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Work conducted by: **W van de Pypekamp**

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

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Title: **Compare the efficacy of commercial spraying equipment with Electrostatic Spraying System (ESS), when applying standard pesticide and fungicide programmes for controlling citrus pests and diseases, and plant growth regulators (PGR) for improved yield and fruit size.**

Aim: **The aim of this project is to determine whether concentration of pesticides and fungicides applied per hectare can be decreased with new generation spraying equipment while maintaining acceptable or improved levels of pest and disease control. Furthermore, determining the effect on efficacy if PGR is applied with ESS compared to Commercial spraying equipment regarding yield and fruit size.**

Crop: **Citrus**

Target Organism: **Disease; *Guignardia* spp (citrus black spot)**
Pests; *Aonidiella auranti* (citrus red scale), *Scirtothrips aurantii* (Thrips)

Season: **2007/2008**

Project Site: **Hoedspruit**

Compare the efficacy of commercial spraying equipment with Electrostatic Spraying System (ESS), when applying standard pesticide and fungicide programmes for controlling citrus pests and diseases, and plant growth regulators (PGR) for improved yield and fruit size.

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Aim

The aim of this project is to determine whether concentration of pesticides and fungicides applied per hectare can be decreased with new generation spraying equipment while maintaining acceptable or improved levels of pest and disease control. Furthermore, determining the effect on efficacy if a plant growth regulator (PGR) is applied with ESS compared to commercial spraying equipment regarding yield and fruit size.

Materials and Methods

The trial was conducted at Bavaria Estates, Hoedspruit, Limpopo Province on a commercial orchards, cv. Delta with 830 trees/ha. A general commercial spray programme of Bavaria Estates was sprayed with commercial spraying equipment (Cima sprayer) and the Electrostatic Spraying System (ESS) for pest and disease control. The trial consisted of 3 programmes, applied on semi commercial scale to approximately 0.5 hectare blocks (approx. 400 trees). Before each fungicide application, 50 leaves and fruit were inspected for phytotoxicity on 10 randomly chosen data trees for each programme. Chemicals and active ingredients applied in this trial are depicted in **Table 1**, with spray programs, dosages and volumes sprayed depicted in **Table 2**.

Table 1. Chemical and active ingredients applied on citrus at Bavaria Estates in the Hoedspruit area, Limpopo Province.

Trade name	Active ingredient	Formulation	Active ingredient
Ultracide	Methidathion	EC	420 g/ℓ
Nemesis	Pyriproxyfen	EC	100 g/ℓ
Mineral oil	Medium narrow range	EC	850 g/ℓ
Regent	Fipronil	SC	200 g/ℓ
Dithane M45	Mancozeb	WG	750 g/kg

Table 2. Spray programs applied on citrus at Bavaria Estates in the Hoedspruit area, Limpopo Province.

Program number	Program description	Spray program	Volume sprayed per ha	Dosage (/ 100 ℓ)	Date applied
1	Cima, Commercial	Ultracide, Nemesis & Oil	3000	150mℓ, 30mℓ & 250mℓ	12-Oct
		Regent & Dithane	3000	10mℓ & 200g	12-Nov
		Dithane	3000	200g	28-Dec
2	ESS 100	Ultracide, Nemesis & Oil	150	3000mℓ, 600mℓ & 50mℓ	12-Oct
		Regent & Dithane	150	200mℓ &, 4000g	12-Nov
		Dithane	150	4000g	28-Dec
3	ESS 80	Ultracide, Nemesis & Oil	150	2400mℓ, 480mℓ & 250mℓ	12-Oct
		Regent & Dithane	150	160mℓ & 3200g	12-Nov
		Dithane	150	3200g	28-Dec
4	Untreated Control	-	-	-	-

- ESS = Electrostatic Spraying System

The concentrations of fungicides (g / 100 ℓ) applied with the ESS were much higher than for the commercial Cima application. However, the volumes applied by ESS were much lower at 150 ℓ per hectare compared to 3000 ℓ applied with Cima spraying equipment. This resulted in the same amount of active ingredients being applied per hectare for programme 2 (ESS 100) and 1 (Cima, Commercial). For example, applying Dithane M45 (a.i. Mancozeb, 750 g/kg) in this trial at 200 g per 100 ℓ water with a commercial Cima spraying equipment at a spray volume of 3000 ℓ per hectare, an amount of 6 kg Dithane M45 or 4.5 kg mancozeb (a.i.) were applied per hectare. Therefore, applying Dithane with the ESS (Program number 2, ESS 100) at 4000 g/100 ℓ and a

spray volume of 150 ℓ per hectare resulted in applying 6 kg Dithane M45 or 4.5 kg mancozeb (a.i.) per hectare.

