PO Box 416, Letsitele, 0885 ●Tel / Fax (015) 345-1227 / 1840● E-Mail: willemv@agriscience.co.za

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**Work conducted by:** **W. van de Pypekamp and S. H. Swart**

**Co Worker:** **J. Ramoshaba**

**Reference Number:** **QR**

**Client:** **I & M Smith (Pty). Limited**

**Lionel de Roland-Phillips and Rodger A. Dryburg**

**Date:** **May 2008**

**Title: Compare the efficacy of conventional spraying equipment with Electrostatic Spraying System (ESS), when applying standard fungicide programmes, for controlling mango diseases.**

**Aim: The aim of this project was to compare the efficacy of fungicides applied with new generation spraying equipment with conventional spraying equipment when application volumes are reduced.**

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|---|---|
| **Crop:** | **Mangoes** |
| **Target Organism:** | **Anthracnose (*Colletotrichum gloeosporiodes*) and Stem-end rot/Soft brown rot (*Botryosphearia* spp)** |
| **Season:** | **2007 / 2008** |
| **Evaluation:** | **March 2008** |
| **Project Site:** | **Hoedspruit** |

# Compare the efficacy of conventional spraying equipment with Electrostatic Spraying System (ESS), when applying standard fungicide programmes, for controlling mango diseases.

**W van de Pypekamp and S H Swart**

QMS Agri Science, P.O. Box 416, Letsitele, 0885
E-mail: willemv@agriscience.co.za

## Aim

The aim of this project was to compare the efficacy of fungicides applied with new generation spraying equipment with conventional spraying equipment when application volumes are reduced.

## Materials and Methods

The trial was conducted at Bavaria Estates, Hoedspruit, Limpopo Province on two commercial orchards, cv. Kent with 820 trees/ha. The standard fungicide programme of Bavaria Estates was sprayed with conventional spraying equipment (Cima sprayer) and the Electrostatic Spraying System (ESS) at different active ingredient dosages. The programme consisted of two systemic fungicides, mainly for control of powdery mildew, followed by copper applications every two weeks, until three weeks before harvest for control of bacterial black spot, anthracnose (ANT), stem-end rot (SER) and soft brown rot (SBR). The first systemic application, Tilt (propiconazole, a.i. 250 g/ℓ) was sprayed on the 19th of September 2007, followed by a contact fungicide, Dimildex (Cu oxychloride, 850 g/kg WP) on the 4th of October 2008. The last systemic application, Punch C (carbendazim/flusilazole, a.i. 125/250 g/ℓ) was sprayed on the 19th of October 2007. Thereafter, Dimildex were applied every 2 weeks, from the 2nd of November 2007 until the 14th January 2008.

The trial consisted of 7 programmes and an untreated control, applied to 20-tree blocks and replicated twice in a randomised block design. Before each fungicide application, 50 leaves and fruit were inspected for phytotoxicity. Test materials, dosages and volumes sprayed are depicted in **Table 1**. The volumes applied by ESS were much lower at 180 ℓ per hectare compared to 1200 ℓ applied with Cima spraying equipment. Therefore, the concentrations of fungicides (g / 100 ℓ) applied with the ESS had to be much higher than for the conventional Cima application in order to spray similar amounts of active ingredient (a.i.) / ha. In treatment 7 Dimildex was applied at 300 g per 100 ℓ water with conventional Cima spraying equipment at

1200 ℓ per hectare (Cima conventional), resulting in 3.6 kg Dimildex applied per hectare, or 3.06 kg copper oxychloride which would be comparable to treatment 6 (ESS 100). If referred to ESS 50 in this text, it implies that 50 percent of the active ingredient applied (for eg. 3.06 kg copper oxychloride) by conventional Cima spraying equipment was applied with the ESS (relating to 1.53 kg copper oxychloride). The same principal applies for ESS 60, 70, 80, 90 and 100, where the number indicating the percentage of the active ingredient applied. In all cases the volume applied with the ESS equipment was equal to 180 l / ha. The same calculations were used for systemic fungicides applied in the trial.

