Control of core rots in red delicious apples

AP011

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Tasmanian Department Primary Industry & Fisheries
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1. Summary

1.1 Industry Summary

In some years, losses of up to 20% due to core rots have been recorded in Red Delicious from a number of Australian orchard centres including southern Tasmania, Victoria and New South Wales.

In 1992 approximately 36% of the Australian apple crop consisted of Delicious and Red Delicious. At present the major Australian markets pay a premium for Red Delicious, therefore the Industry reconstruction has been based on this variety. However according to leading Tasmanian producers, consumer resistance was increasing due to the presence of core rots. Consignments were returned by retailers in Brisbane, Sydney and Singapore.

This project to control core rots in Red Delicious was commenced in 1985/86 with some funds being provided by the Apple and Pear Industry Research Fund in 1986/87 and 1987/88. Since 1988/89, the HRDC has supported the project by providing operating expenses each year.

The early years of the project confirmed that field infections occur at blossom time. The fungi then enter the core cavity via the open calyx tube and later penetrate the fruit tissue. These early years also confirmed that the incidence for core rots varied greatly from orchard to orchard. In 1988 it was established that core rots after long term coolstorage were caused mainly by *Pezicula* spp as well as species of *Alternaria* and the related genera of *Stemphylium* and *Ulocladium*.

In 1988/89 the research program established that an 8 spray program over the blossom period combining Rovral and Benlate reduced core rot to an insignificant level in three commercial orchards. Further studies established that three sprays up to and including full bloom gave results comparable to the eight spray program as later sprays were not effective. The last two years of the research project established that two sprays (of Benlate and Rovral) at late pink and full bloom gave a 77% reduction in the incidence of core rots.
This latter finding was incorporated into the Departments spray chart in 1991/92 and since adopted by 80% of the Tasmanian Apple Industry (See section 2.1 of this report).

1.2 Technical Summary

Preliminary research established that core rots after long term coolstorage were caused mainly by *Pezicula* spp as well as species of *Alternaria* and the related genera of *Stemphylium* and *Ulocladium*. It is also established that core rots after short term storage (4 weeks) was mainly due to *Alternaria* which was controlled by blossom sprays of Rovral (iprodione).

As Rovral alone did not control core rots from long term storage, the 1988/89 program studied fungicide combinations which would target the *Pezicula* groups of fungi as well as the *Alternaria* complex. Eight weekly spaced sprays commencing at pink bud were applied to ensure that incorrect timing (of a lesser number of sprays) did not confound the results. A spray program combining iprodione (Rovral) and benomyl (Benlate) reduced core rot from an average of 5.7% in three commercial orchards to an average of 0.7%.

The 1989/90 program was designed to establish which of the 8 sprays were most effective so that a two or three spray program could be established as a commercial recommendation. Success of the eight spray program was found to be due mainly to sprays applied early in the flowering period. In two orchards three sprays of a mixture of Benlate and Rovral applied at the Pink, 50% Petal Fall and 100% Petal Fall stages reduced core rots by 62% and 76%. A fungicide mixture of Ronilan and Bavistin gave results very similar to that of the Benlate and Rovral mixture. The three early-sprays of Benlate plus Rovral program give results comparable to the eight sprays program. Sprays applied from calyx onwards were not effective. In a third orchard, except for the 8 spray program, all other spray programs did not control core rot significantly. The lack of core rot control in this orchard appeared to be due to a incidence of core rots caused by a basidiomycete that is insensitive to the fungicide mixture used.

The last two years of the project concentrated on establishing a commercially acceptable program of two sprays.

In the 1990/91 season, 2 sprays (at pink and full bloom) were not as effective as anticipated due to have an interval of 21 days between them. Therefore in 1991/92 the two sprays program started at late pink with an interval of 7-10
days to full bloom. This treatment achieved a 77% reduction in the incidence of core rots and has been recommended to industry in Newsletters and the annual Spray Chart.

