BLACK SPOT OF PEARS: CONTROL AND NON-CONTROL UNDER NEW ZEALAND CONDITIONS

J. B. CORBIN

Department of Botany, University of Auckland

J. F. PORTER and M. J. CORNWELL

Neill, Cropper and Co. Ltd., Auckland.

Summary

Reports received during the 1971-72 season of inadequate control of pear black spot were investigated in that and the two following seasons. Investigations showed that inadequate disease control occurred when orchardists used either dodine, captan or benomyl at wider than 10 day intervals between green tip and second cover applications; and that, for the prevention of infection and sporulation on pear fruit, benomyl at 0.0125 to 0.025% can be superior to captan 0.1% or dodine 0.488%. Also a full-season tank-lot programme of benomyl 0.0125% (284 g/ha) plus 0.25% Shell universal orchard oil (9.0 litres/ha) appeared non-phytotoxic and gave excellent disease control and fruit finish.

INTRODUCTION

Black spot, or scab as it is alternatively called, of pear (*Pyrus communis*) is caused by a fungus *Venturia pirina*, and is one of the most important diseases attacking pears in New Zealand.

The conidial stage exists on the tree in lesions for one to three years; and during this time recurrent crops of conidia are produced whenever it is wet enough for long enough. The main period of production begins before blossoming and extends beyond it, but may occur at other times even in winter months. The perithecial stage of the fungus is produced on infected leaves after falling in the autumn. These perithecia mature in late winter and early spring to release ascospores which infect young leaves, flowers and fruits (Cunningham, 1921, 1922 and 1925; Curtis, 1921, 1924).

Control of the disease in the past was most difficult (Monigatti, 1966) but could be obtained by pruning out infected wood, burning or spraying infected leaves and spraying with Bordeaux mixture at both green tip and open cluster; followed by lime sulphur or Bordeaux from petal-fall through summer (Cunningham, 1925).

Research for alternative fungicides has continued to the present day. Captan, copper oxychloride, thiram and dodine are suggested as protectants; dodine and phenylmercuric chloride as eradicants; and phenylmercuric chloride as an autumn post-harvest clean-up spray to reduce perithecial development in the following spring (Atkinson, 1971, N.Z. Department of Agriculture 1967-69 to 1970-71).

Recently a new fungicide, benomyl, a partly systemic compound, was shown overseas to be effective for the control of apple and pear black spot. In New Zealand some growers used benomyl for pear black spot control in the 1971-72 season and reports were received of variable success in disease control. A study was commenced in which growers using benomyl in that season were interviewed and the following trial work commenced.

METHODS

In the 1971-72 season interviews were conducted with some 20 pear orchardists using benomyl for all or part of the season. Of these four were in Auckland, four in Hawkes Bay, 10 in Nelson and two in Christchurch. Records were made of dates and rates of application.

In the 1972-73 season a replicated trial was conducted on a block of young Packham pear trees in the Auckland district of Taupaki. This planting had already had captan applied at wide spray intervals allowing pear black spot fruit infections. Seven treatments were tested, using six single-tree replicates per treatment, in a completely randomised block design. Five dilute sprays were applied with a handgun multi-nozzle lance; operating at 2068 kPa and using 9 litres per tree.

Treatments were applied on 30th November, 18th December 1972; 3rd, 18th January and 7th February 1973. A 50/50 mix of insecticide of TDE-DDT at 0.03% each was incorporated into all sprays except that applied on 7th February.

In the 1972-73 season two tank-lot evaluations were undertaken to determine the performance of fungicides for pear black spot control; with part season programmes as follows:

At Hastings a six-year-old central-leader-trained planting of pears, variety William bon Cretien, was selected, which had already been sprayed twice during the bloom with captan 0.1% (dates not recorded), and subsequently with benomyl 0.0125% on 2nd, 13th November and dodine 0.488% on 25th November because fruit infection was appearing. The planting was divided into duplicated twin blocks which were sprayed dilute at 860 kPa using a tractor driven Fed-Air air-blast sprayer applying 2250 litre/ha. Fungicide regimes evaluated were dodine, 0.488%, and benomyl 0.0187% + 0.5% Shell universal orchard oil on each of the following dates: 4th, 15th December 1972; and 14th January 1973. Harvest was in early February.

At Nelson a block of 40+ year-old pear trees, Packham variety, was selected to evaluate fungicide programmes. This planting had a history of pear black spot which was not successfully controlled in the previous season by benomyl.