Efficacy of fungicide programs was evaluated at harvest by picking 30 fruit from each of five data trees on the 20th of February 2008. Fruit was washed in a 200 parts per million (ppm) chlorine solution (pH = 6.5), ripened at ambient temperature (25 °C) and evaluated for decay (anthracnose [ANT] and stem-end rot [SER] / soft brown rot [SER]) at ripening (day 0) and 7 days after ripening (day 7).

**Table 1.** Test material compared at Bavaria Estates in the Hoedspruit area as a semi-commercial pre-harvest applications.

| Program number | Fungicide programme | Programme description | Dosage per 100 ℓ | Dosage per hectare | Active ingredient applied per hectare | Volume sprayed per ha |
|---|---|---|---|---|---|---|
| 1 | Punch C or<br>Tilt or<br>Dimildex | ESS 50 | 50 mℓ<br>66.7 mℓ<br>1000 g | 90 mℓ<br>120 mℓ<br>1800 g | 11.25 g<br>30 g<br>1530 g | **180 ℓ** |
| 2 | Punch C or<br>Tilt or<br>Dimildex | ESS 60 | 60 mℓ<br>80 mℓ<br>1200 g | 108 mℓ<br>144 mℓ<br>2160 g | 13.5 g<br>36 g<br>1836 g | **180 ℓ** |
| 3 | Punch C or<br>Tilt or<br>Dimildex | ESS 70 | 70 mℓ<br>93 mℓ<br>1400 g | 126 mℓ<br>168 mℓ<br>2520 g | 15.75 g<br>42 g<br>2142 g | **180 ℓ** |
| 4 | Punch C or<br>Tilt or<br>Dimildex | ESS 80 | 80 mℓ<br>106.7 mℓ<br>1600 g | 144 mℓ<br>192 mℓ<br>2880 g | 18 g<br>48 g<br>2448 g | **180 ℓ** |
| 5 | Punch C or<br>Tilt or<br>Dimildex | ESS 90 | 90 mℓ<br>120 ml<br>1800 g | 162 mℓ<br>216 mℓ<br>3240 g | 20.25 g<br>54 g<br>2754 g | **180 ℓ** |
| 6 | Punch C or<br>Tilt or<br>Dimildex | ESS 100 | 100 mℓ<br>133 mℓ<br>2000 g | 180 mℓ<br>240 mℓ<br>3600 g | 22.5 g<br>60 g<br>3060 g | **180 ℓ** |
| 7 | Punch C or<br>Tilt or<br>Dimildex | Cima conventional | 15 mℓ<br>20 mℓ<br>300 g | 180 mℓ<br>240 mℓ<br>3600 g | 22.5 g<br>60 g<br>3060 g | **1200 ℓ** |

* ESS = Electrostatic Spraying System. ESS 50, 60, 70, 80, 90 and 100 the percentage applied of the total amount of active ingredient as applied with the conventional Cima application at 1200 ℓ per hectare.

