Effect of convectional versus electrostatic spraying of calcium-containing formulations to apples

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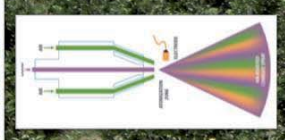
Surface application of calcium fertilisers to apples is a widely used and recommended strategy to prevent the development of bitter pit, a calcium-related disorder that can lead to major economic losses. Air-assisted electrostatic sprayers (ES) produce spray droplets which are 900 times smaller than those supplied by conventional sprayers. These tiny droplets are carried deep into the plant canopy in a high-speed air-stream. Such spraying method may increase more than twice the deposition efficiency of treatments as compared to non-electrostatic sprayers. However, the significantly smaller size of the drops produced by ES may prove critical for the application of treatments under the prevailing dry Summer conditions in Southern Europe, due to the potential rapid evaporation of the solutions applied to the plants.

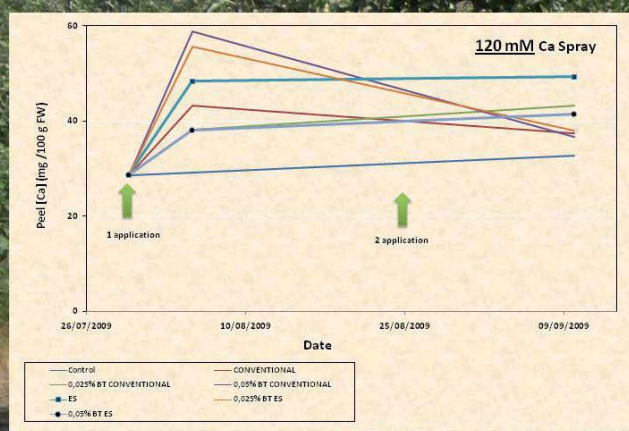


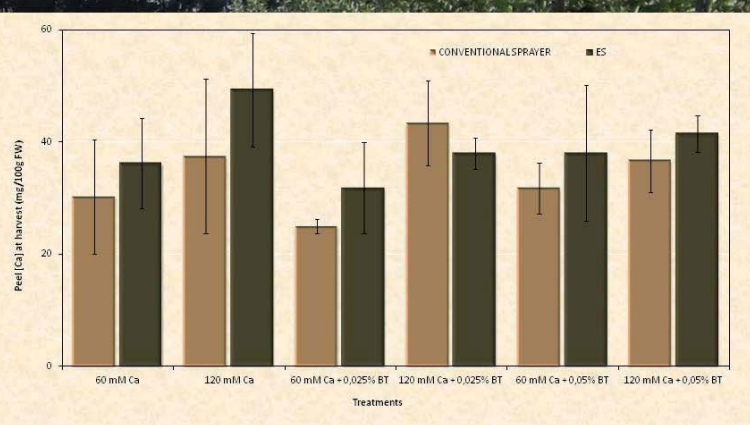
A trial to contrast the effect of supplying calcium formulations with a conventional versus an electrostatic sprayer (ES) to apples cv. "Golden Delicious" was developed in an experimental plot at Estación Experimental de Aula Dei, CSIC, Zaragoza, Spain. Treatments were applied in the early morning of 30/07/09 and 26/08/09, making sure that apples were sprayed to run-off.

Spray volumes used on field treatments (L)

Treatment solution	Convencional	ES
Ca + 0.05%BT	5	2.5
Ca + 0.025%BT	5	3
Ca	5	2.5
Ca 0.25% + 0.05%BT	5	3
Ca 0.25% + 0.025%BT	5	2.5
Ca 0.25%	5	2.5
Mean volume applied	5	2.66

For complete and intense wetting of the fruit surface, ½ of the solution volume was employed but 2-times more time was required when using the ES in contrast to the conventional sprayer, which supplied considerably larger drop sizes.





The effect of $CaCl_2$ (120 and 60 mM) applied alone or in combination with 0.05 or 0.025 % of an organosilicon surfactant (Break Thru, BT; Evonik Goldschmidt, Germany) concentration regarding Ca peel and pulp concentrations 1 week after spraying and at harvest were estimated after wet digestion by Atomic Absorption Spectroscopy.

Anova table with the effect of spraying technique, Ca concentration and surfactant on quality properties of 'Smoothee Golden Delicious' apples at harvest.

	ES	Ca	Surfactant	ES x Ca	ES x Surfactant	Ca x Surfactant	ES x Ca x Surfactant
Fruit Weight	ns	ns	ns	ns	*	ns	*
Firmness	ns	*	**	ns	ns	ns	**
Soluble Solids	*	ns	**	***	ns	ns	***
Acidity	***	***	***	***	***	***	***
Caliper	ns	ns	ns	ns	*	*	*

Not significant (ns), or significant where *P < 0.05 or **P < 0.01

No major effects were observed in terms of fruit quality attributes. However, in relation to tissue calcium increases, differences associated with the 2 spraying techniques and treatment calcium concentrations were observed, in contrast to the lack of surfactant effect.

Conclusion

Evidence was gained that supplying calcium fertilisers to apples with the ES enabled reducing of the solution volume employed and sometimes increased tissue Ca concentrations. However, the lower size of drops produced by ES as compared to the ones supplied with a conventional sprayer may prove critical under the Mediterranean Summer conditions due to the rapid solution evaporation. On the other hand, complete wetting of the tree canopy by ES proved significantly more time-consuming as compared to the application of treatments with the conventional sprayer. In summary, the use of ES techniques to apply foliar fertilisers can be successful providing that plant surfaces are thoroughly covered by the spray solution under environmental conditions inducing lower evaporation rates (e.g., in the early morning).