NET BLOTCH AS A LIMITATION TO BARLEY PRODUCTION IN SASKATCHEWAN

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ABSTRACT

With infected stubble as source of primary inoculum, the development of net blotch on barley and its effect on grain yield were investigated over a two year period. Net blotch symptoms were observed from the first-leaf stage onwards. The severity of net blotch increased during the growing season. The penultimate leaf was entirely affected within three weeks. From fungicide experiments, the yield loss caused by net blotch was estimated at 34% of the disease-free yield. Net blotch decreased the grain yield through a decrease in kernel weight. In addition, net blotch infection of the floral bracts lowered the final grade of the grain.

INTRODUCTION

Pyrenophora teres is the causal agent of net blotch. It produces necrotic and chlorotic symptoms on cultivated barley (Hordeum vulgare). The necrotic symptoms can be divided into two groups, depending on the isolate. For net-type isolates the necrotic symptoms are narrow, dull brown, longitudinal and transverse streaks in a net-like pattern. For spot-type isolates the necrotic symptoms are brown, elliptical lesions. Both types of necrotic symptoms are the extremes. Intermediate types can be found. The chlorosis surrounds the necrotic symptoms. The chlorosis extends until the entire leaf blade is involved.

In the Canadian Prairie provinces, the prevalence of net blotch increased in the 70's from 27 to 76% of the fields surveyed (Tekauz, 1978; Tekauz and Buchannon, 1977). Several attempts have been made to estimate the effect of net blotch on grain yield. In Eastern Canada, estimates of the yield loss caused by net blotch ranged from 16 to 40% (Sutton and Steele, 1983; Martin et al., 1981). In Western Canada, no detailed field studies have been conducted. In this study the development of net blotch during the growing season was investigated and the yield loss caused by net blotch in Saskatchewan was estimated.

MATERIALS AND METHODS

Field experiments were established at Medstead and Shellbrook, Saskatchewan in 1985 and 1986. The experiments were conducted on barley stubble infected with net blotch. At both sites the 2-row cultivar Elrose was grown, which is susceptible to net blotch. At each site five different schedules for the application of the fungicide Tilt (propiconazole) were employed: no application

(untreated), application at elongation stage, application at boot stage, application at both elongation and boot stage, and application at 7 - 10 day intervals (continuous). At Medstead the continuous application was omitted in 1986. Tilt was applied with a hand sprayer model D-201 (R & D Sprayers Inc., Opelousas, LA) at the recommended rate of 125 g a.i. in 200 l water per ha.

At each site treatments were arranged in a randomized complete block design with six replications. Each experimental unit consisted of a plot 3 m wide and 3.6 m long, drill planted with 15 cm row spacing. The experimental unit was bordered with a 1.5 m wide plot of oats in 1985 and spring wheat in 1986 to reduce interplot interference.

Seeding was done with a small plot seeder between May 23rd and 28th. The seeding rate was 110 kg/ha. Fertilizer was placed as 27-27-0 with the seed at 112 kg/ha and was broadcast as 34-0-0 at the seedling stage at 67 kg/ha. Weeds were controlled with 3.5 l/ha Roundup (glyphosate) before seeding, and a tankmix of 1.0 l/ha Buctril-M (bromoxynil and MCPA) and 3.5 l/ha Avenge 200-0 (difenzoquat) at the tillering stage. Harvest was performed with a Hege small plot combine on August 28 and 27 at Shellbrook and September 11 and 10 at Medstead in 1985 and 1986, respectively.

For disease assessment, ten primary tillers from each plot were randomly collected on each observation date. Leaves of these tillers were assessed for the percentage leaf area affected by net blotch, i.e. the leaf area that was necrotic or chlorotic. Disease assessment was made by comparing the sampled leaves to standard area diagrams (James, 1971). The number of tillers per metre square was determined on a 1 m row after anthesis in each plot. Prior to harvest ten spikes per plot were taken at random. The number of kernels on these spikes was counted. Harvested grain was air dried, cleaned and weighed. A sample from the harvested grain was taken for the determination of kernel weight. A sample from each treatment was graded by the Inspection Division of the Canadian Grain Commission in Saskatoon.

RESULTS AND DISCUSSION

Spot-type net blotch was the most prevalent disease at both sites. Spot blotch and scald were also observed, but they covered less then 5% of the total leaf area. Net blotch was present from the first-leaf stage onwards. Net blotch developed as necrotic lesions on the lower leaves. The disease severity on those lower leaves was low (<20%). On the three uppermost leaves, net blotch developed rapidly. The symptoms consisted of chlorosis and necrosis. The development of net blotch on the penultimate leaf in untreated plots is shown in Figure 1. Net blotch affected the entire leaf blade within three weeks. Due to this rapid development, net blotch infection can be confused with early maturity. The difference can only be detected by close observation of the leaves.