2. Recommendations

As the Tasmanian Apple Industry was desperate to overcome market problems caused by core rots, the researchers were approached for interim recommendations for the 1990 fruit season. Interim Recommendations were given in the Departments basic Spray Plan for apples and pears for 1990/91, 1991/92 and 1992/93.

The interim recommendations were also made available to Australia's largest apple exporter (Chilton Thompson) who circulated them to their growers. Similar information was supplied to all Tasmanian apple growers in articles in the Pome Fruits Newsletter. Some of these were reprinted in mainland industry newsletters.

The final recommendation or conclusion of this project is as follows:

_Core Rot (Alternaria and Pezicula spp) Sprays:_
Iprodione plus benomyl as a combined spray for reduction of apple core rot. Two applications at late pink and full bloom.
Rate: Iprodione at 100 g registered product/100L and benomyl at 50g registered product/100L plus 100 mL wetting agent/100L.

2.1 Adoption by Industry of research findings

According to Mr G Merchant, Chairman, Tasmanian Licensed Fruit Exporters Association, at least 80% of the Tasmanian apple industry has implemented the recommendation from the Core Rot Project. Under field conditions these recommendations have provided effective commercial control of core rots.

2.2 Directions of Future Research

The research completed has provided a commercial control method for decreasing core rot significantly. There is still a percentage of rot caused principally by a basidiomycete fungus which cannot be controlled by the current control method.

In addition, the industry now advises that it prefers the core rot incidence to be reduced to zero or near zero level for competitive market advantages.
To accomplish the above, future research should consider the following.

(a) Identify the basidiomycete(s) causing core rot. The basidiospores infecting the blossoms are suspected to be from mushrooms/toadstools in the orchard floor. Control measures for the mushroom/toadstools on the ground or for preventing infections of blossoms need to be investigated.

(b) Identify the orchard factors that reduce core rot incidence. (Some orchards appear not to have a high level of core rots and reasons for this are not understood. For example, are locations, rainfall levels and vegetation types around the orchard important?).

(c) Determine the importance of orchard hygiene in reducing core rots. For example, how significant is removal of fruit from the orchard floor and applications of fungicides on trees in winter in reducing disease inoculum and core rot incidence.

(d) Investigate the possibility of limil (hydrated lime) in combination with Benlate and Rovral sprays for further reduction of core rots. (In the 1991/92 results, Limil was found to have potential in reducing core rot, due probably to its high pH effects on spores in lowering disease inoculum).

(e) Investigate Topsin as a substitute for Benlate.

(f) Investigate methods of detecting apples with core rots during packing by X-rays, ultrasound, etc and removing the affected fruit by a kick-trigger device on the conveyor belt. (This method is likely to be expensive. It may remove most infected fruits but incipient rots may not be detected. Incipient rots may develop to unacceptable core rot in the interval between packing and sale).

2.3 Financial benefits from adoption of research findings.

It is difficult to put a dollar value on the benefits from adopting core rot recommendations for the Australian Apple Industry as the significance of core rots varies from state to state.
However the potential loss and thus the benefit of adopting recommendations for the Tasmanian apple industry can be calculated as follows:

1992 Red Delicious production = 1,150,000 cartons
Assuming 85% packed = 977,500 cartons for dessert quality
Assume presence of core rots results in 10% being rejected by markets and remainder suffering a 20% price discount on an average gross price of $20 per carton

\[
\begin{align*}
\text{Loss from 10% rejection} &= 97,750 \times 20 = $1.955m \\
\text{Loss from 20% price reduction} &= 879,750 \times 4 = $3.519m \\
\text{Total} &= $5.474.
\end{align*}
\]

The nett total is calculated by deducting the cost of applying recommended sprays at say 20c/carton = $230,000

\[
\text{Nett 'Value' of core rot recommendations in controlling core rot per annum} = $5.244m
\]

3. Technical Report

3.1 Introduction

Core rots in Tasmanian Red Delicious apples have been of concern to the industry for many years. At present the major Australian and overseas markets pay a premium for quality Red Delicious, and reconstruction of the Tasmanian industry has been based on this variety. However, according to leading Tasmanian producers and exporters, consumer resistance was increased by the presence of core rots.

