J. Amer. Soc. Hort. Sci. 135(2):95–101. 2010.

Effect of Receiver pH on Infinite Dose Diffusion of $^{55}FeCl_3$ across the Sweet Cherry Fruit Exocarp

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Additional index words. cracking, cuticle, EELS, EDX, ferric salts, permeability, *Prunus avium*, stomata, TEM

Abstract. **Recent studies established that some ferric salts, including $FeCl_3$, decrease water permeability of the sweet cherry (*Prunus avium* L.) fruit exocarp and fruit cracking, presumably by a pH-dependent precipitation reaction that blocks high-flux pathways across the fruit surface. The objectives of our study were the following: to establish the effect of receiver pH on penetration of $^{55}FeCl_3$ through excised exocarp segments (ES) and isolated cuticular membranes (CM) and to localize any Fe precipitates in the epidermal system of mature sweet cherry fruit. Penetration was studied using an infinite dose diffusion system where ^{55}Fe penetrated from donor solutions of ferric salts (10 mM, pH 2.2–2.6) or EDTA-Na-Fe(III) (10 mM, pH 5.0) across an interfacing ES or CM into aqueous receiver solutions of pH values ranging from 2.0 to 6.0. For receiver pH 2.0, ^{55}Fe penetration of the ES from a 10 mM $FeCl_3$ donor (pH 2.6) was linear with time, but for receiver pH ≥ 3.0, penetration was low and insignificant. Increasing the pH of the water receiver from 2.0 to 6.0 in the course of an experiment resulted in an immediate halt of penetration regardless of whether ^{55}Fe penetration occurred from $FeCl_3$ (pH 2.6), $Fe(NO_3)_3$ (pH 2.6), or $Fe_2(SO_4)_3$ (pH 2.4) as donor solutions (all at 10 mM). Only from EDTA-Na-Fe(III) (pH 5.0) ^{55}Fe penetration continued to occur albeit at a decreased rate (–30%). At receiver pH 2.0, the $^{55}FeCl_3$ flux through stomatous 'Sam' ES averaged 10.4 ± 2.3 pmol·m^{-2}·s^{-1} and was positively correlated to stomatal density. Conventional and analytical electron microscopy (energy dispersive X-ray analysis, electron spectroscopic imaging, and electron energy loss spectroscopy) identified ferric precipitates in periclinal and anticlinal cell walls of epidermal cells underlying the cuticle, but not within the cuticle. These data indicate that the lack of ^{55}Fe penetration from donor solutions of ferric salts through the ES into a receiver solution at pH ≥ 3 and the previously reported decrease in water uptake and cracking as a response to immersing fruit in solutions of ferric salts are the result of a precipitation reaction at the cuticle/cell wall interface in the sweet cherry exocarp. Although spray application of ferric salts is prohibitive for ecotoxicological reasons, understanding their mechanism in decreasing water uptake and fruit cracking may be helpful in the search for alternate compounds that are effective and ecotoxicologically acceptable.**