TAMARILLO STORAGE ROT PROBLEMS

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SUMMARY

On three commercial orchards tamarillos were sprayed from late October to April, at three weekly intervals using recommended rates, of the fungicides dinocap, triforine, triadimefon and mancozeb plus dinocap. All failed to provide satisfactory control of storage rots. Fruit rejection was between 20-56% following simulated export storage conditions of 2 and 10 weeks at 4°C then 1 or 2 weeks at ambient temperature. Four fungi, *Glomerella cingulata*, *Phoma exigua*, *Colletotrichum acutatum* and *Diaporthe phaseolorum*, were isolated from tamarillo fruit following storage.

INTRODUCTION

Tamarillos (*Cyphomandra betacea*) are grown in frost-free areas in New Zealand, with approximately 50% of the New Zealand crop grown in Northland. At present most tamarillo fruit are sold on the local market, with some attempts to establish export markets. To date, exports have been mainly to Australia and the USA, with an average of 40 t/year exported in small consignments by air freight.

For the tamarillo to develop as a large volume export crop, it is vital that the storage life of the fruit be improved to enable consignment of large quantities and allow the crop to be exported more cheaply using sea freight.

Tamarillos can be stored for at least 10 weeks following a hot water dip (50°C for 10 minutes) followed by a wax fungicide dip for 1 minute (Harman and Patterson 1982). The hot water dip is not considered practical in a commercial sense, as the tamarillo does not float, and hence packing lines would be difficult to operate.

In addition to post-harvest treatments grower application of fungicide sprays has been suggested as a way of preventing the establishment of fungal infections which cause storage rots. Mancozeb applied at regular intervals was recommended to growers in the Kerikeri district to prevent storage rots (Patterson pers comm).

This study investigated the efficiency of mancozeb sprayed at regular intervals in controlling storage rots, and whether other fungicides, applied for powdery mildew (*Erysiphe cichoracearum*) control, could also reduce the incidence of storage rots.

MATERIALS AND METHODS

This study was part of a larger trial investigating the efficacy of a number of tamarillo spray programmes in the 1981/82 season. There were two sites in Kerikeri, and one in Whangarei, each with mature blocks of red tamarillos. At each site there was a randomised block of eight treatment plots plus unsprayed plots, with each plot being at least three plants wide, and six plants deep, with guard trees between plots.

The treatment plots were sprayed with a mixture of a fungicide and an insecticide as described by Olson *et al* (1983). The fungicide treatments were triforine (Saprol 19 EC) 19 ml ai/100 litres, triadimefon (Bayleton 10 EC) 2.5 ml ai/100 litres, dinocap (Karathane 18.5 WP) 18.5 g ai/100 litres, and mancozeb (Dithane M45 80 WP) 120 g ai/100 litres. Triforine, triadimefon and dinocap were applied at either 3 or 6 weekly intervals to a plot at each site. The mancozeb was applied in combination with dinocap

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at 3 weekly intervals to one plot at two sites, and two plots at one site. Spray applications commenced in late October 1981 and finished in April or May depending on the crop maturity at each site.

Fruit was harvested and graded into two maturity classes; suitable for short term storage as for air freight, and long term storage for sea freight. Fully-red fruit with the calyx starting to lighten in colour, and yellow skin under the calyx lobes, being selected for short term storage. Red fruit, but with a 1-3 mm purplish band around the calyx, was selected for long-term storage. The brix, as measured by a refractometer, and the pH, as measured by a pH meter, of the tamarillo juice from the two storage classes were assessed.

Prior to packing, the fruit stalks were clipped to 5-10 mm above the calyx. The fruit was packed into plix (pocket packs) trays in single layer cardboard trays (as used by N.Z. Apple and Pear Marketing Board) with a polythene liner. The fruit was then stored at $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for 2 or 10 weeks. After storage the fruit was held at ambient temperature for 7 days to simulate the export retailing procedure, before rots were assessed.

The fungi associated with the fruit rots were determined from a representative selection of rotten fruit. Isolates from the fruit were plated onto prune extract agar amended with the same fungicides used in the field trials at five concentrations, 0.1, 1, 10, 100 and 1,000 ppm.

RESULTS

Fruit selected for short-term storage had a higher brix and pH compared with the long-term storage fruit, with brix percentages of 9.6 and 9.0 respectively and pH values of 3.6 and 3.5 respectively.

