ExperiCo
Fruit Technology Solutions

PROJECT NUMBER:	**G 02-08**	SEASON:	**2008**
CLIENT:	**Philagro SA (Pty) Ltd**	DISCIPLINE:	**Biological Systems**
RESEARCHER:	**J F Fourie**	PROJECT STATUS:	**Year 1**
CO-WORKER:	**P Mouton**		

Evaluate the efficacy of the ESS electrostatic spray applicator for the treatment of Thompson Seedless grapes with ProGibb® 40%, compared to application with a conventional spray system

OBJECTIVE:

To determine the effect of ProGibb® 40% applied with an ESS electrostatic spray-applicator, or a conventional spray system, on berry enlargement of Thompson Seedless table grapes, and the effect of such treatments on post-storage quality, as well as bud fruitfulness (measured after bud-break, following the previous seasons applications).

SUMMARY:

- Berry diameter and length, as well as berry mass, was increased significantly by applying ProGibb® 40% (3 sprays of 112.5 g / ha) with an ESS electrostatic spray applicator (60 L water / ha), compared to a conventional spray system (1500 L water / ha).
- The percentage berries meeting the criteria of X-large (>18 mm diameter) was significantly higher for electrostatic, compared to conventional application of ProGibb® 40%.
- Berry distribution exhibited a shift towards the larger diameter groups for ESS electrostatic spray application of ProGibb® 40%, compared to the conventional system.
- Post-storage quality was not affected by the ESS electrostatic spray application of ProGibb® 40%, compared to conventional spraying.
- Bud break, as well as the percentage shoots bearing bunches, was not affected by application method (Electrostatic vs. Conventional), or concentration of ProGibb® 40%.

TREATMENT DETAIL:

Treatments:

Table 1 : Treatment applications for berry enlargement of Thompson Seedless

Treatment	ProGibb®40%	Water volume / spray type	Spray schedule	Timing of application
1	9 x 12.5 g sachets per spray timing	60 - 80 L / ha Electrostatic	1st Spray (ProGibb) 2nd Spray (ProGibb) 3rd Spray (ProGibb)	50% berries @ 4-5 mm 75% berries @ 4-5 mm 100% berries @ 4-5 mm
2	9 x 12.5 g sachets (= 3 x 30 ppm)	1500 L / ha Conventional	1st Spray (ProGibb) 2nd Spray (ProGibb) 3rd Spray (ProGibb)	50% berries @ 4-5 mm 75% berries @ 4-5 mm 100% berries @ 4-5 mm

Procedure:

- Conventional ProGibb® 40% applications for rachis stretching and flower thinning were applied by the producer
- 3 x ProGibb® 40% applications were done for berry enlargement at concentrations (dosages) as indicated above, using either ESS electrostatic spray or conventional applicators.
- Foliwet (3 mL / 100 L water) was used as wetter for conventional spray applications, while no wetter was added for electrostatic applications.
- All applications were sprayed by the producer
- Standard viticultural practices, as required for the production of export quality table grapes, were applied by the producer

Cultivar:

Thompson Seedless, sourced from Southern Farms, Schuitdrift, Orange River area

Examination procedure:

Table 2 : Evaluation procedure utilized for Thompson Seedless treated with ProGibb® 40%, using either ESS electrostatic or conventional spray systems, for examinations at harvest and after cold storage

Parameter	Procedure	Time
Total soluble solids (TSS)	25 Berries selected randomly from the bunches per replicate vine (1-2 berries per bunch, depending on the number of bunches per vine) for measurement of the TSS (ºBrix) with an Atago refractometer	At harvest - when first treatment complied to export standards for harvesting
Titratable tartaric acid (TA)	The same sample as for TSS measurements above, used to measure TA (%) with a Metrohm titrator	At harvest - when first treatment complied to export standards for harvesting
Bunch colour (colour rating)	10 Bunches per replicate vine classified according to green / yellow colour, using colour chart D.38	At harvest - when first treatment complied to export standards for harvesting
Berry size distribution: Length (mm) Diameter (mm) Mass (g)	Berry size distribution of 3 bunches per replicate vine determined by randomly selecting 500 g berries per bunch (5 g divergence), of which the length and diameter (mm) of each of the berries in the sample was measured	After storage
Quality disorders	Determination of the percentage berry split, berry drop, SO_2 damage and decay on each of 4 remaining bunches of the original sample of 7 bunches per replicate vine, as well as rate the stem condition according to level of desiccation (1-5, with 1 = green and 5 = brown and totally desiccated), berry firmness (1-3, where 1 = firm and 3 = flaccid) and level of brittleness (1-3, where 1 = flexible / not brittle and 3 = brittle)	After storage
Bud fruitfulness	Determine on the marked vines after the previous seasons treatments	After bud break

