OIL SPRAYS AND KIWIFRUIT STORAGE

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SUMMARY

Mineral oils are currently not recommended for pest control on kiwifruit close to harvest because severe fruit drop has occurred after oil application. Shell Sunspray was applied to kiwifruit 1 week before harvest, at 0.5%, 1.0%, 2.0% and 4% concentrations, with no subsequent fruit drop, even when used at the highest concentration. Long term storage of the fruit was not detrimentally affected; fruit sprayed with oil ripened more slowly in storage than did untreated fruit. These findings on close-to-harvest oil applications could assist both the organic production of kiwifruit, and the production of fruit with low levels of pesticide residues, because mineral oils have been shown to provide effective control of armoured scales.

Keywords: kiwifruit, storage, oil, soluble solids, firmness.

INTRODUCTION

The recent trends apparent in our overseas markets mean that New Zealand growers of kiwifruit (*Actinidia deliciosa* (A Chev.) C.F. Liang et A. R. Ferguson cv. Hayward) will be facing increasing international pressure to reduce or eliminate the use of conventional pesticides.

As an example of the importance placed on meeting these demands the New Zealand Kiwifruit Marketing Board has instigated a project to produce pesticide residue free kiwifruit for export (Anon. 1992). These fruit will have no conventional chemicals applied post-flowering, but must still meet export standards in all regards, including those for pest control. Mineral oils will be used to control some of the insect pests in this project. Producers of organic kiwifruit are already attempting to control armoured scales using compounds such as spraying oils. Mineral oil sprays at a concentration of 1.0 to 2.0% are used, with 1% being the most common. In trials with growers, DSIR Plant Protection has successfully produced organic kiwifruit to export standards, using a full season programme of mineral oil sprays plus several early season applications of *Bacillus thuringiensis* (Bt) products to control leafrollers (D. Steven and C.E. McKenna, unpublished data).

Unfortunately mineral oils can be extremely phytotoxic, and kiwifruit has been shown to be sensitive to their use in the past. Ford (1971) found that oils were phytotoxic whether applied in combination with other insecticides or on their own, and Sale (1972b) found that a late season application of oil caused kiwifruit to drop from the vines, with more fruit dropping with increased concentrations of oil. Both Ford and Sale described the development of a soft rot at the fruit petiole, and in some cases the skin of the fruit was scorched. For these reasons oils have not been recommended for use on kiwifruit, especially late in the season (Sale 1972a).

There are several research projects in progress to determine more precisely when mineral oils will cause plant damage. The research reported in this paper was carried out to clarify some of the phytotoxic effects of a late season application of mineral oil. In particular this research investigated the storage of kiwifruit which had received a late season oil application because if the oil does cause fruit drop, the remaining fruit may also be adversely affected.

The quality of kiwifruit in storage can be assessed by measuring flesh firmness and soluble solids concentration. The incidence of storage rots, such as botrytis (*Botrytis cinerea*) and ripe rots, also affects storage ability. For commercial reasons

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kiwifruit are kept in storage for many months and are then expected to reach their export destination in good condition. A loss of condition, with fruit softening prematurely, can result in fruit losses and expensive repacking. Any production practice that could contribute to this problem needs to be examined.

METHODS

The trial was carried out on a block of 'Hayward' kiwifruit vines at the DSIR Kumeu Research Orchard (six rows by eleven vines). Four replicates of five treatments were applied in a randomised block design to single-vine plots.

The oil used was Shell Sunspray which was applied at 0.5%, 1.0%, 2% and 4% (v/v) dilution in water. The 'control' treatment was left unsprayed. The 4% treatment was included to maximise the chance of phytotoxic effects occurring.

The oil was applied on May 8, 1990, 1 week before harvest, when the average brix in a 20 fruit sample was 6.4 (range 5.6-7.0). Vines were sprayed to run-off at about 2000 kPa using a 'Universal' handgun from a petrol-driven Comet P48 pump. During spraying, the average temperature was 16.7°C, and the average relative humidity was 73.5%. The quick-drying conditions were within the safety margins recommended by D. Steven and C.E. McKenna (unpublished report).

One hundred fruit were harvested from each vine and packed into trays with 20 fruit per tray. The trays were placed in a coolstore at 0°C. After 0, 4, 8, 12 and 20 weeks of storage, a tray from each vine was removed and placed at room temperature for 24 hours. The fruit were then assessed for firmness and soluble solids content.

Firmness was measured using an effegi penetrometer with a 7.9 mm head (Watkins and Harman 1981). Two measurements per fruit were made, after removing a slice of skin using a blade mounted into a stand which ensured uniformity of samples.

Concentration of soluble solids was measured with a refractometer. A section of fruit was cut from both the sepal and stigma ends of each fruit and the concentration of soluble solids in the juice from each end was measured separately.

RESULTS AND DISCUSSION

No fruit drop was observed in the week between applying the oil sprays and harvest. The changes in flesh firmness and soluble solids during storage were typical for kiwifruit (Beever and Hopkirk 1990) with no evidence of any detrimental effects.

The changes in flesh firmness over the full 20 weeks of the trial were normal for fruit stored at 0°C (Figure 1.). Typically kiwifruit stored at 0°C soften rapidly, with an initial firmness of 7-8 kgf decreasing to about 2.0 kgf over 12 weeks, after which time the fruit soften only very slowly. When fruit are ripe enough to eat, flesh firmness is 0.5 - 0.8 kgf (Beever and Hopkirk 1990). At harvest, untreated fruit were significantly firmer than all fruit treated with oils (Duncan's multiple range test, $\alpha = 0.05$), but this effect was reversed after 8 weeks storage when untreated fruit were significantly softer than all other fruit. No other significant differences in firmness between untreated and treated fruit were found.

Fig. 1: Change in flesh firmness (kgf) of kiwifruit over 20 weeks storage at 0°C following pre-harvest oil treatment.

Fruit were harvested with a soluble solids concentration between 7.3 and 7.9% (Figure 2). The minimum soluble solids value for 'Hayward' fruit to be acceptable for export is 6.2%. The untreated fruit had a significantly higher concentration of soluble solids from week 4 onwards, indicating that the fruit treated with oil ripened more slowly than did untreated fruit (Duncan's multiple range test, $\alpha = 0.05$).

Fig. 2: Change in soluble solids concentration (%) of kiwifruit over 20 weeks storage at 0°C following pre-harvest oil treatment.

There are several reasons why the ability to use an oil spray safely close to harvest would be advantageous. Most chemical residues on harvested fruit originate from the pesticide spray most recently applied, so that if a conventional spray can be replaced by an oil spray late in the season, pesticide residues on fruit would be significantly decreased. Secondly, organic kiwifruit growers are unable to use conventional chemicals and must find effective alternatives. Controlling scale just before harvest is critical because it is reasonably common for newly settled first instars to occur on fruit at harvest.

The oil products available today are considerably more refined than those available to Ford (1971) and Sale (1972a; 1972b), and this may explain why no fruit drop or other phytotoxic effects were observed. However, this work will be repeated in several different kiwifruit growing regions before firm recommendations can be made.

CONCLUSIONS

There were no phytotoxic effects recorded in this trial when Shell Sunspray oil was applied to kiwifruit close to harvest, even when a rate of 4% was used. This is twice the maximum rate normally recommended on other crops to control armoured scale insects during the growing season.

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