Core rots in apples have been recorded in most apple growing countries including Australia, Canada, Europe, India, New Zealand, U.S.A. and South Africa (Comrink et al 1984). Losses have been as high as 20% in some lines of Red Delicious in Victoria and South Africa (Washington, 1982 and Combrink and Ginsberg, 1973), 75% in New Zealand (Atkinson, 1971) and 50% in the United States (Ellis, 1980).

A survey of the literature indicates that several fungi can be associated with core rots (Atkinson 1971; Combrink and Ginsberg 1973; Northover, 1975; Brown and Hendrix 1978; Ellis 1980; Washington 1982; Kennel 1983). It has been suggested that fungal spores land on the blossoms which are progressively colonized as the flower senesces.
The fungi then enter the core cavity via the open calyx tube and later penetrate the fruit tissue after fruit-set.

There is general agreement that there are two kinds of core rots, namely dry core rot and wet core rot. Dry core rot is a field infection that leads to a slow dry rot. Wet core rot is a rapidly developing soft rot caused by several types of fungi (Washington, 1982; Combrink, 1983). A number of studies have been made on the etiology of core rots in recent years (Ellis and Barratt, 1983; Combrink, 1983, Kennel, 1983; Spotts et al 1988 b). The most common dry core rot is caused by *Alternaria* spp.

Wet core rots results mainly from infections by soft-rotting fungi such as *Penicillium*, *Mucor*, *Rhizopus* etc. Wet core rot is less frequent in the field. It is often seen in apples in storage, and is known to be greatly increased when a post-harvest dip treatment in given (Combrink and Ginsberg, 1973; Combrink *et al*, 1987; Spotts *et al* 1998 a, 1988 b).

The approach attempted generally for the control of core rots that occurs in the field has been by fungicide sprays. However the effectiveness of fungicide sprays applied during the blossom period has been variable. Kennel (1983) found that fungicides applied at flowering were ineffective in core rots caused by predominantly *Alternaria* spp. Kock et al (1991) obtained significant reductions in both dry (mainly *Alternaria*) and wet (mainly *Penicillium*) core rots from three fungicides (prochloraz, captan and iprodione) in one season. In the following year only one fungicide (prochloraz) was effective of the following tested: prochloraz, captan, iprodione, terbucnazole and CGA 169374 and captan). They applied five sprays at 35% full bloom (FB), at FB, 75% petal fall, one week later (FB+1) and two weeks later (FB+2).

By applying two sprays (25% and 75% FB) Brown and Hendrix (1978) obtained significant reductions in *Alternaria* core rot with maneb, benomyl, folpet, captafol, captan, chlorothalonil and thiophanate -methyl. Ellis and Barratt (1983) tested a number of fungicides (benomyl, dodine, dikar) and fungicide combinations (benomyl plus captan, benomyl plus mancozeb) from green tip to 8th cover but none were satisfactory in reducing mouldy core.
3.2 Materials and Methods

i Materials

The fungicides used are given below

<table>
<thead>
<tr>
<th>Fungicide</th>
<th>Active Ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benlate 50% WP</td>
<td>benomyl</td>
</tr>
<tr>
<td>Rovral 50% WP</td>
<td>iprodione</td>
</tr>
<tr>
<td>Baycor 30% WP</td>
<td>bitertanol</td>
</tr>
<tr>
<td>Topsin 75% WP</td>
<td>thiophanate methyl</td>
</tr>
<tr>
<td>Ronilan 50% WP</td>
<td>vinclozolin</td>
</tr>
<tr>
<td>Bavistin 50% WP</td>
<td>carbendazim</td>
</tr>
<tr>
<td>Limil</td>
<td>calcium hydroxide</td>
</tr>
<tr>
<td>Bromuconazole</td>
<td>bromuconazole</td>
</tr>
</tbody>
</table>

All fungicides were applied at the rate of 1 kg/1000L except where otherwise indicated. The surfactant TWEEN 20 was added to all sprays at 1L/1000L. In 1991/92 FL formulations of Ronilan and Bavistin were included at 1L/1000L and bromuconazole at 300 ml/1000L.