RESULTS:

Table 3: Effect of applying ProGibb® 40% with an ESS electrostatic spray applicator compared to a conventional spray system, for berry enlargement of Thompson Seedless table grapes. Assessments were done on grapes at harvest

Examination parameter	Treatment (application system and product)		Prob>F[1]
	Electrostatic for ProGibb® 40% @ 3 x 112.5 g in 60 L water / ha	Conventional for ProGibb® 40% @ 3 x 112.5 g in 1500 L water / ha	
Berry diameter (mm)	18.5a	17.2b	**
Berry length (mm)	28.2a	26.4b	*
Berry mass (g)	7.5a	6.4b	**
Total soluble solids[2] (°Brix) at harvest-1	18.2a	18.4a	*
Total soluble solids[3] (°Brix) at harvest-2	-	-	NS
Titratable tartaric acids[2] (g / mL)	0.812b	0.853ab	*
Titratable tartaric acids[3] (g / mL)	-	-	NS
Berries classified as X-Large[4] (%)	62.5a	35.3b	**
Berries classified as Large[4] (%)	28.9	40.4	NS
Berries classified as Regular[4] (%)	8.7b	24.3a	**

1 ANOVA table, with NS, *, ** & *** indicating non-significant and significant differences at the 5%, 1% and 0.1% levels, respectively. Values in the same row, followed by different letters, indicate significant differences (P<0.05) according to the LSD test

2 Total Soluble Solids and Titratable tartaric acids determined for all 4 treatments at day of harvest of treatments 1 & 2 (sugars of treatments 3 & 4 not ready for harvest on 1st harvest date)

3 Total Soluble Solids and Titratable tartaric acids determined for treatments 3 & 4 only, 1 week after harvest 1. No values are displayed for treatments 1 & 2, harvested the previous week

4 Classification into different categories according to berry diameter, X-large (> 18 mm), large (16-18 mm) and regular (<16 mm)

Table 4: Percentage berries per size distribution category, determined by counting the number of berries of a specific diameter, after treatment of Thompson Seedless table grapes with ProGibb® 40%, using an ESS electrostatic or conventional spray system

Berry diameter/ size group[2] (mm)	Treatment (application system and product)		Prob>F[1]
	Electrostatic for ProGibb® 40% @ 3 x 112.5 g in 60 L water / ha	Conventional for ProGibb® 40% @ 3 x 112.5 g in 1500 L water / ha	
≥23	0.8	0.2	NS
≥22<23	1.9	0.1	NS
≥21<22	5.3	1.1	NS
≥20<21	12.6a	4.4b	*
≥19<20	21.8a	11.9b	*
≥18<19	20.0	17.6	NS
≥17<18	17.6	21.1	NS
≥16<17	11.3b	19.4a	*
≥15<16	6.2b	12.5a	*
≥14<15	1.5b	5.8a	**
≥13<14	0.6b	1.8a	*
<13	0.5	4.2	NS

1 ANOVA table, with NS, *, ** & *** indicating non-significant and significant differences at the 5%, 1% and 0.1% levels, respectively. Values in the same row, followed by different letters, indicate significant differences (P<0.05) according to the LSD test

2 Values for the different treatments are indicated per row, with berry diameter distribution ranging between 13-23 mm, while berries of a diameter <13 and ≥23, respectively, are pooled