## Results

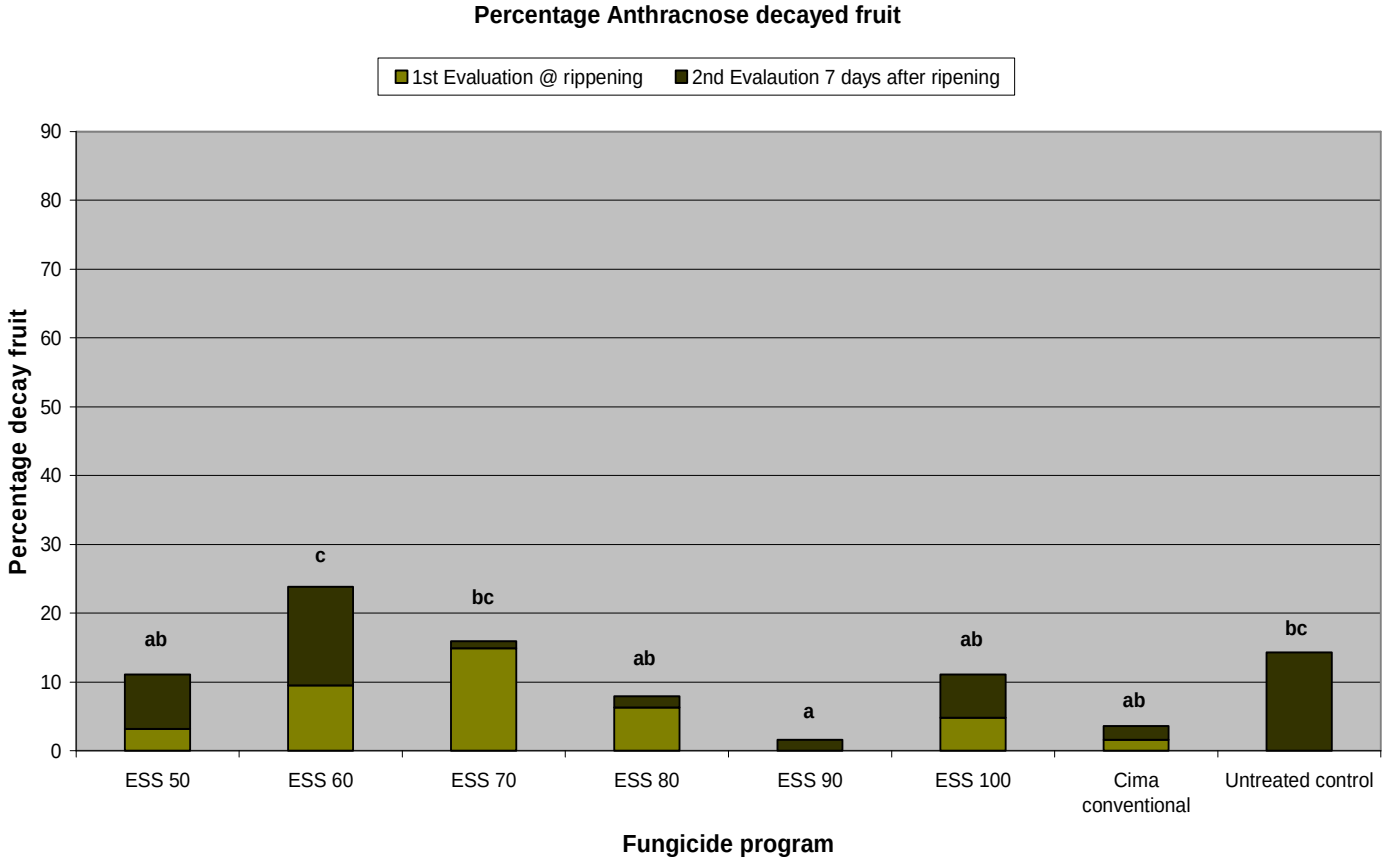
### Anthracnose

The infection potential was low in this trial, with only 14.3 percent of untreated fruit with decay symptoms at the 7-day evaluation. The evaluation of fruit at ripening and 7 days after ripening, showed that fungicides applied with the ESS equipment at a rate of 90 % of the active ingredient (program 5, ESS 90) that was applied with a conventional Cima sprayer (program 7, Cima conventional), resulted in the lowest percentage fruit with symptoms (**Table 2**, **Graph 1**). The percentage fruit with symptoms for ESS 90 was 1.6 % compared to the Cima conventional application with 3.6 % fruit with symptoms. These fungicide programs did not differ statistically from each other, nor from ESS 50, 60, 80 and 100. ESS 60 resulted in a statistically significant higher percentage fruit with symptoms compared to the Cima conventional application.