Efficacy of spray programs were evaluated at harvest by randomly picking 20 fruits from 10 randomly selected trees per spray program, thus 200 fruits in total per program. Fruits were then evaluated for insect damage (Thrips, red scale, rust mite, American bollworm, etc.) and for citrus black spot.

The effect of ProGibb 4% (Gibberellic Acid 4% w/w) on fruit set and size was determined by applying ProGibb 4% with a commercial Cima sprayer and the ESS. ProGibb 4% was applied on the 12th of October 2007 at a dosage of 2.5 mℓ / 100 ℓ as a medium cover spray (2000 ℓ per hectare) with a Cima sprayer (Treatment 1) and at a dosage of 35 mℓ / 100 ℓ as a ultra light cover spray (150 ℓ per hectare) with the ESS (Treatment 3) to 0.33 hectare blocks. The effect of applying PGR's regarding yield and size was monitored at harvest on the 18th August 2008 by striping fruit from 10 randomly selected data trees per treatment. An analysis of variance was performed on arcsin transformed percentages and differences between means of treatments were determined with Fisher's t-test at a 5% level of significance, using Statistica 8.0 by Statsoft Inc.

Results and Discussion

Results at harvest indicated no citrus black spot damaged fruits for all spray programs, including the untreated control. The Hoedspruit area, especially Bavaria Estates, is classified as a low pressure citrus black spot area.

Spray program 3 (ESS 80) resulted in statistically better control of thrips, with 16.5 % of fruits damaged, compared to spray program 1 (Cima, Commercial) with 29.5 % and program 2 (ESS 100) with 31.5 % of fruits with thrips damage (**Figure 1**). However, spray programs 1, 2 and 3 did not differ statistically from the untreated control regarding the percentage thrips damaged fruits. Damage levels of between 16 and 32 % in not commercially acceptable.

Spray program 2 (ESS 100) resulted statistically better control of citrus red scale, with 18 % of fruits affected by red scale, compared to program 1 (Cima, Commercial) ESS 100) with 28 % and program 3 (ESS 80) with 35 % of fruits affected (**Figure 2**).

