

Title Changes in xylem functionality during apple fruit development: Implications on calcium content and incidence of bitter pit

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Abstract

Apple xylem becomes dysfunctional as the fruit develops. This change in xylem functionality has been related to a nutritional imbalance and, consequently, to the increased development of fruit disorders after harvest. The aim of this study was to assess the relationship between xylem failure in developing apples and fruit calcium contents in cultivars with different susceptibilities to bitter pit. 'Fuji' and 'Catarina' apple fruit (considered with low and high susceptibility to bitter pit, respectively) were harvested from an orchard in Sao Joaquim, Southern Brazil, in 2009-2010. Developmental changes in xylem functionality of the fruit were investigated by using a dye infusion technique (1% w/w aqueous acid fuchsin) to stain the vasculature along the path of dye movement. The number of vascular bundles (primary, dorsal and ventral bundles) with presence of dye was recorded in fruits sectioned equatorially at regular intervals throughout the season. The content of Ca, Mg, K and N at the distal end of the fruits was assessed in apples harvested at 40, 68, 96, 131, 173 and 188 days after full bloom (DAFB). As the season progressed, an increasing proportion of vascular bundles failed to show any staining, with the most marked change occurring in the primary bundles. Decreased dye conductance in the primary bundles of 'Catarina' occurred earlier (40 DAFB) than in 'Fuji' (90 DAFB). Accordingly, 'Catarina' apples had lower Ca content and higher K/Ca, Mg/Ca, (Mg+K)/Ca and (K+Mg+N)/Ca ratios at the distal section of the fruit, as well as a higher severity of bitter pit at harvest than 'Fuji' apples. These results show that the apple cultivar with the highest susceptibility to bitter pit has an earlier onset of xylem dysfunction, lower Ca content, and higher (K +Mg+N)/Ca ratio than cultivar with the lowest susceptibility.