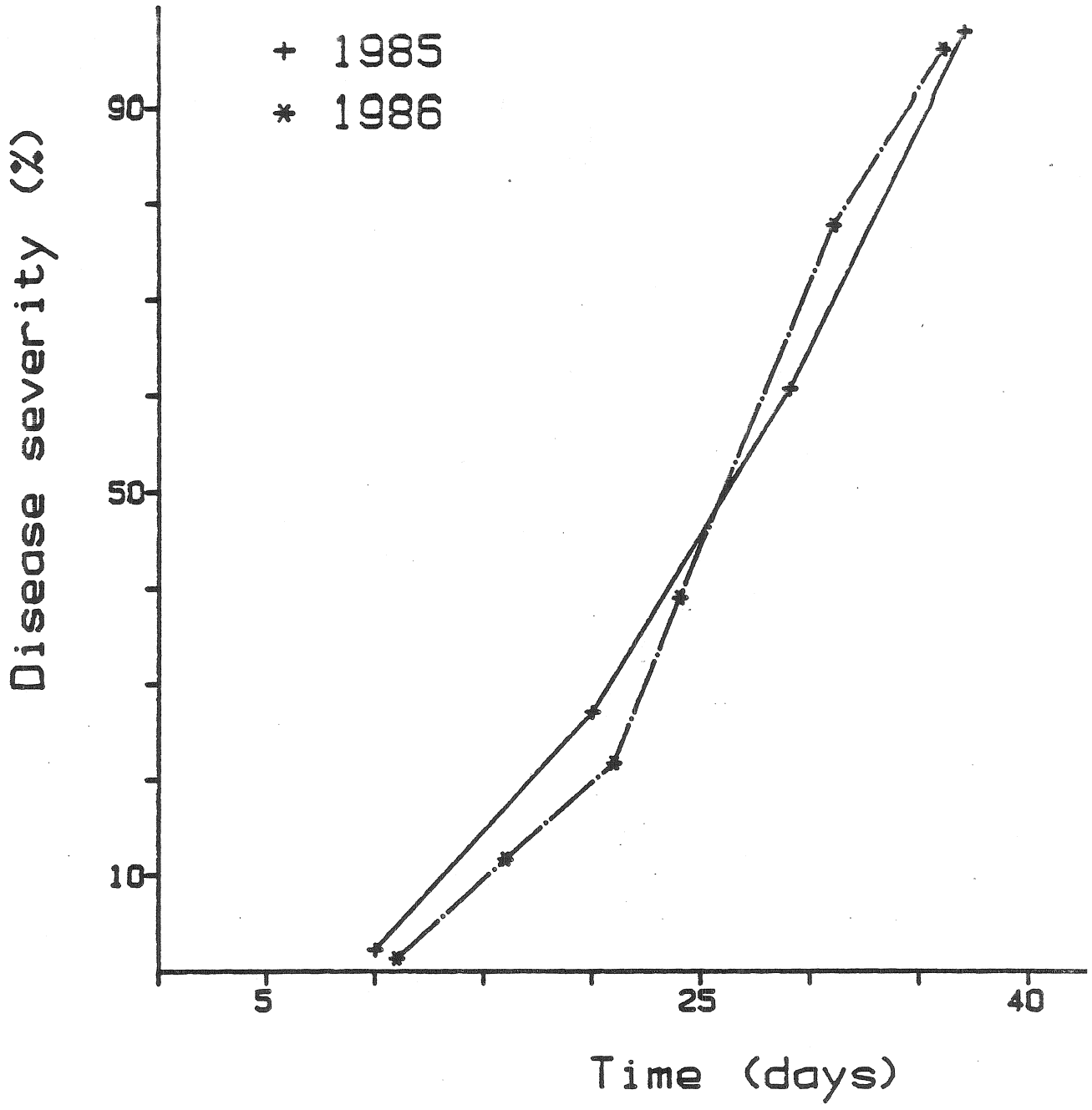

Figure 1. Progress of net blotch on the penultimate leaf in untreated plots of Elrose barley in 1985 and 1986 (July 1st = day 1).

The use of the fungicide Tilt delayed the development of net blotch. However, it provided only partial control of net blotch (Table 1). Even the continuously sprayed plots were severely affected by net blotch in both 1985 and 1986.

