Ineffectiveness of foliar S-ABA application as an apple sunburn suppressant explained through effects on peel biochemistry and leaf ecophysiology

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Abstract

Sunburn is a physiological disorder that affects the visual quality of apple (Malus Domestica) fruit. In South Africa, producers estimate yield losses of up to 50\% in green cultivars due to sunburn damage. Recent research in Japan has found that foliar application of abscisic acid (S-ABA) reduced sunburn in apples by up to 30\%. The aim of this study was to examine the effect of S-ABA application on the occurrence of sunburn and on other fruit quality parameters in ‘Granny Smith’, the apple cultivar that suffers most sunburn under South African conditions. Trials were conducted over three growing seasons from 2010–2011 to 2012–2013 in a ‘Granny Smith’ orchard in Grabouw, South Africa. S-ABA was applied at concentrations between 250 and 1000 ppm and various timings during summer (from November until harvest in March/April). A representative scaffold branch on both sides of the tree was strip picked at commercial harvest resulting in samples of at least 100 fruit per tree for sunburn, fruit color, and red blush assessment. A sub-sample of 20 fruit was randomly selected and used to determine average fruit size, fruit firmness, and internal quality. The application of S-ABA did not decrease sunburn incidence and severity under South African growing conditions. S-ABA application decreased the peel concentration of total antioxidants, total phenolics and reduced ascorbic acid whilst increasing oxidized ascorbic acid. These changes suggest that S-ABA either downregulated synthesis of antioxidants or caused increased oxidative stress. Consistent with S-ABA application possibly causing stress, leaf necrosis was observed when S-ABA was applied just prior to periods of high temperature. Consistent with its physiological role in plants, S-ABA application decreased stomatal conductance and thereby also decreased the net carbon assimilation and transpiration rates, while the stem water potential was increased due to reduced water loss. Concomitant with the decrease in carbon assimilation, there was a significant reduction in total soluble solids, and titratable acidity with repeated S-ABA applications. S-ABA did not affect fruit maturity. Our results suggest that application of S-ABA to reduce sunburn is ineffective under South African conditions and therefore not recommended.