

FUNGI CONTROL IN PIP AND STONE FRUIT WITH TRIFORINE

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Summary

In trials over five seasons the new systemic fungicide, triforine, provided control of black spot (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*) in apples and brown rot (*Monolinia fructicola*) in peaches comparable to the benzimidazole group of fungicides or standard protectant fungicides. Triforine was most effective against brown rot and powdery mildew. The rates for acceptable disease control varied from 10-20g/100 litres. The present formulation may not provide as good fruit finish in apples as alternative materials.

INTRODUCTION

In 1971, the benzimidazole (MBC) group of systemic fungicides were first used commercially for the control of black spot (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*) in apples, and were shown to have both protectant and curative properties. However, during the 1974/75 season a strain of black spot with a high degree of tolerance to the MBC's was identified, and growers have reverted to the protectant fungicides such as captan. Tolerance of brown rot (*Monolinia fructicola*) to MBC fungicides in stone fruit is also likely to occur soon in New Zealand, since it has already occurred in Australia and Michigan, USA (McKenzie pers comm).

An alternative systemic fungicide is therefore needed to control these important diseases and triforine, a recently developed systemic fungicide derived from piperazine, shows promise as such an alternative. It has a different mode of action to the MBC's (Kirkby 1972), and overseas results show that it is effective in controlling these diseases (Adlung and Drandarevski 1971; Gilpatrick 1973; Gilpatrick *et al* 1972).

This paper reports on trials conducted in orchards around Hastings over five seasons which compared triforine with benomyl and thiophanate methyl and a standard mixture of the protectant fungicides, captan and dinocap.

METHOD

Single tree plots were selected in a random design. Applications were made with a handgun at 1400 kPa pressure to give complete coverage to the point of run-off by applying 10-15 litres of spray per tree.

In the apple trials a 2-3 week spray schedule beginning at green tip was maintained throughout the season. An insecticide programme of azinphos-methyl (37.5g/100 litres) was applied from petal fall and the miticide cyhexatin (12.5g/100 litres) was applied as required.

In the peach trials, trees received sprays 7-10 days apart during the blossom period commencing at early pink stage; then a standard 4-weekly captan programme until fruit ripening; then one or two sprays of the

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treatments again 7-10 days apart before harvest. Further trial details are given in Table 1.

TABLE 1: INDIVIDUAL TRIAL DETAILS

<i>Apple trials</i>				
Trial No.	Variety	No. reps.	No. sprays	Harvest date
1	Granny Smith	4	8	—
2	Golden Delicious	4	9	15.3.72
3	Sturmer Pippin	2	11	8.4.75
4	Golden Delicious	3	9	6.3.75
5	Golden Delicious	3	9	8.3.76
6	Red Delicious	3	11	9.3.76
<i>Peach trials</i>				
7	Golden Queen	4	3* (0)	—
8	Golden Queen	3	5 (0)	—
9	Golden Queen	3	4 (1)	11.3.76
10	Golden Queen	3	4 (2)	16.3.76

* No. blossom sprays (No. pre-harvest sprays)

Assessments of disease control were made at intervals throughout the season. To record secondary infections of powdery mildew 10 leaders were selected from around each tree and the 10 terminal leaves scored for the presence or absence of lesions. Leaf lesions of black spot were similarly recorded. At harvest the apples from each tree were picked and a random two-bushel sample examined for black spot and graded for fruit finish according to the New Zealand Apple and Pear Board standards.

Brown rot in peaches was assessed as a percent infection by randomly inspecting 300 blossoms at head height around each tree. In the trials which were harvested, all the peaches on each tree were picked and the number with brown rot recorded. All percent infection results were transformed into arcsine for analysis.

RESULTS AND DISCUSSION

Powdery mildew

The results from five trials, in which widespread leaf infection of powdery mildew occurred, are shown in Table 2.

In all trials, triforine at rates of 12.5, 20, and 25g/100 litres provided control which was comparable with that provided by thiophanate-methyl and which, in Trial 2, was significantly better than the captan + dinocap mixture.

No rating on the severity of the infection is shown, but in the trials in which this was recorded, the percentage of leaves with "moderate" and "severe" infection was between 45 and 50% whereas on the treated trees only 4-10% of "light" infection occurred. Similar differences were found between the severity of black spot lesions on treated and untreated trees.