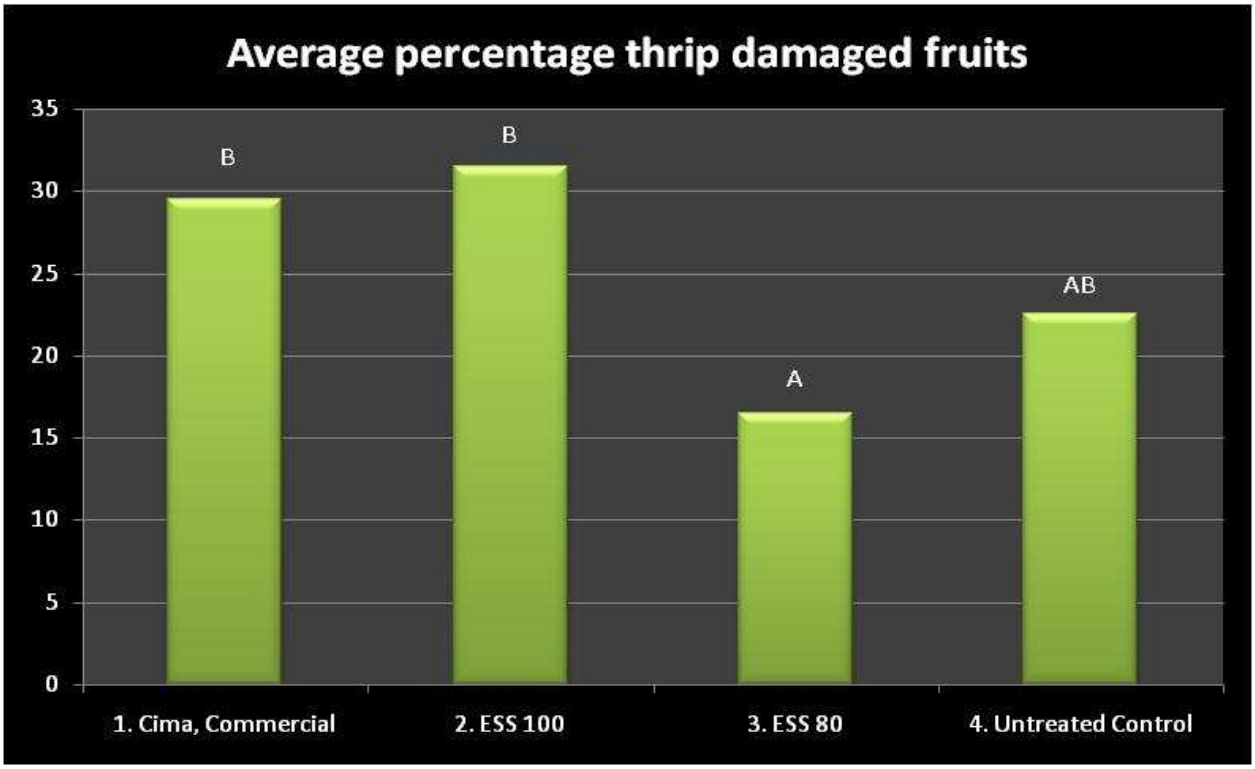

Figure 1. The Average percentage thrips damaged fruits for various programs applied on citrus at Bavaria Estates in the Hoedspruit area, Limpopo Province.