Control of net blotch increased grain yield significantly at both Shellbrook and Medstead in 1985 and 1986. The untreated plots consistently gave the lowest grain yield and the continuously sprayed plots gave the highest grain yield (Table 2). In 1985, the application at boot stage increased grain yield more than the applicaton at elongation stage. In 1986, application at elongation stage resulted in a similar grain yield as the application at the boot stage at Medstead, but resulted in a greater grain yield at Shellbrook. The treatment with two applications of Tilt consistently yielded more than the treatments with a single application.

By comparing the yield of the untreated plots to that of continuously sprayed plots, estimates of the yield loss caused by net blotch ranged from 26 to 34% (Table 2). These estimates are conservative, as the continuously sprayed plots showed high levels of disease infection. A disease-free plot would have yielded more. Estimates of yield loss in this study are comparable to the higher estimates of yield losses obtained in Eastern Canada, where yield losses beteen 16 and 40% have been reported.

No significant differences were observed for the number of tillers per metre square and the number of kernels per spike. Kernel weight was the only yield component that showed significant differences. Differences in kernel weight followed the same pattern as differences in grain yield (Table 3). Thus net blotch affected grain yield primarily through reduced kernel weight. Therefore, infection at later stages is more important than infection at early stages.

The cultivar Elrose is eligible for malting grades. In both 1985 and 1986, all samples received grades for general purpose barley (Table 4), because the kernels were stained. This was due to the development of net blotch on the floral bracts and awns. The necrotic lesions appeared as stains on the mature kernels. In 1985, the test weight in the most severely affected treatments was lower than 58.0 kg/hl. Therefore, the samples from the untreated plots at both Medstead and Shellbrook, and from the plots with an application at elongation stage at Medstead were graded 2 CW.

The grain yield of Elrose barley is greatly reduced by net blotch infection, and the grain grade is lowered by the development of symptoms on the kernels. As infected stubble is the source of primary inoculum, barley should not be grown on barley stubble. As well, susceptible barley cultivars should be avoided in areas with a high prevalence of net blotch.

Table 1. Disease severity on Elrose barley assessed at milk ripe stage at two sites in 1985 and 1986.

Treatment	Shellbrook		Medstead	
	1985	1986	1985	1986
	%			
Untreated	97	96	64	63
Elongation	90	84	39	62
Boot	82	95	28	58
Elongation + boot	73	69	22	27
Continuous	66	50	23	-

Table 2. Grain yield of Elrose barley grown at two sites in 1985 and 1986.

Treatment	Shellbrook				Medstead			
	1985		1986		1985		1986	
	t/ha	%*	t/ha	%	t/ha	%	t/ha	%
Untreated	2.19	(74)	2.91	(66)	1.93	(71)	1.92	(71)
Elongation	2.36	(79)	3.59	(81)	2.09	(77)	2.32	(86)
Boot	2.46	(83)	3.13	(71)	2.26	(84)	2.31	(86)
Elongation + boot	2.69	(91)	3.82	(86)	2.31	(86)	2.69	(100)
Continuous	2.97	(100)	4.42	(100)	2.70	(100)	-	
LSD+	0.22		0.28		0.16		0.23	

* Grain yield is expressed as a percentage of the highest yielding treatment.
\+ Least significant difference at 5% probability level.

Table 3. Kernel weight of Elrose barley grown at two sites in 1985 and 1986.

Treatment	Shellbrook				Medstead			
	1985		1986		1985		1986	
	mg	%*	mg	%	mg	%	mg	%
Untreated	32.9	(83)	32.9	(76)	31.6	(90)	24.8	(84)
Elongation	35.4	(90)	40.1	(93)	33.0	(94)	26.5	(90)
Boot	35.5	(90)	35.4	(82)	33.6	(96)	28.0	(95)
Elongation + boot	38.0	(96)	41.8	(97)	33.9	(97)	29.5	(100)
Continuous	39.5	(100)	43.3	(100)	35.1	(100)	–	
LSD+	1.6		1.2		1.7		1.2	

* kernel weight is expressed as a percentage of the treatment with the largest kernel weight.
\+ Least significant difference at 5% probability level.

Table 4. Grade of Elrose barley grown at two sites in 1985 and 1986.

Treatment	Shellbrook		Medstead	
	1985	1986	1985	1986
Untreated	2 CW	1 CW	2 CW	1 CW
Elongation	1 CW	1 CW	2 CW	1 CW
Boot	1 CW	1 CW	1 CW	1 CW
Elongation + boot	1 CW	1 CW	1 CW	1 CW
Continuous	1 CW	1 CW	1 CW	1 CW

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