Table 5: Colour rating of Thompson Seedless bunches at time of harvest, using colour chart D38, after treatment of Thompson Seedless table grapes with ProGibb® 40%, using an ESS electrostatic or conventional spray system

Berry / Bunch colour range[2]	Treatment (application system and product)		Prob>F[1]
	Electrostatic for ProGibb®40% @ 3 x 112.5 g in 60 L water / ha	Conventional for ProGibb®40% @ 3 x 112.5 g in 1500 L water / ha	
Yellow (%)	20.0	19.0	NS
Green/ Yellow (%)	42.0	44.0	NS
Green (%)	38.0	37.0	NS

1 One-way ANOVA table, with NS, *, ** & *** indicating non-significant and significant differences at the 5%, 1% and 0.1% levels, respectively. Values in the same row, followed by different letters, indicate significant differences (P<0.05) according to the LSD test

2 Bunch colour: rated according to colour chart D38. The percentage bunches within categories 1 & 2, categories 3 & 4 and categories 5 & 6 were grouped into a green, green/ yellow and yellow range, respectively

Table 6: Post-storage quality of Thompson Seedless grapes treated for berry enlargement with ProGibb®40%, applied using an ESS electrostatic or conventional spray system. Assessments were done after 5 weeks storage at -0.5°C, followed by 3 days shelf life at 7.5°C

Examination parameter[2]	Treatment (application system and product)		Prob>F[1]
	Electrostatic for ProGibb®40% @ 3 x 112.5 g in 60 L water / ha	Conventional for ProGibb® 40% @ 3 x 112.5 g in 1500 L water / ha	
Decay from natural infections (%)	0.0	0.2	NS
Berry split (%)	0.2c	0.5	NS
Loose berries (%)	0.3	0.3	NS
Pedicel SO_2 damage (%)	1.2	1.6	NS
Total SO_2 related damage (%)	1.7	2.4	NS
Stem condition (1-5, 1 = green)	2.1	2.2	NS
Berry firmness (1-3, 1 = firm)	1.6	1.7	NS
Brittleness of stems (1-3, 1 = flexible)	1.3	1.2	NS

1 One-way ANOVA table, with NS, *, ** & *** indicating non-significant and significant differences at the 5%, 1% and 0.1% levels, respectively. Values in the same row, followed by different letters, indicate significant differences (P<0.05) according to the LSD test

2 Examination parameters: Decay, berry split, loose berries and SO_2 damage were expressed as a percentage of the sample mass. Stem condition was rated according to a 5-point scale (1 = green stems and 5 = brown and desiccated), berry firmness according to a 3-point scale (1 = turgid and 3 = flaccid) and brittleness of stems according to a 3-point scale (1 = flexible and 3 = brittle). Pedicel SO_2 indicate SO_2 damage occurring at the pedicel attachment area, while "Total SO_2 related damage represents a summation of berry split and loose berries showing SO_2 damage, and berries showing SO_2 damage at the surface or pedicel attachment area. "Natural decay" = *Botrytis* decay developing naturally from inherent infections

