Use of the pulsFog® to Control Diseases in Mango

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ABSTRACT
Copper application with the pulsFog® was compared to copper application with conventional hand guns. Copper count N (copper ammonium carbonate) was the copper source. Trees were sprayed (solution: 300 ml Copper count N/100 l water + 6 ml/100 l Agral 90) or fogged (solution: 2.5 l Copper count N + 2.5 l Dillad oil + 5 l water) every 28 days from Oct. 1, 1997 until Feb. 19, 1998. Dense Heidi mango trees, and Kent mango trees spaced at 3 x 3 m, were used. Fogging was as effective as conventional hand-gun spraying in controlling disease (anthracnose and soft brown rot). The pulsFog is considered to have specific application in high density orchards, trees with exceptionally dense canopies, and trees situated on terrain which is inaccessible to conventional spraying equipment.

INTRODUCTION
The pulsFog® (Fig. 1) emits minute droplets (a “fog” comprising droplets of the order of 15 µm in diameter) and can be considered as being an ultra-ultra low volume chemical solution applicator. Very small droplets are produced as a result of liquid injection into a moving air stream, this air stream resulting from air displacement caused by a pulsejet engine (air displacements resulting from repetitive explosions). Oil emulsions are injected to limit evaporation, and to actuate vaporisation and the formation of evenly sized droplets.

The pulsFog is filled with a small volume of concentrated liquid (5 or 10 l). It has the advantage of being small enough to be carried by persons. Hence, it is specifically useful for the application of chemicals to trees in ultra-high density orchards (Fig. 2), or to large trees situated on slopes or in other regions which are inaccessible to conventional spraying equipment (Fig. 3). Moreover, due to the fog permeation and upward movement, the pulsFog may be more suitable than conventional sprayers for the application of chemicals to trees with very dense canopies (e.g. large Heidi trees).

In the present study, the use of the pulsFog, as opposed to conventional hand-guns, was evaluated for the application of copper to dense-canopied Heidi trees, and to Kent mango trees in a high density orchard. Effectiveness was gauged on the manifestation of fruit diseases after harvest.

MATERIALS AND METHODS
A Bio-System pulsFog was obtained from Cyrose (Pty.) Ltd. (P.O. Box 2405, Edenvale, 1610). 2.5 litres of Copper count N (liquid) was added to 2.5 litres of Dillad oil and 5 l litres of water. This solution was made up and used for “fogging” on each occasion (injected through the “cool” inlet). The pulsFog was fitted with 20 mm nozzles. The solution, 300 ml of Copper count N per 100 litres of water, was used when spraying with hand-guns (conventional spraying; 14 bar pressure; spray to run-off). Agral 90 (6 ml/100 l water) was used as a wetting agent.

Fogging was done early during the morning (before 7 am) or late during the evening (after 6 pm) when conditions were windless and the evaporative demand was low. Copper spraying was done immediately after fogging.

Experiment I
Ten Heidi mango trees with dense 3 m wide canopies were selected in an orchard in the Tzaneen region. Every four weeks from 1 Oct. 1997 until harvest on 19 Feb. 1998, five of the trees were fogged, and five of the trees were sprayed with hand-guns.

At harvest, two cartons of fruits were removed per tree. The fruits were harvested whilst walking around each tree. After the conventional packline treatment, [1% BiProx wash, dip for 5 minutes in water at 50°C, dip for 20 seconds in Omega (180 ml per 100 l water), wax with TAG], the
fruits were placed in cool-storage at 9.5°C for 32 days. They were subsequently allowed to ripen at 20°C.

Disease in each fruit was rated immediately and seven days after cool-storage. A rating of 0 was given if a fruit was disease free, a rating of 1 if symptoms were present but were localised to a small portion of the fruit’s surface, a rating of 2 if approximately 1/3 of the fruit’s surface showed symptoms, a rating of 3 if 2/3 of the fruit’s surface was affected, or a rating of 4 if the entire fruit’s surface was visibly diseased. The diseases occurring were also identified.

The randomised complete blocks design was adopted in which there were 5 replicates of 2 treatments. Single trees served as plots. The tree averages were subjected to analysis of variance.

Experiment II

Four adjacent tree-rows were selected in a 3 x 3 spaced orchard Kent orchard situated in the Tzaneen region. Three of the rows were fogged every four weeks from 1 Oct. 1997 until harvest in 19 Feb. 1998. The remaining row, situated between two fogged rows, was hand-gun sprayed.

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**Fig. 2** Fog operation in a high density orchard.

**Fig. 3** Fog permeation through a dense Heidi tree.

**Fig. 4** Experiment I: Extents of disease manifestation directly after cold-storage (above) and 7 days after cold-storage (below) (anth = anthracnose; sbr = soft brown rot; dmax = averages of rating maxima). None of the testable differences were statistically significant (5% LSD).

**Fig. 5** Experiment II: Extents of disease manifestation directly after cold-storage (left) and 7 days after cold-storage (right) (anth = anthracnose; sbr = soft brown rot; dmax = averages of rating maxima).
It required 2 minutes and 10 seconds, and 1.31 of Copper count N/Dillad oil solution to fog 18 trees (solution cost: R 9.18). It required 10 minutes and 12 seconds, and 75 litres of Copper count N solution to hand-gun spray 15 trees (solution cost: R 3.31). The costs indicated are based on the price of R 306 for 25 l of Copper count N, and that of R 400 for 25 l of Dillad oil.

At harvest, one carton of fruits was removed per tree. The fruits were removed whilst walking around each tree. After conventional packline treatment, the fruits were placed in cool-storage at 9.5°C for 32 days. The fruits were subsequently allowed to ripen at 20°C.

Disease in each fruit was rated and identified as stated previously.

RESULTS

Experiment I

Fig. 4 shows the averages of the disease ratings for each treatment (anth and sbr), and the treatment averages of the rating maxima (dmax). Anthracnose was the prevalent disease directly after cool-storage. Anthracnose and soft-brown rot occurred to similar degrees seven days after cool-storage. A difference relating to treatment (fogging vs hand-gun spraying) was not apparent at either stage. The results suggest that fogging was as effective as hand-gun spraying in controlling disease.

Experiment II

Fig. 5 shows the averages of the disease ratings for each treatment (anth and sbr), and the treatment averages of the rating maxima (dmax). Anthracnose occurred to a greater extent directly after cool-storage, whereas soft-brown rot occurred to a greater extent seven days after cool-storage. A difference relating to treatment (fogging vs hand-gun spraying) was not apparent. It might be concluded that fogging was as effective as hand-gun spraying in reducing disease.

The cost of the fogging solution was almost three times as high as that of the hand-gun solution in considering treatment of 18 trees (R 9.18 vs R 3.31). The high cost of Dillad oil (carrier) was the prime reason for the difference. Alternative carriers, suggested by Cyrosa, were stated to be cheaper, but still required testing.

CONCLUSION

It is the opinion of the author that the pulsFog will not be practical for treating conventionally spaced trees, where the between-row spacing exceeds 4 m. A benefit might be found in treating closely spaced trees in orchards where the between-row spacing is less than 4 m. Application may also be found in treating trees on terrain which is inaccessible for conventional spraying equipment, or trees with exceptionally dense canopies, e.g., large trees of the cultivar, Heidi.

It is noteworthy that the pulsFog is noisy, and at times, is difficult to start. The maintenance and service cost is low. The application of suspensions was found by the author to be difficult due to frequent nozzle blockage. The effectiveness of fogging with curative fungicides has still to be assessed.