In 1988/89 the research program consisted of eight sprays applied at weekly intervals commencing at pink bud. The various 8 spray combinations were water (control), Rovral, Rovral and Benlate, Rovral and Baycor, Baycor and Benlate. The other treatment consisted of three Benlate sprays applied at 25% bloom, full bloom and five weeks after full bloom.
The spray treatments applied in 1989/90 are listed in Table 1.

Table 1 - Details of Fungicides Applied in 1989/90

<table>
<thead>
<tr>
<th>Code</th>
<th>No.</th>
<th>Treatment</th>
<th>Actual Application Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (1)</td>
<td>3</td>
<td>Water</td>
<td>Early Pink</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>Rovral + Benlate</td>
<td>50% Petal Fall (PF), 100% PF</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>Rovral + Benlate</td>
<td>Weekly from early pink</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>Rovral + Benlate</td>
<td>EP, 50% PF, 100% PF</td>
</tr>
<tr>
<td>E</td>
<td>2</td>
<td>Rovral + Benlate</td>
<td>Calyx + 1 wk + 2 wk</td>
</tr>
<tr>
<td>F (2)</td>
<td>2</td>
<td>Rovral + Benlate</td>
<td>50% PF, 100% PF</td>
</tr>
<tr>
<td>G</td>
<td>3</td>
<td>Ronilan + Bavistin</td>
<td>50% PF, 100% PF</td>
</tr>
<tr>
<td>H</td>
<td>2</td>
<td>Ronilan + Bavistin</td>
<td>Early pink, 50% PF, 100% PF</td>
</tr>
</tbody>
</table>

Notes: (1) The no fungicide treatment received three sprays of water
       (2) Benlate for this treatment applied at half rate i.e. 0.5kg/1000 L

In 1990/91 the spray program detailed in Table 2 was applied to two of the three commercial orchards. On the third orchard instead of treatment B, three Benlate and Rovral sprays were applied at pink, full bloom and 50% petal fall.

Table 2

Details of fungicides applied in 1990/91

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Application Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Water</td>
</tr>
<tr>
<td>B</td>
<td>8 (Benlate &amp; Rovral) sprays</td>
</tr>
<tr>
<td>C*</td>
<td>3 (Benlate &amp; Rovral) sprays at reduced rates</td>
</tr>
<tr>
<td>D*</td>
<td>3 (Bavistin + Ronilan) sprays at reduced rates</td>
</tr>
<tr>
<td>E</td>
<td>1 (Benlate &amp; Rovral) spray</td>
</tr>
<tr>
<td>F</td>
<td>2 (Benlate &amp; Rovral) sprays</td>
</tr>
<tr>
<td>G</td>
<td>1 (Bavistin + Ronilan) spray</td>
</tr>
<tr>
<td>H</td>
<td>2 (Bavistin + Ronilan) sprays</td>
</tr>
</tbody>
</table>

Note: *These two sprays were applied at half rate i.e 0.5 kg/1000L
In 1991/92 two sprays of the following materials were applied at late pink and full bloom: water, Benlate, Rovral, Benlate and Rovral, Topsin and Rovral, Ronilan and Bavistin, Limil, bromuconazole. In addition a spray treatment of one application of Benlate and Rovral was applied at full bloom.

ii Methods

In each year two-tree plots of Red Delicious were selected in three commercial orchards in Southern Tasmania and were replicated five times. Sprays as detailed above, were applied by hand lance to run-off. Each sprayed pair of trees was buffered on all side to minimise any possibility of spray drifting to neighbouring treatments.