**Table 2.** Percentage fruit with anthracnose and soft brown rot symptoms, evaluated at ripening and 7 days after ripening

| Program number | Fungicide programme | Programme description | Percentage decayed fruit | | | |
|---|---|---|---|---|---|---|
| | | | Anthracnose | | Soft brown rot | |
| | | | 0-day (ripening) | 7-day post-ripening | 0-day (ripening) | 7-day post-ripening |
| 1 | Punch C or Tilt or Dimildex | ESS, 50 | 3.2 ab | 11.1 ab | 14.3 cd | 34.9 b |
| 2 | Punch C or Tilt or Dimildex | ESS, 60 | 9.5 bc | 23.8 c | 9.5 abc | 34.9 b |
| 3 | Punch C or Tilt or Dimildex | ESS, 70 | 17.5 c | 15.9 bc | 4.8 abc | 42.9 b |
| 4 | Punch C or Tilt or Dimildex | ESS, 80 | 6.3 ab | 7.9 a | 17.5 d | 44.4 b |
| 5 | Punch C or Tilt or Dimildex | ESS, 90 | 0 a | 1.6 a | 9.5 bc | 30.2 b |
| 6 | Punch C or Tilt or Dimildex | ESS, 100 | 4.8 ab | 11.1 ab | 1.6 ab | 17.5 a |
| 7 | Punch C or Tilt or Dimildex | Cima, conventional | 1.6 ab | 3.6 ab | 4.8 abc | 33.9 b |
| 8 | Untreated control | UC | 0 a | 14.3 bc | 0 a | 34.9 b |

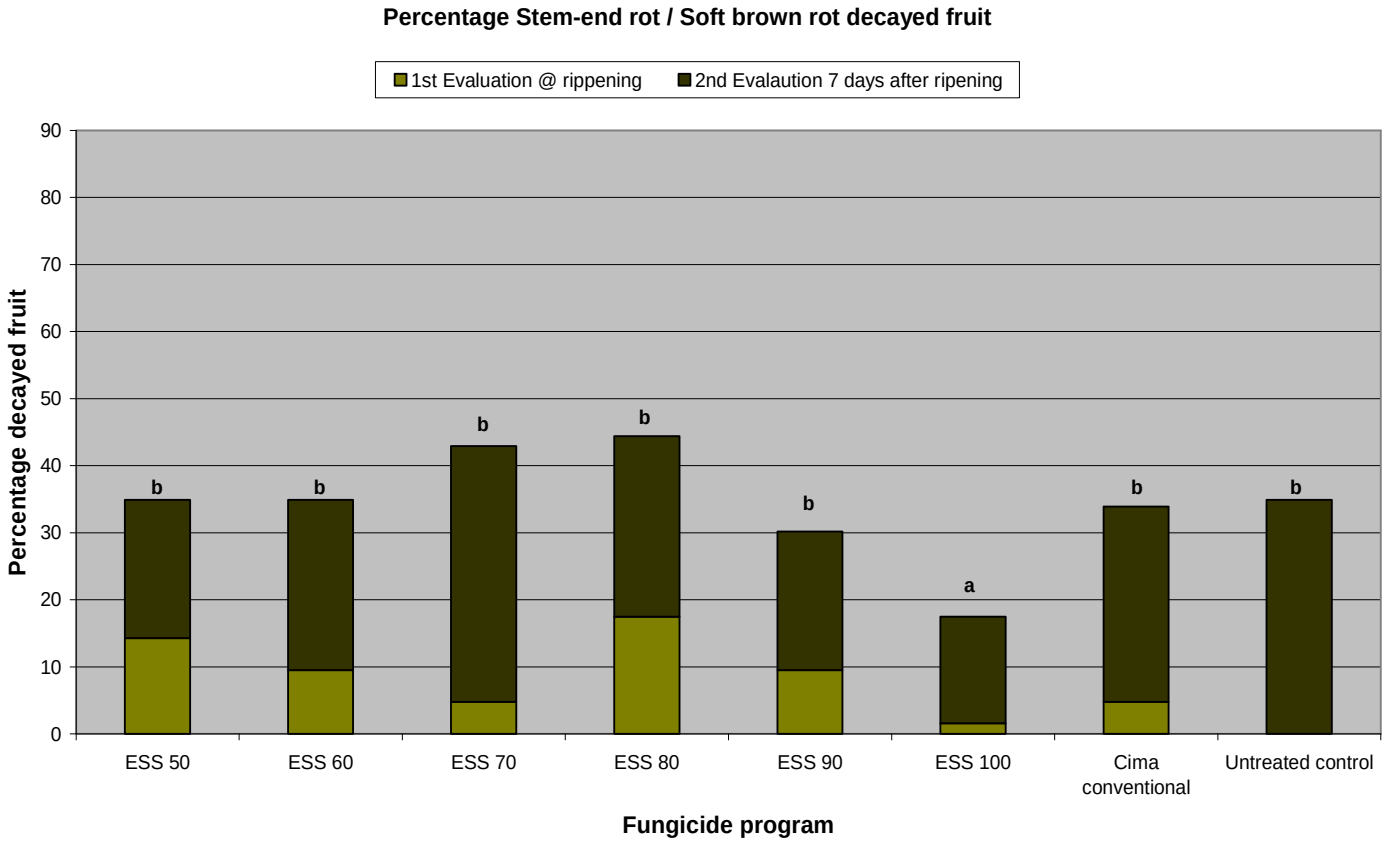
* Values in the same column followed by the same alphabetical letter do not differ according to Fishers' protected t-test at the 5 % level of significance.




