STRUCTURE OF THE SURFACE OF THORNLESS BLACKBERRY FRUITS: RELEVANCE TO POSTHARVEST WEIGHT LOSS

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Strategies to improve marketability of small fruits include the identification of characteristics that contribute to longer shelf life. One characteristic of a durable berry is that it retains moisture after harvest and resists desiccation. In our study of 10 thornless blackberry cultivars and selections during refrigerated storage, weight loss varied from 1% to 3% per day and rates were linear for 10 days (1). Fluid leakage was not a factor, and the primary source of weight loss was concluded to be transpiration. Microscopy was performed to identify structural correlates of berry weight loss. Surface wax on plant structures is known to be a barrier to water loss (2).

Representative berries from the hand-selected fruits, sorted for weight loss analysis, were processed for microscopy 24-36 hr after harvest, during which time the fruits were held at 0-1 C. Samples were fixed with glutaraldehyde and osmium tetroxide, dehydrated with an acetone series, and embedded in Spurr's resin. To preserve epicuticular wax in situ, all processing was done in an ice bath except for resin infiltration which was at 19 C. Light microscopy sections were stained with methylene blue. TEM sections were stained with uranium and lead. Segments of unfixed epidermis were dried in a desiccator prior to SEM. Fruit from one cultivar were dewaxed with chloroform prior to EM processing. From micrographs, measurements or observations were made of cell structures potentially relevant to weight loss: cell size and shape, wall dimensions, cell-cell adherence, wax thickness.

Berries from high weight-loss cultivars tended to reveal that fact in their epidermal cells, which were flattened and empty of vacuolar material in samples prepared 24-36 hr after harvest. More retentive cultivars exhibited full, rounded epidermal cells containing suspended material. Failure of tonoplasts and/or plasma membranes of epidermal cells may be significant in liberating fluid that becomes available for evaporation at the berry surface and may reflect changes in the membrane or the cell wall due to senescence.

Blackberry fruit epicuticular wax was a continuous surface layer with local thickenings or mounds of wax. There was no evidence of plates, spicules, or other discontinuous wax forms. Stomates (about 20 per fruit) were localized to the apical region of drupelets, were well covered by wax and remained wax-filled in locations where epicuticular wax had been displaced apparently by mechanical means.

No single structural feature, including epicuticular wax thickness, was consistently correlated with high or low weight loss, suggesting that a combination of factors is needed to describe water loss rates. The blackberry fruits examined had variable wax deposition in three locations on or within the skin, all of which are potential vapor barriers.

1. G. M. Sapers et al., J. Amer. Soc. Hort. Sci., in press.
2. J. T. Martin and B. E. Juniper, The Cuticles of Plants. Edward Arnold, Ltd., London. 1970. pp. 199-209.

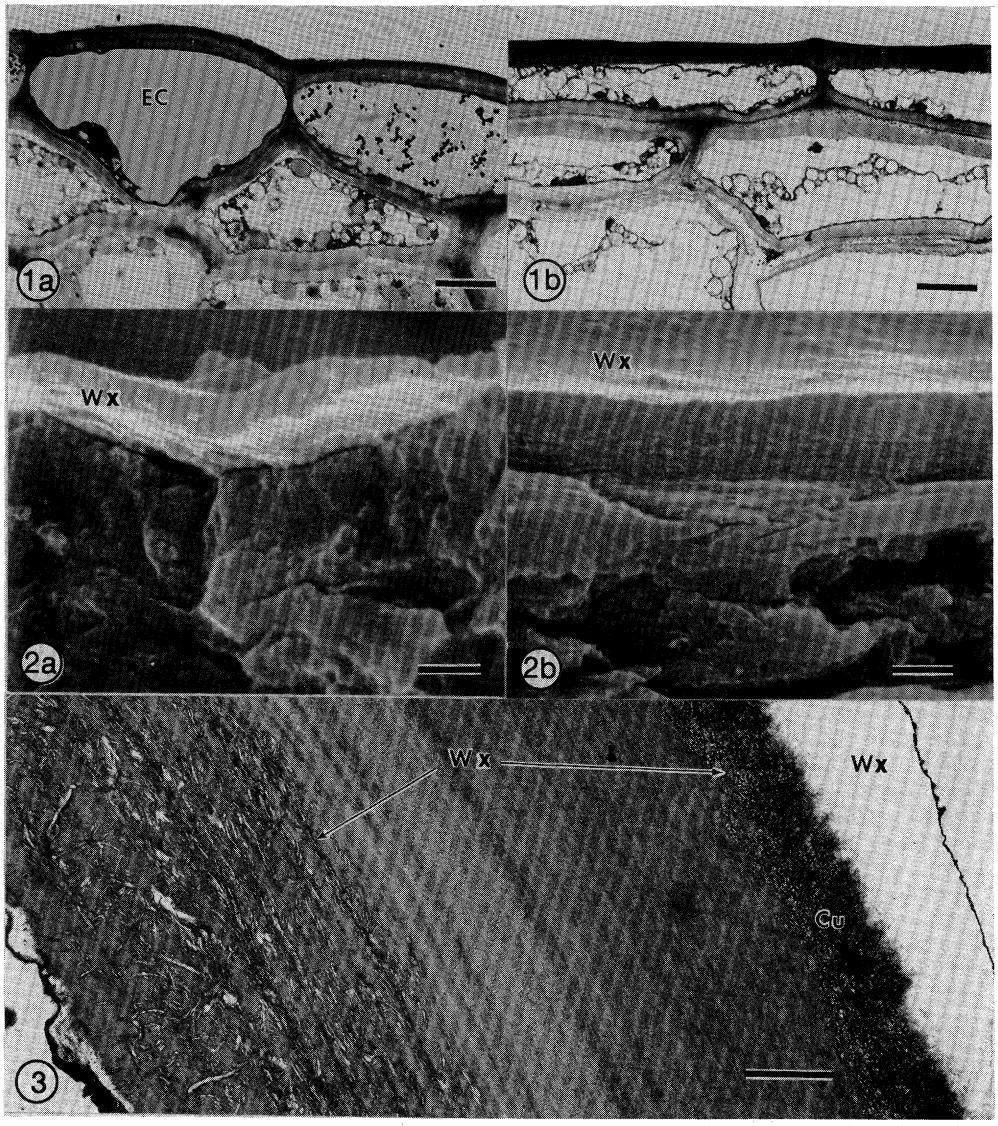

Fig. 1. Skin of ripe 'Black Satin' of slightly different maturities. 1a- less mature, with full epidermal cells (EC), weight loss 11% in 6 days; 1b- more mature, with empty epidermal cells, weight loss 17% in 6 days. All micrographs are of samples prepared 24-36 hr after harvest. Bars = 20 µm.

Fig. 2. Cross-sections of 'Chester' surface. 2a- Wax appears as a flow on the surface; 2b - Dewaxing left a thin layer of residual surface wax. Dewaxed berries were useful standards for interpreting wax disposition in the various samples. Wx = wax. Bars = 1 µm.

Fig. 3. Cross-section of wall-cuticle complex of ripe 'Hull Thornless' showing three locations of wax deposition. In TEM, the surface of the epicuticular wax stained heavily. Cu = cuticle, Wx = wax. Bar = 1 µm.