The two-tree plots were harvested during the third week of March providing between 300 and 400 apples per plot. All samples were placed in a conventional coolstore at 1°C on the day they were harvested. They were removed early in August (after about 20 weeks storage) and held at ambient temperatures for a week before rot assessment.

Rots were assessed by cutting the apples transversely and scoring for core rots that have extended into the flesh from the carpel walls. Fruits in which only the core cavity area was colonised were designated "non-invasive mouldy core" and not considered a core rot.

Results and Discussion

(i) 1988/89 season

Results in Table 3 highlight the effectiveness of 8 sprays of a combination of Benlate and Rovral which reduced core rots to commercially insignificant levels in all 3 orchards. In Orchard H, core rots were reduced from 6.47% to 0.27% in orchard S from 4.78 to 0.41% and in Orchard C from 5.9% to 1.29%.

It is interesting to note that Rovral alone or Benlate alone at 8 sprays did not provide a consistent result. In Orchard H, iprodione significantly decreased core rot, but benomyl gave no significant control. In Orchards S & C, benomyl provided significant control, whereas iprodione did not. The inconsistencies at first appeared puzzling but they can be explained when it is realised that the relative occurrence of Alternaria and Pezicula core rots can vary from orchard to orchard. In Orchard H, for example, Alternaria core rot was found to be more predominant. One would then expect iprodione to provide good core rot control, and that benomyl would not provide control as it is ineffective against Alternaria. In Orchards S and C, the situation was reversed, with Pezicula core rots.
rot the predominant rot; hence use of benomyl was more effective, whereas use of iprodione was not. It is possible that the use of Benlate could increase the incidence of *Alternaria* rot (Orchard H) due to the removal of competition provided by fungi which are sensitive to Benlate.

The strategy for using a combination of fungicides to simultaneously control both *Alternaria* complex and *Pezicula* spp provided the breakthrough needed to control core rots reliably.

(ii) 1989/90

The effect of fungicide treatments on the incidence of core rots is summarised in Table 4. Eight sprays of Rovral plus Benlate starting at pink bud (Treatment B) gave good core rot control in all three orchards confirming the results obtained in the 1988/89 season (Wong *et al*, in press). The extent of significant reduction in core rots, compared with untreated, varied from orchard to orchard. This ranged from a 76% reduction for Orchard S, 71% for Orchard H but only 37% for Orchard C.

In Orchards H and S there was no statistically significant difference in the incidence of core rots between three sprays of Rovral plus Benlate applied at pink, 50% petal fall and 100% petal fall (Treatment C) and the eight sprays program. The results obtained from the three early sprays programs were significantly different from the untreated controls. However when three sprays were applied later (calyx, calyx + 1 week, calyx + 2 weeks) (Treatment D) there was no significant control of core rots.

Ronilan plus Bavistin mixture used as a three early spray program (Treatment G) controlled core rots significantly in Orchard H, and gave results comparable to the corresponding Rovral plus Benlate treatment. The three early sprays with Ronilan plus Bavistin, however, did not give significant control of core rots in Orchard S.

Treatment E was generally not successful in controlling core rot. The only statistically significant difference was observed for the Rovral plus Benlate treatment in Orchard S. Halving the amount of Benlate used (Treatment F) decreased core rot control marginally compared to the full strength Benlate treatment (Treatment E) but there was no statistical difference between the two treatments.
The predominant fungi observed in the core rots in Orchards H and S were found to be due to *Pezicula* spp. and *Alternaria* spp.

In orchard 3 as in the other two orchards the eight spray treatments provided significant core rot control. All other treatments in this orchard however did not give significant control of core rots. In this orchard, *Pezicula* spp. and *Alternaria* complex types of core rot were common but there was also a high incidence of a wet core rot caused by an as-yet unidentified basidiomycete which was insensitive to the fungicides applied.