Black spot

Conditions in 1972 and 1976 were very favourable for black spot development and the results from these two seasons are shown in Table 3.

The control achieved with triforine at the two lowest rates was variable, indicating that 20g/100 litres may be needed to provide control comparable to the standards.

TABLE 2: PERCENT LEAF INFECTION BY POWDERY MILDEW

Treatment	g/100 litres	Trial No./Date assessed				
		1 13.1.72	2 16.12.71	3 20.12.74	4 8.1.75	5 15.12.75
thiophanate-methyl	20	6.8 cd	3.0 c	3.5 b	13.0 b	—
captan + dinocap	80+17	15.2 b	10.0 b	11.5 b	—	10.3 b
triforine	12.5	11.0 bc	4.0 c	—	—	—
triforine	20	—	—	4.0 b	13.3 b	3.7 b
triforine	25	5.2 d	1.5 c	—	—	—
untreated	—	56.5 a	43.0 a	31.0 a	44.0 a	48.7 a
CV %	—	5	5	34	29	39

Fruit finish from the 1975/76 trials, expressed as a percentage of fruit with export fancy grading, have been included in Table 3. The emulsifiable concentrate formulation of triforine used in these trials caused a small decrease in the proportion of export fruit at 20g/100 litres, which was accentuated when twice the rate was used. The russet which occurred, was observed as a thin line in a ring around the calyx of the fruit. Further evaluation of this formulation over several seasons is needed to provide more reliable information.

TABLE 3: PERCENT BLACK SPOT INFECTION AND FRUIT FINISH

Treatment	g/100 litres	Trial No./Date rated						Percent fruit graded Export Fancy	
		2 14.1.72 Leaf	5 15.3.72 Fruit	6 8.3.76 Fruit	6 22.1.76 Leaf	6 9.3.76 Fruit	Trial 5	Trial 6	
thiophanate-methyl	20	4.5 d	0	—	—	—	—	—	
thiophanate-methyl + captan	20+80	—	—	0	0	0.6 c	97 a	97 a	
captan + dinocap	17+80	27.5 b	0.9	0.3	1.0	0.3 c	99 a	95 a	
triforine	12.5	17.8 c	0	—	—	—	—	—	
triforine	15.0	—	—	—	0	5.2 b	—	—	
triforine	20.0	—	—	0	0.7	1.2 bc	96 a	93 a	
triforine	25.0	6.0 d	0	—	—	—	—	—	
triforine	40.0	—	—	0	—	—	50 b	—	
untreated	—	62.8 a	56.7	18.9	26.0	56.4 a	93 a	97 a	
CV %	—	5	6	47	53	24	6	5	

TABLE 4: PERCENT BROWN ROT INFECTION IN PEACHES

Treatment	g/100 litres	Trial No./brown rot infection				
		7 Blossom	8 Blossom	9 Blossom	10 Fruit	10 Fruit
thiophanate-methyl	20	0	—	—	—	—
thiophanate-methyl + captan	20+80	—	0	0	4.9 b	—
benomyl	12.5	—	0.2	0	9.9 b	7.5 bc
triforine	10	0	0.2	0	11.3 b	11.7 b
triforine	20	0	0	0	7.0 b	5.9 c
untreated	—	27.8	35.2	19.6	39.4 a	47.6 a
CV %	—	26	59	30	30	28

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Brown rot

The brown rot control achieved in four trials is in Table 4.

Triforine at 10g/100 litres compared favourably with the standard treatments, all giving excellent control of brown rot over the blossom infection period. The low rate of triforine was also comparable to the MBC's in their control of brown rot in the fruit as a pre-harvest spray, although in Trial 10, control was better with 20g/100 litres. The level of fruit rot (39%) in Trial 9 may have been reduced if a second pre-harvest spray had been applied. This aspect, plus the efficacy of triforine on the development of stored fruit diseases, needs further investigation.

CONCLUSION

Triforine, a new type of systemic fungicide, shows promise as being effective for the control of fungal diseases in pip and stone fruit. The present formulation appears to minimise the russetting which occurs on sensitive apple varieties. By restricting its use to the main infection periods and possibly using it in mixture with a protectant fungicide, the development of tolerant fungal strains which may otherwise occur could be avoided.

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