

Post-bloom and preharvest treatment of ‘Braeburn’ apple trees with prohexadione-calcium and GA₄₊₇ affects vegetative growth and postharvest incidence of calcium-related physiological disorders and decay in the fruit

Cassandro V. T. do Amarante, João Paulo G. Silveira, Cristiano A. Steffens, Sergio T. de Freitas, Elizabeth J. Mitcham and Aquidauana Miqueloto

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Abstract

Calcium (Ca) deficiency disorders in apple fruit have been associated with high gibberellins (GAs) activity in the tree. This study was carried out to assess the effects of treatments of ‘Braeburn’ apple trees with prohexadione-calcium (ProCa, an inhibitor of GAs biosynthesis) or gibberellins (GA₄₊₇) on vegetative growth of the trees and postharvest incidence of Ca-related physiological disorders and decay in the fruit. ProCa (300 mg L⁻¹) or GA₄₊₇ (300 mg L⁻¹) treatments were applied post-bloom (PB) and preharvest (PH). PB treatments started 15 days after full bloom (DAFB), with one application every week and six applications in total. PH treatments started five weeks before anticipated harvest (125 DAFB), with one application every week and four applications in total. Control trees were left untreated. When applied PB, ProCa reduced and GA₄₊₇ promoted vegetative growth of the trees. ProCa PB delayed the impairment of xylem functionality (at the proximal region of the fruit) during fruit growth on the tree. Treatments had no effect on fruit weight, pectinmethylesterase (PME) activity or the expression of *CAX3*, *CAX6* and *V-ATPase* (transporters of Ca into the vacuole) genes assessed in the external cortical tissue at the distal end of the fruit at harvest. When sprayed PB, ProCa increased the total Ca content and reduced K/Ca, Mg/Ca, N/Ca, (Mg + K)/Ca and (K + Mg + N)/Ca ratios in the flesh at the distal portion of the fruit, compared to the treatment with GA₄₊₇, but without differing from the control. In general, ProCa application PB or PH reduced the expression of *Ca-ATPase1*, *Ca-ATPase2*, *H⁺-PPase* and *CAX2* (Ca transporters into the vacuole) genes, increased total water-soluble Ca and reduced electrolyte leakage in the fruit at harvest. After two months of cold storage followed by

five days of shelf-life, the incidence and severity of bitter pit (BP) was lower on fruit from trees treated with ProCa PH, and higher on fruit from trees treated with GA₄₊₇ PB. GA₄₊₇ PB also increased the incidence of skin cracking and decay in the fruit. The results showed that ProCa application represents a feasible tool to reduce the incidence of BP. However, ProCa is more effective to reduce BP if applied weekly for five week before harvest.