The present studies demonstrated that the success of the eight sprays program is due to sprays applied at the early flowering stages where *Alternaria* and *Pezicula* are the pathogens identified as responsible for core rots. Three sprays applied up to 50% petal fall gave similar control to that achieved from the full eight sprays program for the control of both groups of pathogens in two of the three orchards. Rovral (or Ronilan) and Benlate (or Bavistin) controlled *Alternaria* complex and *Pezicula* spp. respectively.

As expected, two sprays (at 50% PF and 100% PF) were intermediate between the three sprays treatment and that without sprays. This treatment provided a much lesser degree of core rot control as there was no protection prior to the 50% PF, and the second spray (at 100% PF) was probably applied too late to have a significant effect. The three sprays treatment started at early pink bud which was 17 days before 50% PF and covered a period of 22 days. The most effective treatment (8 sprays) had 4 of the sprays applied at weekly intervals during the 22 days period.

(iii) 1990/91

Results for the 1990/91 seasons program were disappointing (Table 5). Only the 8 spray program produced a significant reduction in core rots for both orchards H and S. The treatment was not applied to orchard C.

A check of trial spray records revealed that the pink bud sprays were applied at a very early stage leaving a gap of 21 days between the pink bud and full bloom sprays. The authors surmised that the pink bud spray had been too early and therefore was ineffective.

Therefore the 1991/92 program was based on an initial spray at late pink which meant that the gap between this spray and full bloom was only 7-10 days.
(iv) 1991/92 season

The combination of Benlate and Rovral at late pink and full bloom reduced core rots by 82%, 72% and 57% of untreated controls in orchards C, S & H respectively. The smaller improvement in Orchard H is thought to be related to the relatively low level of infection in untreated fruit - approximately one third of the incidence in orchards S and C. Similar results were obtained from combinations of Topsin and Rovral and Ronilan and Bavistin.

Rather surprisingly the sprays of Benlate alone produced core rot levels which were not significantly different from Benlate and Rovral treatment. This was probably due to the *Pezicula* type of core rot being more frequent in the 1991/92 season. Conversely Rovral alone did not produce as great a reduction as Benlate since it targets the *Alternaria* complex.

Limil also gave a significant reduction in core rots for orchards S & C but further studies would be necessary to establish its potential (probably in conjunction with one fungicide), as a control option. The new fungicide tested (bromuconazole) was not as effective as mixtures of Benlate and Rovral (or equivalent mixtures).

Another component feature of the 1991/92 result was the relatively low level of core rots in untreated fruit from orchard H. There had been a steady reduction in core rot from this orchard since the 1988/89 season when 6.5% was recorded. The authors consider this due to improved hygiene and the use of the recommended Benlate + Rovral treatment on all trees outside the trial block.

Thus the 1991/92 program indicated that 2 sprays of Benlate + Rovral at late pink and full bloom will provide commercial control of core rots. This research result has been supported by commercial experience during the 1991/92 season. The only orchards where core rots were a problem were those where the recommended sprays were not applied.

**Acknowledgements**

We wish to acknowledge the support of the Apple and Pear Industry Research Fund which provided operating expenses for the 1986/87 and 1987/88 studies, and the Horticultural Research and Development Corporation for the 1988/89 studies. The cooperation of the three orchardists, C. Hansen, M. Salter and P. Calvert from whose properties samples were collected was greatly appreciated. Technical assistance was provided by Messrs A. Dix, B. Russell, M. Oakford and P. Schupp at all stages of the project.
References