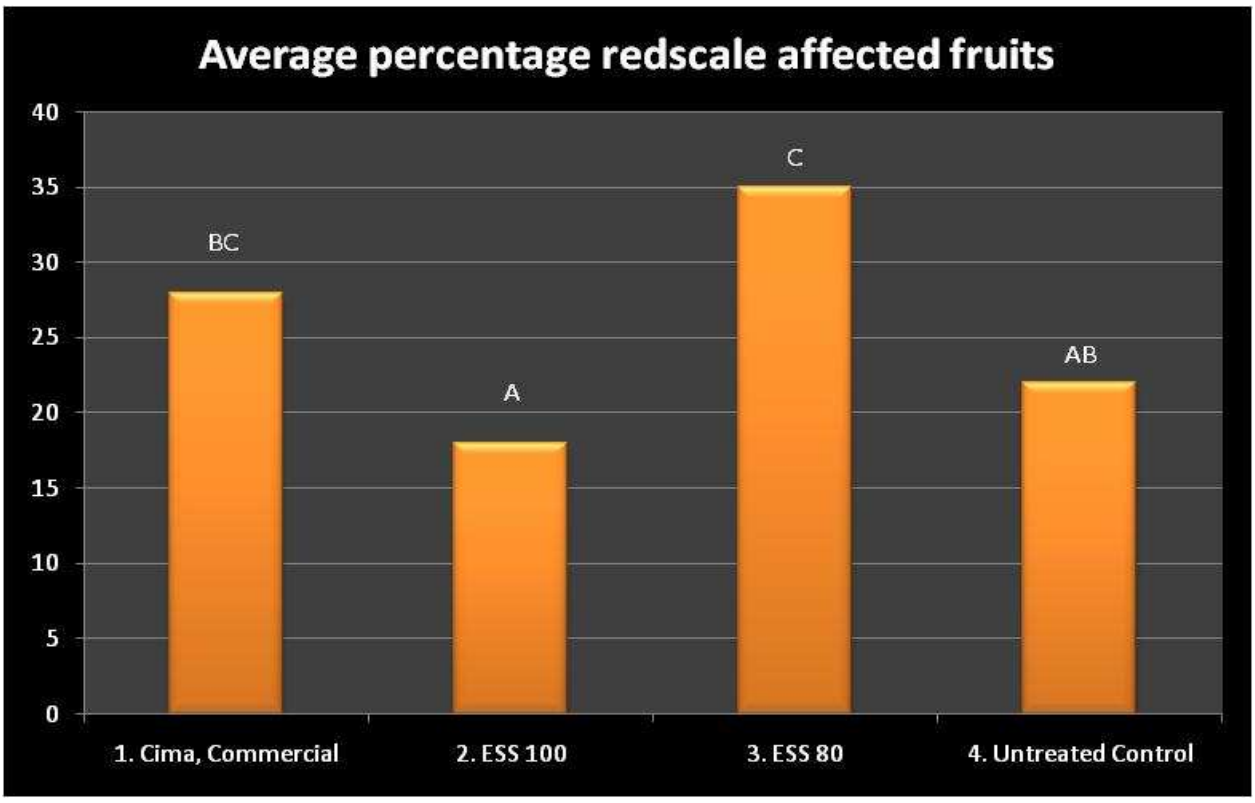

Figure 2. The Average percentage red scale affected fruits for various programs applied on citrus at Bavaria Estates in the Hoedspruit area, Limpopo Province.

Spray program 2 (ESS 100), with 0 % damaged fruits, gave statistically significantly better control of American bollworm compared to the untreated control with 5 % damage (**Figure 3**).

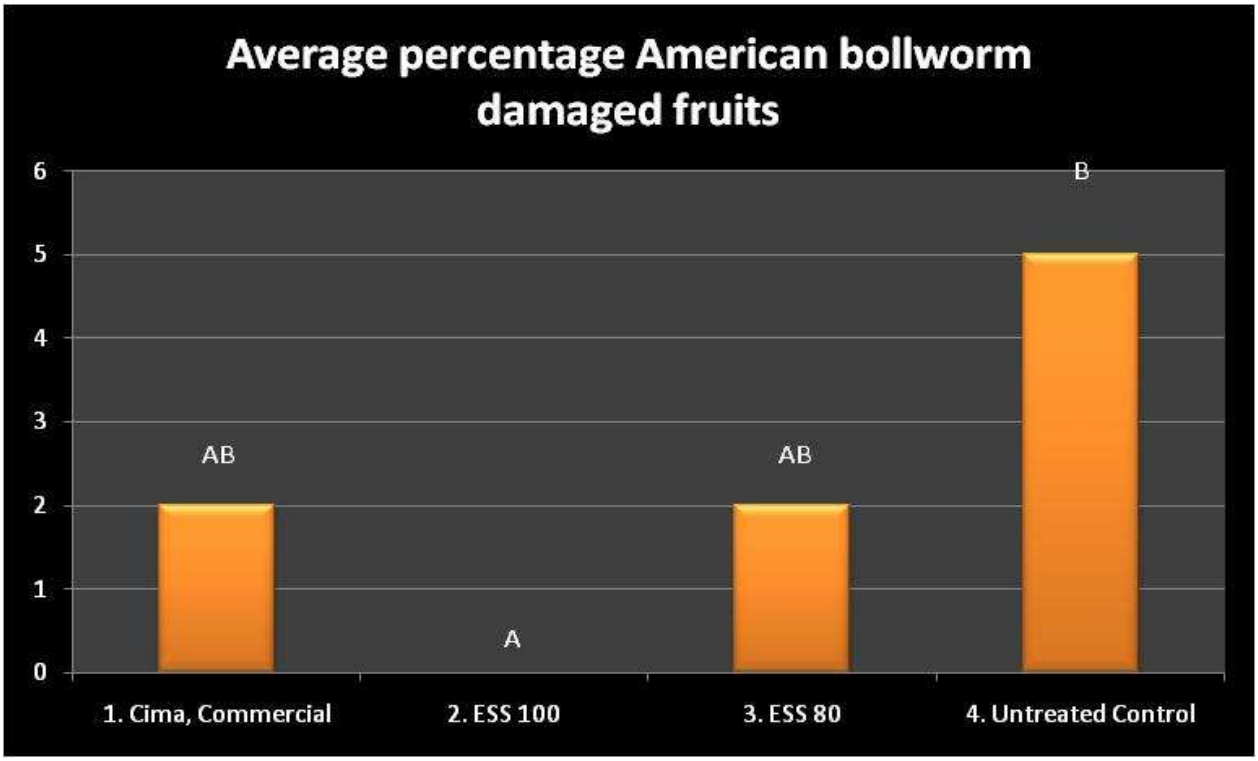

Figure 3. The average percentage American bollworm damaged fruits for various programs applied at Bavaria Estates in the Hoedspruit area, Limpopo Province.

