replace seed treatment. Again there appears to be cultivar specificity. Propiconazole gives good control on cvs Triumph and Mata. Prochloraz is best on cv Zephyr. Prochloraz gives best yield in all 3 cultivars. Further work is required to determine which cultivar responds to which chemical by showing good disease control and yield increase.

Only spring cultivars have been studied and discussed. The introduction of winter barley cultivars could raise new problems particularly if they are grown in the North Island. Surveys have shown that net blotch infection is severe on autumn-sown green feed crops. Crops of winter sown barley could act as a source of inoculum for surrounding spring sown crops and nullify the effects of seed treatment.

Chemical control should go hand in hand with good husbandry. Barley seed treated with an effective fungicide should be sown in ground free of any volunteer barley plants or stubble. After harvest the straw should be removed and the debris burned or ploughed under. A winter green feed barley crop should not be sown in areas where the climate is conducive to net blotch disease.

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