Differentiation of Black and Sugar Maple Cultivars with Scanning Electron Microscopy¹

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Abstract. Two cultivars of sugar maple, (Acer saccharum Marsh.) and a cultivar of black maple (A. nigrum Michx. f.) which could not be distinguished from one another by conventional techniques were differentiated with scanning electron microscopy. Leaf margins of the black maple cultivar were fringed with trichomes whereas sugar maple cultivars lacked marginal trichomes. Leaf surfaces of black maple appeared smooth while sugar maple possessed flocculent wax. Stomatal collars and trichome surfaces showed distinguishing features between both black and sugar maple cultivars.

The ability to detect and confirm a cultivar’s true identity and integrity holds widespread implications for the scientific and horticultural communities. Classical identification methods using gross morphology are often difficult or inadequate. Chemical analysis, a useful identification tool at the species level, is currently being explored to distinguish cultivars (6, 7, 12). Standard paper and liquid chromatographic procedures involving extraction and quantification are time-consuming. Recently, high pressure liquid chromatography has been used as a quicker and easier method for cultivar identification (1). Protein electrophoresis has been used to separate rose cultivars (11).

Scanning electron microscopy (SEM) has also been used to identify plants within the same species. Foliar trichomes of oak (Quercus spp.) were used as taxonomic characters in an SEM study of 42 oak species (8). Differences in cuticular ultrastructure and cracking susceptibility of fruit were described for apple (2) and nectarines (4, 5). Pollen of Prunus spp. and Malus spp. clones were characterized with SEM (3). I have used SEM to identify 2 American elm clones, Ulmus americana L. (9) and 4 cultivars of red maple (Acer rubrum L.) which could not be distinguished by classical identification techniques (10).

Black maple and sugar maple, are frequently used for landscape plantings. Since they are closely related and difficult to distinguish by conventional techniques, cultivars of either species are easily confused with each other during commercial production. The objective of this study was to determine if differences exist between foliar surfaces of black and sugar maple cultivars, which could be used as aids in their taxonomic separation.

Materials and Methods

Fig. 1. Scanning electron micrographs of *Acer nigrum* and *A. saccharum* abaxial leaf surfaces.

A. Black maple ('Greencolumn') leaf edges fringed with trichomes (bar=50μm);
B. C. Sugar maple leaf edges ('Green Mountain', 'Jeffers' lacking marginal trichomes (bar=50μm);
D. Smooth epicuticular wax surface of 'Greencolumn' (bar=5μm);
E, F. Flocculent leaf wax of 'Green Mountain' and 'Jeffers' lacking marginal complete stomatal collar of 'Green Mountain' (arrows); F. Note incomplete stomatal collar of 'Jeffers' (arrows) partially exposing guard cells;
G. Leaf trichomes with oval nodulations on 'Greencolumn', note arrows (bar = 5μm);
H, I. Sugar maple trichomes (bar=5μm);
H. 'Green Mountain' appeared smooth with recessed nodulations (arrows);
I. 'Jeffers' seemed wrinkled with elongated nodulations (arrows).

The black maple appears to be a distinct species from the 2 sugar maple cultivars. The presence of marginal trichomes and the absence of flocculent wax on black maple foliage clearly separates it from sugar maple. In addition, stomatal configurations and trichome surfaces can be used to differentiate the two sugar maple cultivars.

Variations were not observed within any cultivar due to ontogenetic and environmental influences or due to the ages of individual plants. Tissue preparation procedures did not appear to contribute artifacts when compared to unfixed and uncoated specimens.

Table 1. Key to black and sugar maple cultivars using characteristics observed with scanning electron microscopy.

| 1. | Abaxial leaf margins fringed with simple trichomes; epicuticular wax smooth on abaxial leaf surfaces; abaxial trichrome surfaces with simple trichomes. Acer nigrum, 'Green Mountain' |
| 1'.| Abaxial leaf margins lacking marginal trichomes; flocculent epicuticular wax on abaxial leaf surfaces. Acer saccharum 'Greencolumn' |
| 2. | Stomatal collars complete, encircling stomata; abaxial trichrome surfaces smooth with recessed nodulations. Acer saccharum 'Green Mountain' |
| 2'. | Stomatal collars incomplete; abaxial trichrome surfaces, wrinkled with elongated nodulations. A. saccharum 'Jeffers' |

This study and others (3, 9, 10) show that cultivar identification using SEM provides 3-dimensional-like images of structures that are unique to each cultivar of a given species. Quality control of nursery products, patent protection and verification of plant reference collections will be enhanced using the SEM technique.

Literature Cited