Three fungicide regimes were tested:

- (1) At green tip, benomyl 0.025% (568 g/ha) + 2% Shell universal orchard oil followed by benomyl 0.0187% (426 g/ha) + 0.5% Shell universal orchard oil at early bloom (22nd September), full bloom (5th October), petal fall (17th October), and first cover (30th October);
- (2) A similar programme excluding 0.5% Shell universal orchard oil from 22nd September onwards, and
- (3) A grower standard programme of copper oxychloride (9.1 kg/ha) + 2.5% Shell universal orchard oil at green tip, followed by 0.028% thiophanate-methyl, on 22nd September, 5th, 17th, 30th October. Dicofof 0.035% was included on 30th October. All spraying was then discontinued and evaluations made on 21st November 1972.

In the 1973-74 season two orchards were observed closely for pear black spot control. At Hastings two programmes were compared on a full season basis:

- (1) 10-8-100 Bordeaux at green tip, then benomyl at 284 g/ha — initially applied at 0.025% (2500 litres/ha) + 2.5% Shell late winter oil (56.2 litres/ha), then at 0.025% + 0.25% Shell universal oil (5.6 litres/ha) in the bloom period decreasing to 0.0125% + 0.25% Shell universal orchard oil (11.2 litres/ha) in pre-harvest sprays. A total of nine benomyl applications were made; at 7 to 12 days intervals between green tip and first cover and thereafter at 18 to 25 day intervals till harvest.

Orchards and Vineyards

- (2) 10-8-100 Bordeaux at green tip, then 0.4% copper oxychloride (9.1 kg/ha) + 2.5% Shell late winter oil (56.2 litres/ha) followed by 0.24% copper oxychloride (5.5 kg/ha), then dodine, eight applications varying from 0.325% (692 ml/ha) to 0.488% (1477 ml/ha). Insecticides were added to the fungicides as required and agrimycin was applied separately for fireblight control.

At Taupaki in Auckland a benomyl programme was used full season at 12 to 15 day intervals between green tip and second cover and thereafter 21 to 32 day intervals until harvest. The first benomyl spray following the 10-8-100 Bordeaux was applied at 0.187%. The remaining benomyl applications were of 0.025% (284 g/ha).

RESULTS

Table 1 shows that of the twenty orchardists interviewed, seventeen used only benomyl on their pears up to preharvest and of these only three had fruit infection in late December, but nine had infection after using captan preharvest sprays. A group of three orchards used a mixture of benomyl on some occasions and dodine on others. Two of these had infection by December and a third by harvest, after using captan.

TABLE 1: ASSOCIATION BETWEEN FUNGICIDE PROGRAMMES AND INCIDENCE OF PEAR BLACK SPOT FOR 20 ORCHARDISTS DURING THE 1971/72 SEASON.

<i>Fungicide Programme</i>		<i>Proportion of orchards with black spot at late December</i>	<i>Pre-harvest fungicide programme</i>	<i>Proportion of orchards with black spot at harvest</i>
<i>Pre Cover</i>	<i>Cover</i>			
benomyl/ dodine	benomyl/ dodine	2/2	captan	2/2
benomyl/ dodine	benomyl	0/1	captan	1/1
benomyl	benomyl	3/17	captan	9/17

Table 2 shows that the three orchardists using benomyl and having black spot were those with 10 to 21 day intervals up to second cover. Provided intervals of 7 to 10 days were used in this period no pear black spot was present at late December, even though spray intervals were increased up to 21 days after the earlier sprays.

TABLE 2: ASSOCIATION BETWEEN BENOMYL SPRAY INTERVALS AND INCIDENCE OF PEAR BLACK SPOT FOR 17 ORCHARDISTS DURING THE 1971/72 SEASON.

Average Number of Days Spray Interval		Proportion of orchards in each category with pear black spot at late December
During precover and up to second cover	From second cover till late December	
7-10	7-10	0/2
7-10	10-14	0/2
7-10	14-21	0/2
10-14	10-14	1/4
10-14	14-21	1/5
14-21	14-21	1/2

Orchards and Vineyards

Table 3 shows the distribution of the seventeen pear orchardists with respect to differing tank rates and area rates. There is some suggestion that lower rates were associated with the presence of disease by late December.

TABLE 3: ASSOCIATION BETWEEN APPLICATION RATES OF BENOMYL AND INCIDENCE OF PEAR BLACK SPOT, FOR SEVENTEEN ORCHARDISTS, DURING THE 1971/72 SEASON.

<i>Tank rate (g/100 litres)</i>	<i>Proportion of orchards in each category, with disease at late December</i>
12.5	2/9
12.5-18.7	0/3
18.7-25.0	1/3
15.0	0/2
<i>Area rate (kg/ha)</i>	
0.28-0.36	2/5
0.43-0.57	0/8
0.57-1.14	1/4

Table 4 shows the results of the replicated trial at Taupaki in the Auckland district. Benomyl at all rates was superior. While there was no significant difference between dodine and captan in suppressing sporulation, dodine was superior in preventing secondary infection on these same pear fruit.

