

BRIEF NOTE

PRELIMINARY INVESTIGATION OF AIR BLISTERS IN
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A form of highly ornamental variegation in higher plants known as "air blisters" (Kirk and Tilney-Bassett 1967) in which the leaves have silver or cream-colored dotting or striping patterns is very common. Species of the genera *Pilea*, *Begonia*, *Episcia*, *Dioscorea*, *Zebrina* and *Trifolium*, to name but a few, have distinct air blisters. As common as this condition appears to be, it is perhaps surprising that it has not been extensively studied. Hara (1957) investigated these plants by light microscopy but did no physiological or subcellular studies, and genetic data regarding these plants were summarized by Kirk and Tilney-Bassett (1967). No likely role for these air blisters has been considered in either work. We examined air blister tissue from *Pilea cadieriei*, commonly known as aluminum plant, by electron microscopy to determine which structures are present and to suggest what functions they may serve.

The plants of *Pilea cadieriei* were grown in a mixture of peat, perlite and vermiculite under greenhouse conditions at Miami University. Leaf sections were fixed in 3% glutaraldehyde in cacodylate buffer, post-fixed in 1% osmium tetroxide and dehydrated with spectral grade acetone. Material was infiltrated with Spurr's Low Viscosity resin by gradual addition to 100% acetone over an 8 hour period. Ultrathin sections (<0.1 μ) were cut with a DuPont diamond knife, mounted on fine copper mesh grids, and post-stained with aqueous uranyl acetate and lead citrate. Specimens were ex-

amined with an Hitachi HS-9 electron microscope.

Mueller and Greenwood (1978) observed that phenolic-storing cells contained a blackened, osmiophilic cytoplasm due to the leaching of the phenolics from the vacuoles, obscuring cellular detail and making any ultrastructural study difficult. This same blackening was found in the subepidermal air blister and thus possibly indicated that these cells are also phenolic-storing cells. Figure 1 shows a dark, osmiophilic phenolic-storing cell of the air blister of *Pilea cadieriei* with relatively electron transparent epidermal and other cells. The plastids and other organelles contained in the air blister cells are highly osmiophilic due to the presence of phenols in the cells. Phenolic crystals in the relatively large intracellular spaces adjacent to the air blister cells are also noted. The presence of these phenols differentiates the air blister condition from variegation. The colors associated with variegated plants, *i.e.* the variegated *Tradescantia* and *Chlorophytum*, are due to the effects of various mutant chloroplasts (Kirk and Tilney-Bassett 1967), whereas the silver or cream color in air-blistered plants is probably due to the high concentration of phenolics present. These phenols may be flavones or similar compounds since Harborne (1976) and Swain (1975) observed that white or cream coloration in flowers is caused by high levels of flavones in the petals.

The chloroplasts of the cells subtending the air blister tissue are characteristic shade type plastids, as described by Anderson (1973) and Boardman (1977), in which the grana are large and numer-

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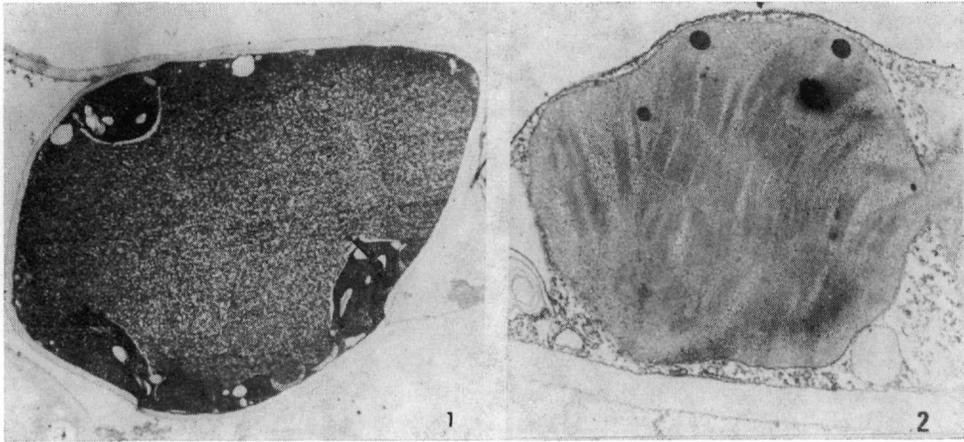


FIGURE 1. Typical phenolic cell from the air blister region of *Pilea cadierei*. Cell contents are intensely stained black due to the high phenolic concentration. $\times 4,500$.

FIGURE 2. Shade-type plastid typical of those found in the cells subtending the air blister. $\times 10,000$.

ous, relative to the stroma lamellae, and irregularly arranged (fig. 2). Only the cells subtending the air blister tissue contain such unmistakably shade type plastids, indicating the blister may behave effectively as a light screen. Caldwell (1968) and others have shown that a function of plant phenolics, which are at high levels in the epidermis, is as a protective light screen. This finding may indicate that the air blisters, with their high concentration of phenolics can effectively screen out the ultraviolet light from the underlying tissue, resulting in some of the chloroplasts becoming adapted for relative shade. Since most of the plants with air blisters were already somewhat shade-adapted, these protective phenolic cells may serve as a substitute shade during times when natural shade is absent.

The Golgi bodies of the air blister tissue were observed to bleb-off vesicles with dark, osmiophilic material seemingly identical to that found in the vacuole. This suggests phenolic synthesis or concentration and packaging in the vacuoles. Interestingly, Hansjörg and Grisebach (1975) found that some phenolic enzymes appear to be localized in the microsomes fraction, indicating an endoplasmic reticulum or Golgi location, which supports these ultrastructural observations.

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