All treatments had a high rejection rate of fruit because of storage rots after both the 2 and 10 week cool storage intervals (Table 1). The mancozeb and untreated fruit had fewer fruit rejected (20-24%) than the other fungicide treatments (33-56%) but there was no significant difference between treatments.

TABLE 1: The effect of four fungicides applied as sprays at regular intervals during the 1982 season on tamarillo storage. Rejection of fruit due to fungal rots after simulated export storage.

Fungicide and application interval		Percentage fruit rejected	
		2 weeks at 4°C plus 15 days ambient	10 weeks at 4°C plus 7 days ambient
mancozeb + dinocap	3 weekly	20	24
dinocap	3 weekly	36	49
	6 weekly	33	35
triadimefon	3 weekly	46	41
	6 weekly	47	56
triforine	3 weekly	34	39
	6 weekly	38	33
untreated		22	21

It was noticeable when examining the fruit, that the mancozeb-treated fruit had a shiny yellow calyx, compared with the other treatments, where the calyx was a dull green or black.

Four fungal organisms were isolated from the rejected fruit following storage. The symptoms expressed and the organisms associated with them were:—

- (a) Grey white cottony mycelium, mostly superficial on the stem end of the fruit. Two organisms were consistently present, *Phoma exigua* and *Glomerella cingulata*.

- (b) Circular brown depressed spots up to 10 mm diameter and often confluent. Two organisms were associated with these to differing degrees, *Glomerella cingulata* (85%) and *Colletotrichum acutatum* (15%).
- (c) Irregularly shaped white spots, not depressed to 15 mm diameter, from which *Diaporthe phaseolorum* was consistently isolated.

The effect of the fungicides, in inhibiting fungal growth on agar plates, was similar on all of the four fungi isolated from the rotten tamarillos. Triadimefon was most effective in giving an ED₅₀ value for inhibition of hyphal growth of 0.1-1 ppm. Dinocap was the next most effective with an ED₅₀ value from 1-10 ppm. Triforine gave variable ED₅₀ results from 1-100 ppm depending on the organism. Mancozeb was the least effective with ED₅₀ values 100-1000 ppm.

DISCUSSION AND CONCLUSIONS

Ripe rot latent infection caused by slime spore fungi are common on many plants and may prejudice successful storage and marketing (Mordue 1971). Spores of these fungi germinate and penetrate the fruit lenticels within which they remain dormant while the fruit is actively growing. During ripening the latent infections become aggressive, and develop into fruit rots (Viennot-Bourgin 1966). This study has shown that none of the fungicide treatments applied at regular 3 weekly intervals during the growing season will give satisfactory control of fungal rots of tamarillos. The high levels of fruit rejection were not acceptable even following storage of only 2 weeks. This suggests that latent infections are responsible for these rots, as the fruit was free of visible blemishes prior to storage.

The reason for the failure of sprays to prevent rots could be due to the fungicides being ineffective at controlling spore germination and growth, or they were applied after latent infections had been established. The lack of control could also be attributed to the spray interval of 3 weeks being too long, removal of fungicide protection by rainfall, or through handling during picking and packing.

Laboratory evaluations suggest that mancozeb was relatively ineffective against the fungi isolated from tamarillos, namely *G. cingulata*, *P. exigua*, *C. acutatum* and *D. phaseolorum*. This finding is consistent with a recent laboratory study investigating the same fungal rot organisms on kiwifruit (*Actinidia chinensis*) (Hawthorne and Reid 1982). While the fungicides used primarily for powdery mildew control were more effective in the laboratory studies than mancozeb, they did not, however, give improved protection in the field.

The moist microclimate created within the packed fruit by the polythene liner, following the removal from the cool store, would also assist fruit rot development.

Large scale exports of tamarillos should not be encouraged until storage rots can be markedly reduced. This study has not provided any solution to the prevention of storage rots in tamarillos. Field protection may yet prove to be a viable option as a number of fungicides have activity against the rot organisms (Hawthorne and Reid 1982). An investigation of timing and alternative materials is currently in progress. Further work is also required to understand the mechanism of infection, and the role of packaging in rot development.

The current method of exporting tamarillos in small quantities and using air freight, is the only safe option available unless either post-harvest or orchard spray treatments can be markedly improved.

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