CONTROL OF LOOSE SMUT IN BARLEY

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Summary

Success has been shown in controlling loose smut disease (*Ustilago nuda*) in barley with systemic fungicides. Methods and rates of application of the fungicides are discussed in the light of disease levels and their effects on yield. Fungicides applied as a seed dressing have proven more successful in loose smut control than hot water treatment.

INTRODUCTION

Loose smut (*Ustilago nuda* (Jens.) Rostr.) of barley had been controlled in New Zealand since the 1930s by the hot water treatment (HWT) of early seed generations, with the virtual elimination of the disease when over 90% of barley was controlled by one organization. More recently there have been outbreaks of the disease associated with the introduction of smut-susceptible barley varieties and a rapid increase in the national barley crop. The release of systemic fungicide materials has come at an opportune time to maintain adequate control of loose smut.

Trials have been conducted to evaluate systemic fungicides for control of loose smut in barley during the four years 1968-9 to 1971-2.

METHOD

Seed lines treated for trial work have had below 11% infected kernels. Plots were 0.035 ha with four replications where possible. With low levels of infection the most relative basis for comparison of treatments has been the total number of infected heads per plot rather than the percentage infection indicated by random tiller counts.

HWT consisted of presoaking grain for five hours in water 26.7°C, submerging for five minutes in water 52.8°C, cooling in cold water (approximately 10°C) for five minutes, and dried to between 12 and 14% grain moisture.

Fungicide materials were normally applied as a slurry in a commercial slurry treatment machine.

Chemicals were used as formulations and at rates recommended by the manufacturer. The rates were as follows: Carboxin 187 g/100 kg of seed; benomyl 124.7 g/100 kg of seed; pyranil (dry seed dressing) 75 g/100 kg of seed; pyranil (wetable powder) 75 g a.i./100 kg of seed; BAS 3280F at 120 g a.i./100 kg of seed.

RESULTS

DISEASE CONTROL

In 1968-9 (Table 1), the degree of smut control by carboxin was proportional to the active ingredient applied. This indicated insufficient material (a dust) was adhering to the seed for satisfactory disease control. As a consequence, all later trials were conducted with carboxin applied as a slurry.

In the 1969-70 trials (Table 2), carboxin applied as slurry gave improved control, while both increased active ingredient and increased volume of water as a carrier further enhanced smut control. Benomyl was less effective than HWT on barley. Results of HWT in Table 2 are below that normally expected from this method. The possibility of faulty HWT is ruled out since the same seed was grown in the trials described in Table 3.

In contrast to previous trials, all treatments in 1970-1 (Table 3) showed satisfactory disease control. Carboxin applied at higher than normal rates gave 100% control. Both pyranil formulations gave better control than HWT and considering the relative rates fared well against carboxin.

TABLE 1: NUMBER OF LOOSE SMUT INFECTED HEADS AND % CONTROL IN CAPE BARLEY, MORVEN, 1968-9

<i>Treatment</i> (g/100 kg seed)	<i>Infected Heads</i>	<i>% Control</i>
HWT	213	93
carboxin 46.6	1614	46
carboxin 93.4	984	67
carboxin 187	636	79
Untreated	2968	0

TABLE 2: NUMBER OF LOOSE SMUT INFECTED HEADS AND % CONTROL IN ZEPHYR BARLEY 1969-70

<i>Treatment</i> (g/100 kg seed)	<i>Vol. ml</i> <i>slurry/</i> <i>4.54 kg</i> <i>Seed</i>	<i>Geraldine</i>		<i>Rakaia</i>		<i>Blenheim</i>	
		<i>Infec.</i> <i>Heads</i>	<i>%</i> <i>Cont.</i>	<i>Infec.</i> <i>Heads</i>	<i>%</i> <i>Cont.</i>	<i>Infec.</i> <i>Heads</i>	<i>%</i> <i>Cont.</i>
HWT		13	66	17	40	53	66
carboxin 93.5	23	8	79	0.67	98	0.5	99.7
carboxin 93.5	46	3	92				
carboxin 187.0	23	4	89	0	100	0.5	99.7
carboxin 187.0	46	1	97				
benomyl 62.4	23	38	0	33	—15	115	26
benomyl 62.4	46	22	42				
benomyl 124.7	23	19	50	33	—15	90	42
benomyl 124.7	46	13	66				
Untreated		38	0	28	0	155	0