16
Table 3

Effect of fungicide treatments on Incidence of total core rots 1988/89 season.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Incidence of Core Rots (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Orchard H</td>
</tr>
<tr>
<td>Rovral &amp; Benlate, 8 Sprays</td>
<td>0.27a</td>
</tr>
<tr>
<td>Rovral &amp; Baycor, 8 Sprays</td>
<td>2.61b</td>
</tr>
<tr>
<td>Rovral, 8 sprays</td>
<td>3.43b</td>
</tr>
<tr>
<td>Baycor, 8 sprays</td>
<td>5.37c</td>
</tr>
<tr>
<td>Benlate, 8 sprays</td>
<td>5.78c</td>
</tr>
<tr>
<td>Benlate, 3 sprays</td>
<td>9.17d</td>
</tr>
<tr>
<td>Untreated</td>
<td>6.47c</td>
</tr>
<tr>
<td>Predominant rot organisms</td>
<td>Alternaria</td>
</tr>
<tr>
<td></td>
<td>complex</td>
</tr>
</tbody>
</table>

* Means with a common letter within the same column do not differ significantly at P = 0.05 using Duncans New Multiple Range Test on square root transformed data.
Table 4
Effect of Fungicide Treatments on Incidence of Total Core Rots 1989/90 Season.

<table>
<thead>
<tr>
<th>Code</th>
<th>Fungicides</th>
<th>No of sprays</th>
<th>Application time</th>
<th>Orchard H</th>
<th>Orchard S</th>
<th>Orchard C</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Rovral + Benlate</td>
<td>8</td>
<td>Weekly spray from pink</td>
<td>1.05a</td>
<td>0.82ab</td>
<td>2.64a</td>
</tr>
<tr>
<td>C</td>
<td>Rovral + Benlate</td>
<td>3</td>
<td>Early pink, 50% petal fall, 100% petal fall</td>
<td>1.37a</td>
<td>0.82ab</td>
<td>2.90ab</td>
</tr>
<tr>
<td>G</td>
<td>Ronilan + Bavistin</td>
<td>3</td>
<td>Early pink, 50% petal fall, 100% petal fall</td>
<td>1.52a</td>
<td>1.96bcd</td>
<td>4.36cd</td>
</tr>
<tr>
<td>H</td>
<td>Ronilan + Bavistin</td>
<td>2</td>
<td>50% petal fall, 100% petal fall</td>
<td>1.76ab</td>
<td>2.61cd</td>
<td>3.19abc</td>
</tr>
<tr>
<td>F*</td>
<td>Rovral + Benlate</td>
<td>2</td>
<td>50% petal fall, 100% petal fall</td>
<td>1.90ab</td>
<td>2.90cd</td>
<td>4.85d</td>
</tr>
<tr>
<td>E</td>
<td>Rovral + Benlate</td>
<td>2</td>
<td>50% petal fall, 100% petal fall</td>
<td>2.12ab</td>
<td>1.86abc</td>
<td>4.69cd</td>
</tr>
<tr>
<td>D</td>
<td>Rovral + Benlate</td>
<td>3</td>
<td>Calyx, Calyx + 1 wk, Calyx + 2 wks</td>
<td>3.22b</td>
<td>3.08cd</td>
<td>2.73ab</td>
</tr>
<tr>
<td>A</td>
<td>NIL</td>
<td>0</td>
<td>-</td>
<td>3.62b</td>
<td>3.48d</td>
<td>4.21bcd</td>
</tr>
</tbody>
</table>

Means with the same letter do not differ significantly at P=0.05 using Duncan’s New Multiple Range Test on Log transformed data.

