CONTROL OF LOOSE SMUT OF OATS

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Summary

The incidence of loose smut (*Ustilago avenae*) in oats (*Avena sativa*) has increased in recent years and is higher in feed oats than in milling oats. Trials show that seed treatments with systemic fungicides are effective in controlling the disease and are superior to captan, the most commonly used seed dressing. 'Taiko' was twice as susceptible as two commercial varieties while the high yielding 'Omihī' selections were resistant. With the development of resistant varieties and use of effective seed dressing on 'Taiko' infection should fall to a low level again.

INTRODUCTION

Trace amounts of oat loose smut (*Ustilago avenae*) are present in oats (*Avena sativa*) throughout New Zealand. Over the past few seasons, however, the number of infected crops has risen with high levels of disease in some cases. In 1972 a sample of oats which had produced 25% of infected heads was received from Southland. As this seed had been treated with fungicide prior to sowing, it was believed that resistance to the chemical had developed.

Many reports of loose smut infection came from the Southland and Otago areas during 1973. Seed of three lines was used in glasshouse seed treatment trials.

Field trials were conducted during the seasons 1973-76 at both Lincoln and Gore, while a chemical screening trial was conducted during the 1975-76 season at Lincoln.

METHODS AND RESULTS

1972 Glasshouse trial

No seed of the original sowing was available so smutted heads from the current crop which had produced 25% infection were used to inoculate clean 'Mapua' oats. A vacuum infiltration process was used to lodge the spores under the glumes, a method of inoculation which closely simulates the natural process. Chemicals were applied to seeds by a small laboratory type mixer in which conical flasks could be held. The seed in the flask was first moistened and the chemical added while the flask rotated. This resulted in a very evenly-treated sample of seed.

Clean seed, spore inoculated seed, and inoculated seed treated with fungicides was sown separately in boxes of sterilised soil and grown on to maturity. Each box held 50 seedlings and all treatments were replicated four times.

The plants grown from clean seed showed no infection while plants from inoculated seed produced 28% of smutted heads. When seed was treated with captan at the manufacturer's recommendation ($N = 0.5 \text{ g/kg}$) 1% of the plants developed infection; $\frac{1}{2}N$ rates allowed 4% infection to develop, while $\frac{1}{4}N$ rates gave 6% infection. When seed was treated at these rates with the systemic materials, benomyl or carboxin, no infection developed.

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1973 Glasshouse trial

Three lines of naturally-infected oats were tested using boxes of sterilised soil and sowing at similar densities as outlined in the 1972 trial. All treatments were replicated five times. The results listed in Table 1 show that when the level of natural infection was 10% or less, control was adequate, but with a more heavily infected line, control was lost.

TABLE 1: EFFECT OF FUNGICIDES ON THREE LINES OF OAT SEED FROM 1973 HARVEST, SOUTHLAND

Treatment	Rate g/kg	% Infected heads		
		Line 1	Line 2	Line 3
3192 F	0.5	0	0	0
3192 F	1.0	0	0	0
benomyl	0.5	0	0	1.7
benomyl	1.0	0	0	1.8
carboxin	0.5	0	0	4.8
carboxin	1.0	0	0	7.2
mancozeb	1.0	0	0	5.0
mancozeb	2.0	0	8.0	8.0
untreated seed	0	1.6	10.0	13.7

1973 - 75 Field trials

Trials were conducted during the 1973 - 75 seasons at both Lincoln and Gore. Seed of the black seeded feed oat 'Taiko' was artificially inoculated with loose smut spores employing the vacuum infiltration method and the resultant plants developed 56% of smutted heads. The systemic fungicides gave excellent control even when used at half the recommended rates but the non-systemic chemical, mancozeb, was unsatisfactory even at twice the suggested rates. A slight amount of infection was recorded in the clean untreated seed and may have been caused by a natural low level of infection or by contamination during the preparation of the trial. The figures given in Table 2 are the means of six replications.

TABLE 2: EFFECT OF FIELD TREATMENT OF INOCULATED 'TAIKO' OATS, GORE, 1974 - 75

Treatment	Rates g/kg	% Infected heads
mancozeb 80%	0.5	24
mancozeb	1.0	22.2
mancozeb	2.0	8.75
benomyl	0.5	0
benomyl	1.0	0
3192 F	0.5	0.2
3192 F	1.0	0
3192 F	2.0	0
carboxin	1.0	0
carboxin	2.0	0
clean seed	0	0.8
inoculated seed	0	56.0
CV %		31.5

1975 - 76 Field screening trial Lincoln

Following this trial at Gore it was decided to test a range of chemicals at Lincoln for their efficiency, against oat loose smut. Some were still experimental but commercially-available materials were included as standards. All materials except captan were applied at recommended and half the recommended rates. The results in Table 3 again demonstrate the superiority of those chemicals with systemic activity.

TABLE 3: CHEMICAL SCREENING OF FUNGICIDES,
LINCOLN, 1975 - 76

<i>Treatment</i>	<i>Rate g/kg</i>	<i>% Infected heads</i>
*mancozeb	1.0	12.2
*mancozeb	2.0	7.4
*benomyl	0.25	2.2
*benomyl	0.5	0
*carboxin	0.25	0.3
*carboxin	0.5	0
*3192 F	0.25	0.2
*3192 F	0.5	0.2
captan	0.5	29.5
mancozeb 70% + RH 3928 6.5%	0.25	23.0
mancozeb 70% + RH 3928 6.5%	0.5	16.2
*m.e.b. 25% + fubiridazol 4%	0.25	0
*m.e.b. 25% + fubiridazol 4%	0.5	0
*m.e.b.	0.25	0
m.e.b.	0.5	0
glycophene	0.5	39.9
glycophene	1.0	31.9
clean seed	0	0.5
inoculated seed	0	29.2

* Systemic fungicides.

The accepted non-systemic seed treatment containing captan failed to exercise any control and gave infection levels equal to those of the untreated controls.

Varieties resistance to oat loose smut

Oat varieties differ in their susceptibility or resistance to loose smut and many of the reports of increases in disease levels concerned the black seeded oat 'Taiko'. A survey in the Southland area during 1975 showed 5-7% loose smut in milling oats and up to 10% in feed oat varieties (including 'Taiko').

To determine if 'Taiko' was more susceptible to oat loose smut it was included in a field trial of advanced breeding material. Two of the lines included in this collection were known to have a high level of resistance and because of their high yields would be suitable for early release. All the selections in this trial were inoculated with spores from the Gore trial of the previous season using the vacuum infiltration process.

Results in Table 4 taken from 10 replications show 'Taiko' to be the most susceptible of the lines under test, showing twice the infection of the three other susceptible lines.

The excellent resistance of 'Omih/2' and 'Omih/10' was confirmed and as this variety shows an increase in yield of 10-20% over 'Mahua 70' in trials at Lincoln it should prove an excellent replacement.

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TABLE 4: INCIDENCE OF OAT LOOSE SMUT IN
INOCULATED OAT VARIETIES, GORE, 1975 - 76

<i>Variety</i>	<i>Total infected tillers (10 replicates)</i>
'Omihi/2'	0
'Omihi/10'	0
'Oreti'	186
'Okawa'	189
'Taiko'	336
'Makura' (selection of 'Mapua 70')	177

The introduction of a loose smut resistant oat will improve the general health of both feed and milling oats. If the level of infection in susceptible feed oats such as 'Taiko' can be reduced by effective chemicals, or seed treatment to enable the chemical to be carried under the glumes and control the spores lodged there, the total inoculum in the main oat growing areas will be greatly reduced. The possibility of the widespread and heavy carry-over of spore inoculum will also be lessened.