**Graph 1.** The percentage Anthracnose decayed fruit evaluated at 0 and 7 days after ripening, (Values in the same column followed by the same alphabetical letter do not differ according to Fishers' protected t-test at the 5 % level of significance).

### Stem-end rot / Soft brown rot

The infection potential was medium in this specific trial, with 34.9 percent of untreated fruit at the 7-day evaluation showing decay symptoms. The evaluation of fruit at ripening and 7 days after ripening, showed that fungicides applied with the ESS (program 6, ESS 100) at a rate of 100 % of the active ingredient as applied with a conventional Cima sprayer (program 7, Cima conventional), resulted in the lowest percentage decayed fruit (**Table 2**, **Graph 2**). Fungicide program 6, ESS 100, resulted in statistically lower percentage decayed fruit compared to all other fungicide programs. The percentage decayed fruit for ESS 100 was 17.5 % compared to the Cima conventional with 33.9 % decayed fruit. ESS 90 also had a lower percentage decay compared to Cima conventional, however, not statistically significant.




**Graph 2.** The percentage Stem-end rot / Soft brown rot decayed fruit evaluated at ripening and 7 days after ripening. (Values in the same column followed by the same alphabetical letter do not differ according to Fishers' protected t-test at the 5 % level of significance).

## Discussion and Conclusion

Results obtained during a previous trial indicated that the best control of post-harvest mango diseases was obtained when the active ingredient of fungicides applied with the ESS was reduced with 20% (80 % of a.i. applied with a conventional Cima sprayer). Results obtained during this trial (2007 / 08 growth season) showed that the best control of post-harvest anthracnose was achieved by reducing the active ingredient applied to 90 % when applied with the ESS (Fungicide program 5) compared to the conventional Cima sprayer (Fungicide program 7). The best control of post-harvest SER / SBR was achieved by applying fungicides with the ESS at 100 % dosage (Fungicide program 6) compared to the conventional Cima sprayer.

The application of fungicides with the ESS at reduced a.i. during the 2007 / 08 season again resulted in effective control of post-harvest anthracnose when compared to the conventional Cima sprayer or untreated treatment. However, results were not consistently related to dosage. Fruit sprayed with ESS 100 had more anthracnose compared to ESS 90 and ESS 80 treatments. It is also unclear why poor control of SER / SBR was obtained with all fungicide

applications compared to the control treatment. This might be related to the fact that conventional applications with the Cima applicator at 1200 l / ha was also too low for adequate control of this disease. ESS 100 and ESS 90 showed some improved efficacy, probably due to better distribution of the a.i., in spite of the low volume applied. We propose that further research is needed to answer some of the questions that arose from this initial work. Optimal dosages and other factors (eg. air humidity, wind speed, temperature, etc.) that can affect efficacy when pre-harvest fungicides are applied with the ESS sprayer should also be investigated.