Bitter pit and soft scald development during storage of unconditioned and conditioned 'Honeycrisp' apples in relation to mineral contents and harvest indices

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Abstract

'Honeycrisp' apple fruit are highly susceptible to development of soft scald and bitter pit during storage. However, the commercial postharvest treatment of conditioning fruit at 10 °C for 7 d before storage at 3 °C to reduce soft scald development can increase bitter pit incidence. Prediction of these physiological disorders would enable storage operators to modify management techniques to reduce fruit losses due to both disorders. To develop prediction tools, harvest indices and mineral concentrations of fruit were analyzed from orchard blocks in Pennsylvania (PA) for three years, the Hudson Valley region (HV) for four years, the Champlain region for two years, and Western New York (WNY) for five years. Fruit were stored at 3 °C, without or with conditioning, and stored for 2 - 5 months in 2013- 2017. Fruit were also stored at 0.5 °C without or with conditioning in 2013, 2015, 2016. Multivariate analysis described significant relationships that were different for unconditioned and conditioned fruit. In unconditioned fruit, bitter pit incidence was negatively correlated with increasing internal ethylene concentration (IEC) and starch pattern indices (lower starch content), positively with higher chlorophyll content as indicated by the index of absorbance difference and with all minerals except N, as well as mineral ratios. In conditioned fruit, bitter pit incidence was correlated negatively with IEC, Ca, and positively with firmness, and all mineral ratios. Soft scald incidence in fruit stored at 0.5 °C was positively correlated with IEC and firmness, and all fruit mineral ratios except N/Ca and P/Ca, and negatively with Ca and Mg. For conditioned and unconditioned fruit stored at 3 °C, harvest indices predicted 27-28 % and 21-26 % bitter pit, respectively, while minerals and mineral ratios predicted 22-55 % and 18-54 % bitter pit, respectively. Harvest indices predicted 29-57 % soft

scald, while minerals and mineral ratios predicted 29-49 for % soft scald for fruit stored at 0.5 °C. Correlations of bitter pit against P, K, and Mg were higher, and Ca and all mineral ratios lower, in conditioned fruit stored at 3 °C as opposed to those stored unconditioned at 3 °C. Nonlinear iterative partial least square algorithms based on variable importance plots *vs* coefficients showed that the regression of determination was affected by postharvest treatment in relation to harvest indices, minerals and their ratios. A negative correlation of bitter pit incidence against soft scald incidence was found for a region with high bitter pit and soft scald development.