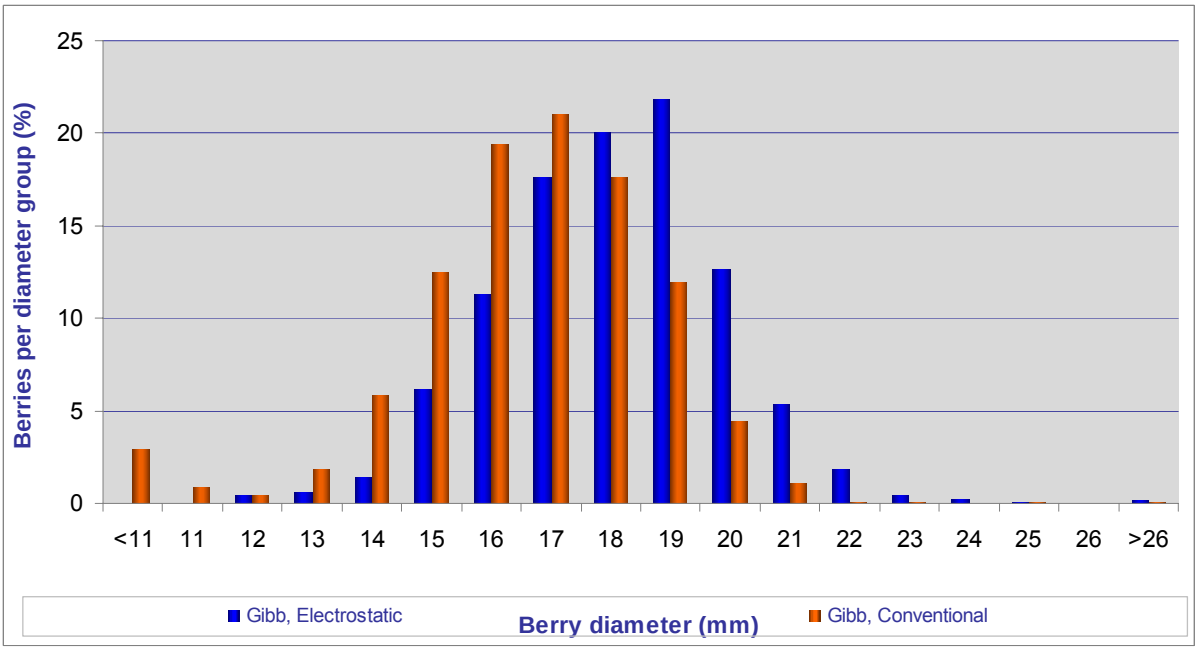

Figure 1 : Distribution of berries within each of the berry diameter categories, after treatment of Thompson Seedless table grapes with ProGibb®40%, using either an ESS electrostatic spray applicator (60 L water / ha), or a conventional spray system (1500 L water / ha)

