

California Avocado Society Yearbook 76 (1992): 119-121.

## Occurrence of Stone Cells in Avocado Fruit Pericarp in Response to Mechanical Injury

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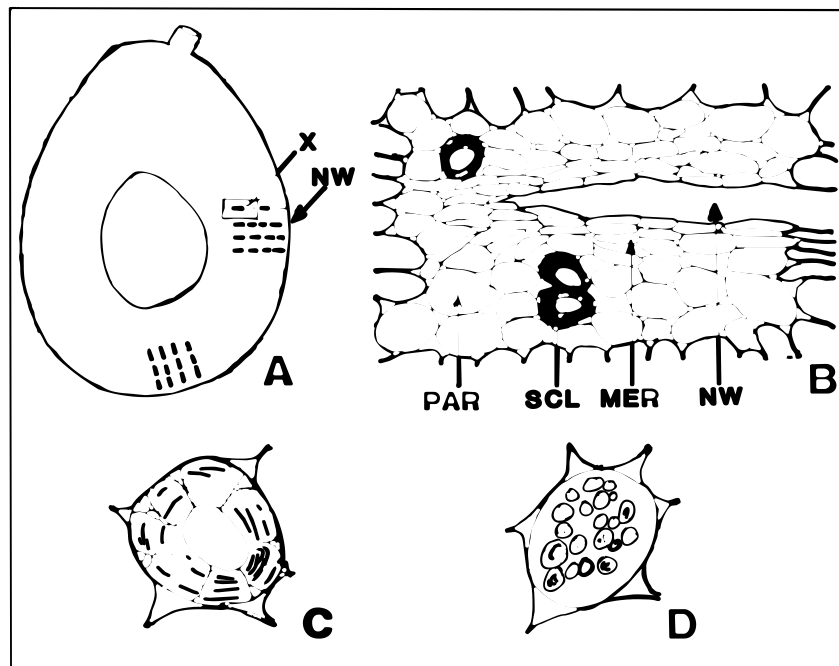
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The normal thick, fleshy pericarp wall of the avocado fruit is characterized by a soft tissue composed of thin-walled parenchymatous cells containing numerous oil droplets. Permeating this thin-walled tissue is the vascular system with elongated, slightly lignified vessels and elongated phloem elements. Occasionally in abnormal avocado fruits there appear isolated, or sometimes masses, of sclereids or stone cells in the otherwise soft pericarp. This condition is comparable to the gritty flesh found in fruits of many pear varieties [Smith, 1935; Sterling, 1954]. Sand pears in particular contain a large number of stone cells which gives the "gritty" texture of the fruit. Normally, the avocado is free of stone cells except those which are located in close association with the skin of thick-skinned varieties. The rinds, or skins, of most Guatemalan fruits are characterized by a hardness or rigidity which results from the normal development of clusters of stone cells or sclereids just beneath and closely associated with the epidermis. Sclereids or stone cells normally do not develop deep within the soft pericarp tissue of these fruits.

The occasional abnormal development of stone cell clusters deep within the soft fruit pericarp has been associated as one of the responses to the disease caused by *Phytophthora citricola*. A severe attack by this disease results in a weakened tree, and in extreme conditions will cause death of the tree. Some of the fruits on severely affected trees can develop masses of stone cells or sclereids to various degrees of density in the otherwise soft edible tissue. The factors which induce the development of the sclereids in these abnormal locations are presently not clearly defined or understood.

An attempt to induce the development of sclereids in the avocado experimentally has been reported [Schroeder, 1991]. The present investigation corroborates and extends these earlier observations. Attempts were made to induce wound responses in developing fruits by forcing a steel dissecting needle into the intact flesh to various depths at several points of nearly mature fruits of Hass avocado. The injured fruits were collected after a period of three months as they attained maturity. The tissues in proximity to the zone of injury were sectioned by hand and examined under the microscope. Some sections were stained with phloroglucinol and hydrochloric acid, a reagent which indicates the presence of lignin in the cell walls by a pink coloration. The greatly thickened walls of the stone cells are easily distinguished when compared with the thin walls of regular parenchymatous tissue of the pericarp wall.

The external evidence of needle injury was a small brown mass of corky tissue about 1 mm. in diameter which covered each point of needle entry. Deep within the pericarp tissue there was evidence of intense cell division along the axis of needle penetration. This resulted in long tiers of small, thin-walled cells characteristic of cork cambium, consisting of small, brick-shaped cells without oil droplets (Fig. 1-B, MER). Occasional cells in the outer peripheral region of this induced meristematic tissue became distinctively larger, with thickened, lignified cell walls (Fig. 1-C). These aberrant cells found deep within the pericarp tissue were identified as typical sclereids or stone cells comparable to those found in fruits from trees infected by *Phytophthora citricola*. The cell walls of these induced sclereids are thick and lignified and penetrated by large, simple and branching pits. The lumen or cell cavity of the sclereid is small and without apparent contents.



*Figure 1. Mechanical injury in avocado pericarp.*

*A: Longitudinal section through avocado pericarp indicating points of needle wounds (NW) and area of detailed sketch (X). B: Longitudinal section through base of needle wound at point (X) showing tissue response.*

*SCL = sclereids, MER = meristemic tissue, PAR = parenchymatous tissue, NW = path of needle wound, C = isolated sclereid showing thick, pitted wall, D = single parenchymatous cell with oil droplets.*

These induced aberrant sclereids were observed at depths of 8 to 10 mm. beneath the skin of the fruit. The observations made in these limited experimental procedures do not warrant strong conclusions regarding any factors or precise conditions which are necessary for sclereid formation. They do confirm the fact that sclereids can be induced *in vivo*, a phenomenon which appears to be unique in the tissues of the avocado fruit.

The induction of somewhat similar sclereids in the callus tissue of citrus juice vesicles grown *in vitro* [Khan, *et al.*, 1986] suggests that an acidity range of pH 5.0-6.0 of the medium favors sclereid formation. The studies by Walter, *et al.*, [1990] indicate that retarded water loss in wounded cucumber fruit promoted the lignification and sclerification of subepidermal tissues in such fruits. Neither of these studies resulted in the induction of the very thick-walled, typical stone cells or sclereids, which have been observed in wounded avocado pericarp tissue.

#### Literature Cited

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