TABLE 4: EFFECTS OF FUNGICIDES ON SPORULATION AND SECONDARY INFECTION OF PEAR FRUITS BY *VENTURIA PIRINA*.

<i>Fungicide treatment (14-day application intervals)</i>	<i>Mean % fruit sporulating</i>	<i>Mean % fruits with secondary infection</i>	<i>Mean no. of secondary lesions per infected fruit</i>
1. benomyl 0.0125%	6.3 bB	0 cC	0 cC
2. benomyl 0.025%	8.1 bB	0 cC	0 cC
3. benomyl 0.0125% + 0.5% B.P. summer oil	3.1 bB	0 cC	0 cC
4. benomyl 0.0125% + 0.5% Shell universal oil	3.4 bB	0 cC	0 cC
5. captan 0.1%	62.9 aA	82 aA	7 aA
6. dodine 0.488%	43.3 aA	11 bB	2 bB
7. untreated with fungicide	57.2 aA	93 aA	13 aA

Results from the various tank-lot trials conducted in the two seasons 1972-73 and 1973-74 are represented in Table 5.

Fruit finish, foliage and compatibility with insecticides and oils was good in all instances. There is no evidence that benomyl is ineffective for pear scab control and in fact in one instance at Hastings in 1972-73 season benomyl 0.0187% + 0.5% Shell universal orchard oil was superior to a dodine programme of 0.488% (Table 5). In one instance at Nelson there was a suggestion of control of red mite early in the season.

TABLE 5: INCIDENCE OF BLACK SPOT AFTER TANK-LOT APPLICATION OF FUNGICIDES TO PEAR TREES.

Assessment	Fungicide treatment			
	Dodine	Benomyl	Benomyl + oil	Thiophanate- methyl
1972/73 season				
(a) Hastings, "W. B. Cretien"				
% infected fruit at harvest	33.4*		4.9*	
% sporulating fruit at harvest	28.5*		2.3*	
(b) Nelson, "Packham"				
% infected fruit at 20 November, 1972		<0.1	<0.01	<0.1
Red mite No./leaf at 20 November, 1972		1.2	nil	5.0
1973/74 season				
(a) Hastings, "W. B. Cretien"				
% infected fruit at harvest	trace		trace	
(b) Auckland, "Packham"				
% infected fruit at harvest		nil		

*Figures are means of two cases from each of eight bins from each treatment. Differences between treatments are highly significant ($p < 0.01$).

DISCUSSION

From our very preliminary investigations there is no substantive evidence that tolerant strains of *Venturia pirina* occurred in the orchards investigated.

(a) Efficacy of fungicides for pear scab control:

Despite some failures in disease control by pear growers in recent years in New Zealand, studies of fungicide schedules, a replicated trial, and tank lot assessments suggest that benomyl successfully controls pear scab and was superior to both dodine and captan. This complements the earlier findings in New Zealand when benomyl controlled the related fungus *Venturia inaequalis*, black spot of apple (Corbin, 1969, Slade, 1969).

(b) Rates of fungicide used:

Rates of dodine, captan and benomyl cited in overseas trials are comparable to those used and recorded under New Zealand conditions. There is some evidence that a preferable rate of application of benomyl for pear scab control is approximately 0.55 kg/ha when used in water (Table 3) or 0.28 kg/ha if combined with 0.25 to 0.5% non-phytotoxic spraying oil (Tables 4 and 5).

(c) Timing of application and intervals between applications:

Data from tables 1 and 2 suggest that growers used all materials; dodine, captan and benomyl at intervals wider than recommended for adequate control. For successful control captan must be used at intervals of 7 to 10 days throughout the season including cover sprays since it has a short half-life and is sensitive to ultra-violet light. Dodine and benomyl, for cover sprays, can be used at wider intervals than captan, but if used beyond a 14 day interval an unnecessary risk is assumed.

Orchards and Vineyards

Finally, it may be worth considering more specific wording of spray recommendation procedures for pear black spot control in New Zealand than are presently found (N.Z. Department of Agriculture, N.Z. Ministry of Agriculture and Fisheries, N.Z. Fruitgrowers Federation 1970-71, to 1973-74).

Emphasis could be made especially on the importance of close-interval spraying, regardless of the nature of the fungicide, and of the particular need to spray pears at least once before waiting for advanced bud movement on apples, which develop later than pears.

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