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## Foliar absorption of calcium by tomato plants: Effects of calcium source & adjuvant

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The deficiency of calcium can have a detrimental effect on the quality and shelf life of fruits. In addition to appropriate soil fertilization, foliar sprays containing  $\text{Ca}^{2+}$  sources present an alternative solution to prevent and address this issue. X-ray fluorescence microanalysis was utilized to observe the foliar absorption of  $\text{CaCl}_2$ , Ca-citrate complex, and  $\text{Ca}_3(\text{PO}_4)_2$  nanoparticles, with and without mineral oil as an adjuvant. The foliar absorption of  $\text{Sr}^{2+}$  was utilized as a physiological tracer for  $\text{Ca}^{2+}$ . The impact of treatments on the cuticle structure was measured via scanning electron microscopy. For this study, 45-day-old tomatoes (*Solanum lycopersicum* L., cv. Micro-Tom) were employed as the model plant species.

During the 100-hour period, the leaves absorbed 90%, 18%, and 4% of aqueous  $\text{CaCl}_2$ , Ca-citrate, and  $\text{Ca}_3(\text{PO}_4)_2$  nanoparticles, respectively. The addition of an adjuvant increased the absorption of Ca-citrate to 28%, decreased that of  $\text{CaCl}_2$  to 77%, and did not affect  $\text{Ca}_3(\text{PO}_4)_2$ .  $\text{CaCl}_2$  demonstrated an exponential decay absorption profile, with  $t_{50\%}$  of 15 hours and 5 hours without and with adjuvant, respectively, while Ca-citrate and  $\text{Ca}_3(\text{PO}_4)_2$  exhibited a linear behavior.  $\text{Sr}^{2+}$  proved to be an appropriate tracer for  $\text{Ca}^{2+}$  since their absorption profiles were similar. The adjuvant disrupted the epicuticular crystals, and the movement of Ca inside of the leaf was limited to a few millimeters away from the deposited spot. The findings of the study suggest that  $\text{CaCl}_2$  was more effective than the other sources of  $\text{Ca}^{2+}$ . The effects caused by the adjuvant imply that  $\text{CaCl}_2$  and Ca-citrate were mainly absorbed through hydrophilic and lipophilic pathways, respectively.

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