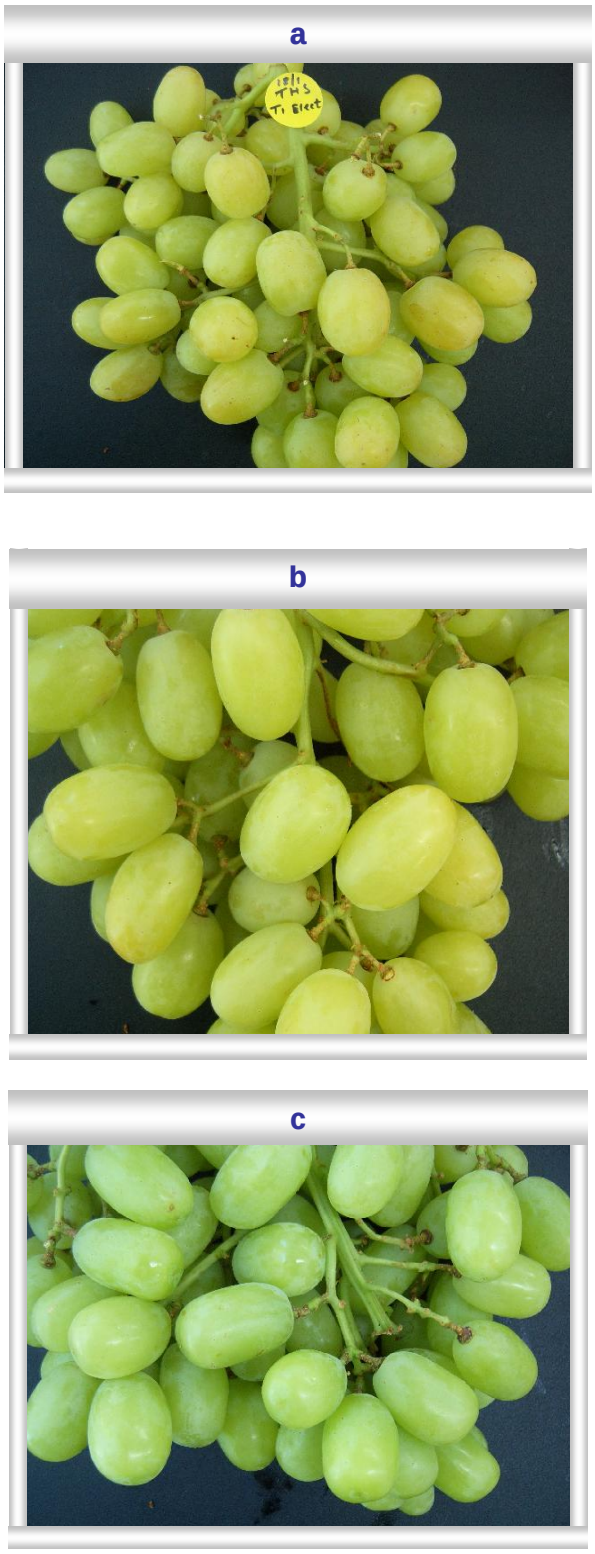

Figure 2 : Effect of applying ProGibb®40% electrostatically at 112.5 g / 60 L water for berry enlargement of Thompson Seedless table grapes, with Fig's 2a-c exhibiting berries of a relative even size throughout the bunch, and berries of a large diameter, with a 'squared' appearance

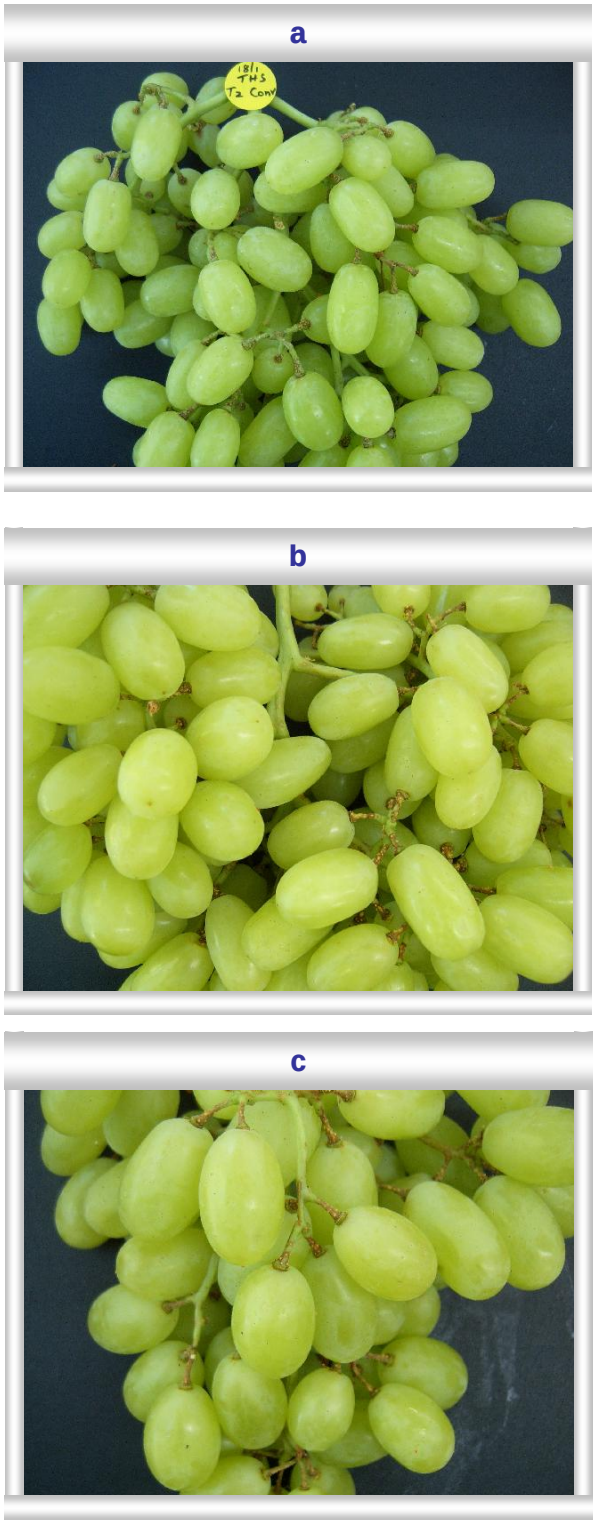

Figure 3 : Effect of applying ProGibb®40% with a conventional spray system at 112.5 g / 1500 L water for berry enlargement of Thompson Seedless table grapes, with Fig's 3a-c exhibiting berries of varying size, and berries of a smaller diameter than the ESS electrostatic application, with an 'elongated' appearance