* Benlate at half rate (0.5 kg per 1000L).
Table 5

Effect of Fungicide Treatments on Incidence of Total Core Rots - 1990/91

<table>
<thead>
<tr>
<th>Code</th>
<th>Fungicides</th>
<th>No. of sprays</th>
<th>Orchard H</th>
<th>Orchard S</th>
<th>Orchard C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Nil</td>
<td>3 water sprays</td>
<td>2.85 c</td>
<td>7.64 d</td>
<td>13.24 c</td>
</tr>
<tr>
<td>B</td>
<td>Rovral, Benlate</td>
<td>8</td>
<td>1.26 a</td>
<td>3.46 a</td>
<td>-</td>
</tr>
<tr>
<td>C*</td>
<td>Rovral, Benlate</td>
<td>3</td>
<td>2.17 abc</td>
<td>4.20 ab</td>
<td>9.68 abc</td>
</tr>
<tr>
<td>D</td>
<td>Ronilan, Bavistin</td>
<td>3</td>
<td>1.43 ab</td>
<td>6.14 bcd</td>
<td>12.72 bc</td>
</tr>
<tr>
<td>E</td>
<td>Rovral, Benlate</td>
<td>1</td>
<td>2.44 bc</td>
<td>5.26 abc</td>
<td>9.56 abc</td>
</tr>
<tr>
<td>F</td>
<td>Rovral, Benlate</td>
<td>2</td>
<td>1.79 abc</td>
<td>4.34 abc</td>
<td>8.9 abc</td>
</tr>
<tr>
<td>G</td>
<td>Ronilan, Bavistin</td>
<td>1</td>
<td>2.06 abc</td>
<td>6.31 cd</td>
<td>10.22 abc</td>
</tr>
<tr>
<td>H</td>
<td>Ronilan, Bavistin</td>
<td>2</td>
<td>1.93 abc</td>
<td>4.43 abc</td>
<td>8.16 ab</td>
</tr>
<tr>
<td>J</td>
<td>Rovral, Benlate</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>5.70 a</td>
</tr>
</tbody>
</table>

Means with the same letter do not differ significantly at $P = 0.05$ using Duncan's New Multiple Range Test on Square Root transformed data.

*Both fungicides each at 0.5kg per 1,000L. All other treatments at 1 kg per 1,000L.
### Table 6

Effect of Fungicide Treatments on Incidence of Total Core Rots - 1991/92

<table>
<thead>
<tr>
<th>Code</th>
<th>Fungicides</th>
<th>No. of sprays</th>
<th>Orchard H</th>
<th>Orchard S</th>
<th>Orchard C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Nil</td>
<td>2</td>
<td>1.50 bc</td>
<td>4.19 e</td>
<td>4.78 d</td>
</tr>
<tr>
<td>B</td>
<td>Benlate</td>
<td>2</td>
<td>1.52 bc</td>
<td>1.46 a</td>
<td>1.50 a</td>
</tr>
<tr>
<td>C</td>
<td>Rovral</td>
<td>2</td>
<td>1.35 abc</td>
<td>2.99 d</td>
<td>2.97 bc</td>
</tr>
<tr>
<td>D</td>
<td>Benlate, Rovral</td>
<td>2</td>
<td>0.86 abc</td>
<td>1.20 a</td>
<td>0.90a</td>
</tr>
<tr>
<td>E</td>
<td>Topsin, Rovral</td>
<td>2</td>
<td>0.74 a</td>
<td>1.52 ab</td>
<td>1.43a</td>
</tr>
<tr>
<td>F</td>
<td>Ronilan, Bavistin</td>
<td>2</td>
<td>0.77 ab</td>
<td>2.21 bcd</td>
<td>1.73 ab</td>
</tr>
<tr>
<td>G</td>
<td>Benlate, Rovral</td>
<td>1</td>
<td>1.04 abc</td>
<td>1.98 abc</td>
<td>1.75 ab</td>
</tr>
<tr>
<td>H</td>
<td>Limil</td>
<td>2</td>
<td>1.69 c</td>
<td>2.52 cd</td>
<td>1.74 ab</td>
</tr>
<tr>
<td>I</td>
<td>Bromuconazole</td>
<td>2</td>
<td>1.56 bc</td>
<td>2.92 cd</td>
<td>3.40 c</td>
</tr>
</tbody>
</table>

Mean with the same letter do not differ significantly at P = 0.05 using Duncan's New Multiple Range Test on Square Root transformed data.