TABLE 3: NUMBER OF LOOSE SMUT INFECTED HEADS AND
% CONTROL IN ZEPHYR BARLEY 1970-1

<i>Treatment</i> (g/100 kg Seed)	<i>Sedgemere</i>		<i>Motukarara</i>	
	<i>Infected</i> <i>Heads</i>	<i>%</i> <i>Control</i>	<i>Infected</i> <i>Heads</i>	<i>%</i> <i>Control</i>
HWT	15	87	5.2	90.6
carboxin 187.0	0	100	0.5	99.1
carboxin 374.0	0	100	0	100
carboxin 748.0	0	100	0	100
pyranil (dust) 37.5	27	76*	0.75	98.6
pyranil (dust) 75	13	88*	1.5	97.3
pyranil (WP) 37.5	20	82*	2.5	95.5
pyranil (WP) 75	11	90*	1.0	98.2
Untreated	112	0	55.1	0

*Weight of product/100 kg seed instead of recommended weight a.i./100 kg seed, i.e., 0.25 of indicated rate of pyranil (dust) and 0.5 of indicated rate of pyranil (WP).

TABLE 4: NUMBER OF LOOSE SMUT INFECTED HEADS AND %
CONTROL IN ZEPHYR BARLEY 1971-2

<i>Treatment</i> (g/100 kg Seed)	<i>Sedgemere</i>		<i>Methven</i>	
	<i>Infected</i> <i>Heads</i>	<i>%</i> <i>Control</i>	<i>Infected</i> <i>Heads</i>	<i>%</i> <i>Control</i>
HWT	68	70	149	85
carboxin 187	0	100	21	98
pyranil (dust) 75	1	99.6	215	78
pyranil (WP) 75	20	91	371	62
BAS 3280F 120	2	99.1	159	84
Untreated	220	0	976	0

TABLE 5: GRAIN YIELD OF ZEPHYR BARLEY FOR TWO YEARS

<i>Treatment</i> (g/100 kg Seed)	<i>Yield kg/ha</i> <i>1970-1</i>	<i>Yield kg/ha</i> <i>1971-2</i>	<i>Tillers/</i> <i>Infected</i> <i>Plant</i>
HWT	4944 bcAB	4351 bcBC	3.24
carboxin 187	5380 aAB	4420 bBC	1.9
carboxin 374	5300 abAB		
carboxin 748	4812 cB		
pyranil (dust) 37.5	5275 abAB		
pyranil (dust) 75	5484 aA	4140 cC	2.2
pyranil (WP) 37.5	5362 aAB		
pyranil (WP) 75	5344 abAB	4485 bABC	2.3
BAS 3280F 120	5519 aA	4579 abAB	2.01
Untreated	5519 aA	4826 aA	3.9

At Sedgemere (Table 4), carboxin, pyranil (dust) and BASF 3280F gave satisfactory results but apart from carboxin control was erratic at Methven. This inconsistency could be attributed to factors such as soil moisture and temperature. For these trials where the mean yields were 4467 kg/ha and 4471 kg/ha at Sedgemere and Methven, respectively, the infected heads in the untreated plots would be expected to be similar. The levels of smut expressed by the smutted heads recorded differ markedly between the two environments, suggesting that environmental factors, within a tolerance range for those directly responsible for grain yield, affect the development of the fungus.

GRAIN YIELD

In 1970-1 (Table 5), all treatments yielded less than untreated but significant reductions occurred only with HWT and where carboxin active ingredient was applied at four times the recommended rate. Again in 1971-2 the untreated yield is higher than all treatments. Significant yield reduction occurred with each treatment other than BAS 3280F, the greatest reduction being by pyranil (dust).

The fungicide materials reduced tillering and Table 5 shows the tillers per infected plant. Assuming that tiller numbers of healthy plants were also affected, less tillering can explain the reduction in yields. However, in the 1970-1 trial, tillers per metre row were recorded with no significant differences between treatments, suggesting that seeding rate was above optimum or that yield components other than tillering were also affected by the fungicides.

When chemicals have been used to control loose smut at low levels of infection (below 10% in the crop) yield reduction has occurred. Economic yield increases from seed treatment may only occur when the smut infection levels are higher (10 to 20%) than those present in these trials. Similar conclusions were drawn by Stoker and Dewey (1970) who found significant yield increases occurred only where the loose smut infection levels approached 20% in Gem barley.

CONCLUSIONS

- (1) Systemic fungicides gave better control of loose smut in barley than HWT.
- (2) It was imperative to get adequate coverage and sufficient quantity of active ingredient of systemic fungicide on to the seed for reliable disease control.
- (3) Yield reduction may result from the application of systemic fungicides on barley, particularly when the level of seed infection is low.
- (4) Systemic fungicides should be applied to the higher generation seed barley at a rate sufficient to obtain 100% control.
- (5) Of the materials tested, carboxin at the rate of 187 g/100 kg of seed applied as a slurry at 46 ml/4.5 kg of seed was the most successful.
- (6) Other materials tested show a considerable improvement on HWT and further trials are justified.

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REFERENCE

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