Table 7: Effect of applying ProGibb®40% at different dosages, using either an ESS electrostatic spray applicator or a conventional spray system, on bud fruitfulness of Thompson Seedless table grapes in the next season, recorded after bud break (August 2007)

Treatment[2] (application method & dosage)	Average[1] bud fruitfulness		Standard deviation	
	Bud break (%)	Shoots with bunches (%)	Bud break (%)	Shoots with bunches (%)
Electrostatic at 3 x 86.25g in 60 L water / ha	82.8	49.9	7.0	15.0
Electrostatic at 3 x 127.5 g in 60 L water / ha	79.6	47.9	8.2	10.8
Electrostatic at 3 x 168.75 g in 60 L water / ha	80.5	49.1	7.1	13.3
Conventional at 3 x 127.5 g in 1700 L water / ha	81.6	43.6	9.2	5.4

1 Average calculated for 10 replicates of 3 shoots each, for each of the treatments
2 Treatments refer to trial conducted in 2007. Refer to previous report for more detail

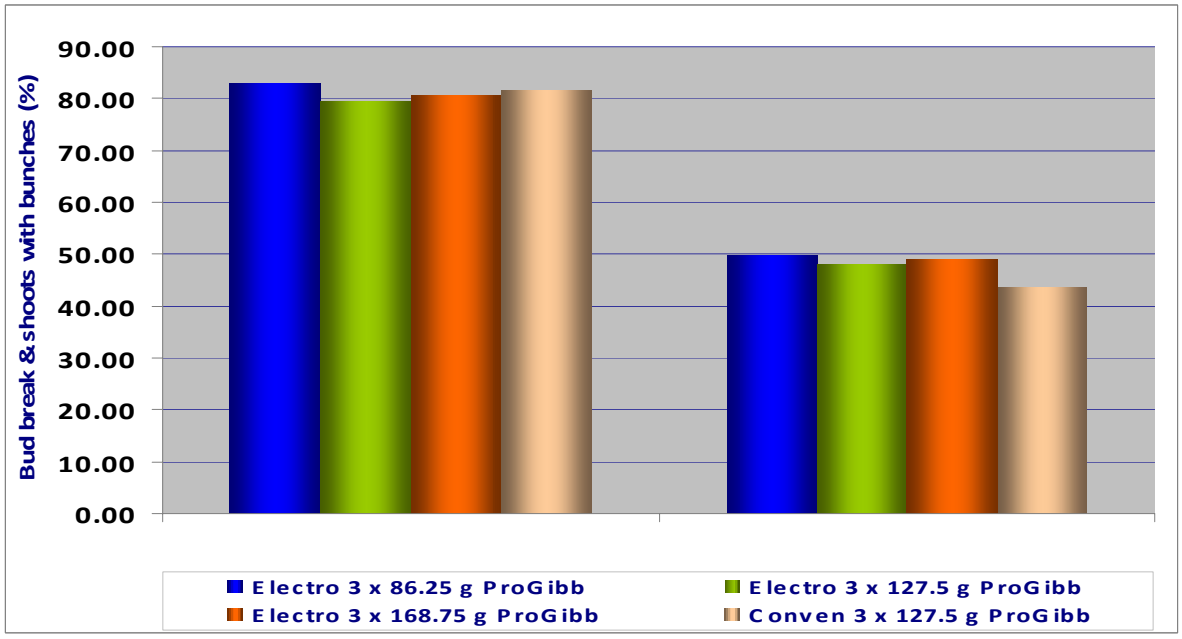

Figure 4: Effect of applying ProGibb®40%, at different dosages, using either an ESS electrostatic spray applicator, or a conventional spray system, on bud fruitfulness of Thompson Seedless table grapes, as recorded after bud break (August 2007)