Data obtained at harvest indicated that trees that did not receiving any ProGibb resulted in significantly higher average yield per tree. The untreated control resulted in an average yield per tree of 118.6 kg compared to programs 1 (Cima, Commercial) and 2 (ESS 100) with 106.2 and 105.4 kg respectively (**Figure 4**). Treatment 3 (untreated control) peaked on a count 72, with an average of 31 export cartons (15 kg) per count, compared to treatment 1 (Cima, Commercial) and treatment 3 (ESS 100) both peaking on a count 105 (**Figure 5**).

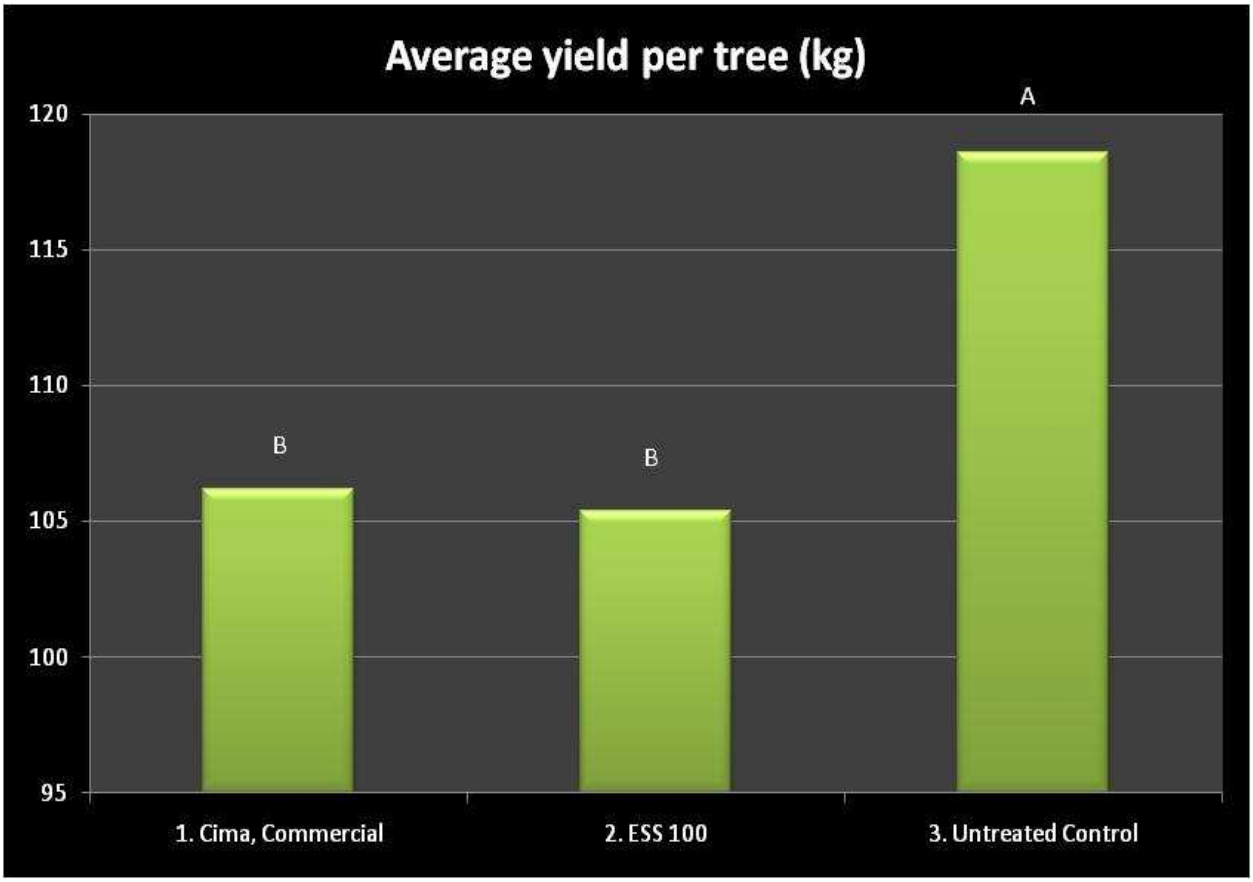

Figure 4. The average yield per tree for various treatment methods of ProGibb on citrus at Bavaria Estates in the Hoedspruit area, Limpopo province.