FINDINGS TO DATE:

Effect of electrostatic sprays on berry enlargement and harvest maturity (Table 3 and Fig's. 2 & 3)

- Berry diameter and length, as well berry mass, was significantly increased by using the ESS electrostatic spray applicator (60 L water / ha), compared to the conventional system (1500 L water / ha), for treatment of Thompson Seedless with ProGibb® 40% for berry enlargement.
- The percentage berries meeting the criteria of 'X-large' (>18 mm diameter) was significantly higher, and significantly lower for 'Regular' size, for treatment of Thompson Seedless electrostatically with ProGibb® 40% at 112.5 g in 60 L water / ha, compared to the conventional spray system (1500 L water / ha).
- Berries of a relative even size, and berries of a large diameter, with a slightly 'squared' appearance occurred with electrostatic application of ProGibb®40% at 112.5 g / 60 L water (Fig. 2).
- Berries of varying size, a smaller diameter and 'elongated' appearance, occurred for application of ProGibb®40% with a conventional spray system at 112.5 g / 1500 L water (Fig. 3).

Effect of electrostatic sprays on berry size distribution (Table 4 & Fig. 1)

- Only a small percentage of the berries, with no significant differences between any of the treatments, were of the diameter categories ≥ 23 mm, 22-23 mm and 21-22 mm.
- A significantly higher percentage berries were of a diameter 20-21 mm and 19-20 mm where ProGibb® 40% was applied electrostatically, compared to the conventional system. Consequently, less smaller berries, of diameter 16-17 mm, 15-16 mm, 14-15 mm and 13-14 mm occurred for electrostatic, compared to conventional application.
- The distribution of the number of berries within each diameter group clearly shows a shift towards a higher percentage of berries within the larger diameter group (>18 mm) for application of ProGibb® 40% electrostatically, compared to the conventional method (Fig. 1).

Effect of electrostatic sprays on bunch colour (Table 5)

- No significant differences in colour rating occurred as result of the application method for treatments assessed on the first harvest date. Most bunches were classified in the green/ yellow and green band.

Post storage quality of Thompson Seedless (Table 6)

- No differences in post-storage quality occurred between the two application methods.

Effect of spray method and treatments on bud fruitfulness (Table 7, and Figures 4)

- Data refer to assessment of percentage bud break and bunch bearing shoots in August 2007, for vines sprayed during the 2006/ 2007 growing season.
- Bud break, varying between ± 80-83% and shoots with bunches, varying between ± 44-53%, appeared to be not affected by treatment or dosage (Table 5 & Fig. 4).

RECOMMENDATIONS:

Experimental

(i) Conduct tests for the application of ProGibb® 40% with use of the ESS electrostatic spray technology on other cultivars.

(ii) Conduct ProGibb® 40% electrostatic application trials on Thompson Seedless and other cultivars in the Western Cape.

(iii) Confirm the finding that the ESS electrostatic spray application does not affect bud fruitfulness (August 2008).

Commercial

Commercial recommendations for the use of the ESS electrostatic spray system for the treatment of Thompson Seedless with ProGibb® 40% for berry enlargement, can be made with confidence, without apparent risk of affecting bud fertility or post-storage quality. It is advised not to recommend the application of dosages higher than 112.5 g ProGibb® 40% at 60 L water / ha, for possible deformed berries, tight bunch clusters and bruising during storage. It is imperative to conduct further trials to incorporate the recommendation for electrostatic applications of ProGibb® 40% on the "label".

BENEFIT TO CLIENT:

Results of three seasons for electrostatic application of ProGibb® 40% are now available, all being positive. Berry enlargement (diameter and length), increased berry mass, improved berry uniformity and increased percentage bunches with 'X-large' berries, were exhibited. No negative effect on bud fertility has been shown for two consecutive years for electrostatic applications of ProGibb® 40%. A third assessment for bud fruitfulness will be conducted after the next bud break (August 2008).