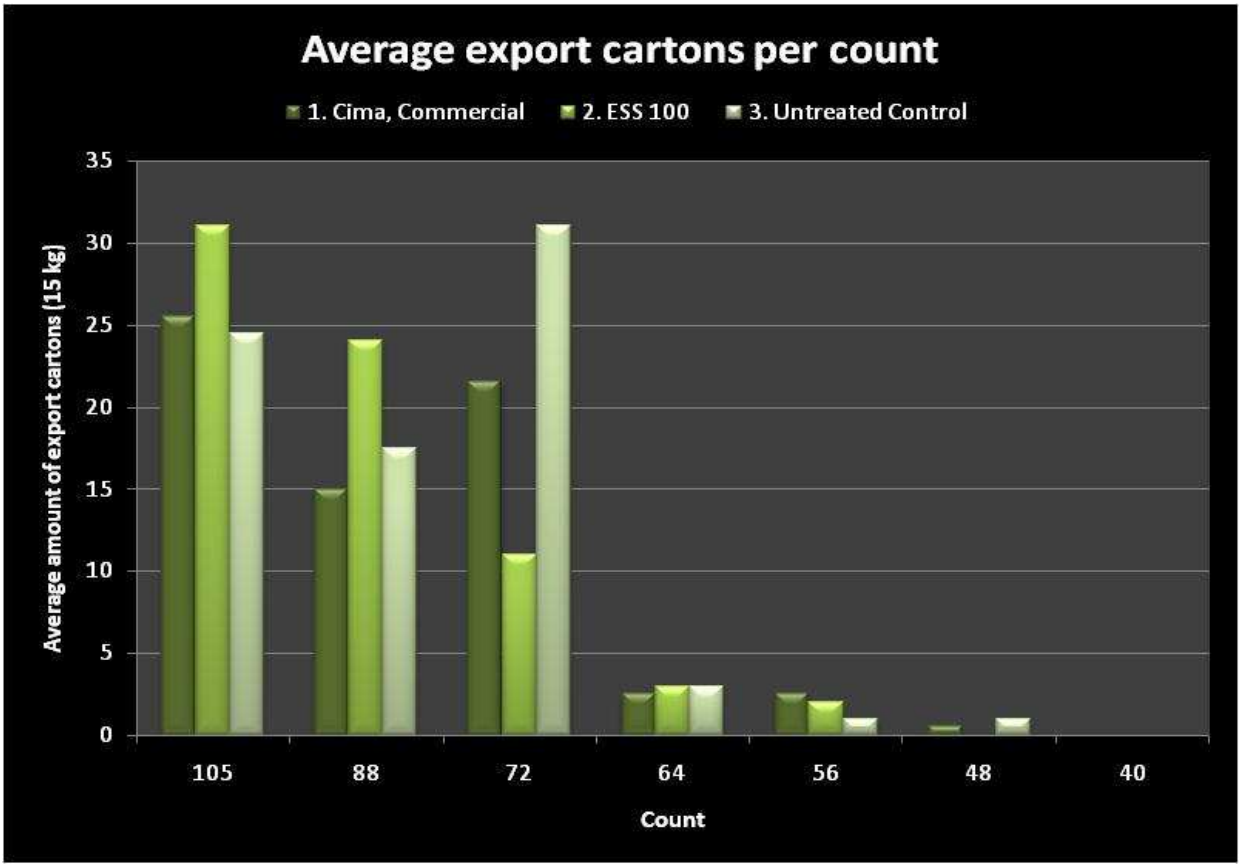

Figure 5. The average export cartons per count for various treatment methods of ProGibb on citrus at Bavaria Estates in the Hoedspruit area, Limpopo Province.

Conclusion

The first years' application of a citrus spray program with the ESS entered uncharted grounds. Results obtained are only preliminary results and should indicate the road forward regarding future research. Results indicated that it is possible to spray a citrus spray program with the ESS and achieve fair control of pests compared to the commercial spraying equipment. The different dosages applied per hectare with the ESS resulted in mixed results regarding degree of control of different pest. The natural infestation levels of different pest can vary dramatically in a specific orchard, and might possibly affected results to certain extend. No significant positive effect was observed by applying ProGibb 4% (Gibberellic Acid 4% w/w) with a commercial Cima sprayer or the ESS regarding fruit set and size. Management practices (irrigation cycles, fertiliser programs, etc.) and climatic conditions could mask the affected of gibberellic acid on fruit set and size.