Table 1. (continued)

Species	Common name	Fluoride susceptibility	Symptoms associated with injury
Hoya carnosa	Wax plant	L	Some purpling of leaves; very slight pinking of white leaf margins.
Maranta leuconeura erythroneura	Maranta, red-vined prayer plant	M	Tip and marginal chlorosis and necrosis developed after about 14 days at 10 $\mu g/m^3$ in older leaves. Leaves marred by scattered, irregular necrotic patches. Character spots on leaves and other markings faded.
Nephrolepis exaltata 'Bostoniensis'	Boston fern	VL	No visible damage.
Nephrolepsis exaltata 'Fluffy Ruffles'	Fluffy ruffles fern	L	Slight pinnae tip browning on older fronds.
Peperomia caperota	Crinkled peperomia	VL	No visible damage.
Peperomia obtusifolia 'Variegata'	Variegated ovalleaf peperomia	VL	No visible damage.
Philodendron 'Red Emerald'	Red emerald philodendron	L	No visible damage.
Philodendron bipennifolium 'Panduriforme'	Fiddle-leaf philodendron	H	Marginal and interveinal chlorosis of older and mid-aged leaves. The interveinal chlorosis produced a streaked pattern similar to a variegated pattern.
Philodendron scandens oxycardium	Heart-leaf philodendron	M	Interveinal and marginal chlorosis at 2 and 10 $\mu g/m^3$ in mid-aged and older leaves; younger leaves and marginal and tip chlorosis. Chlorotic areas became water-soaked, later necrotic and finally dehydrated to leave tan-colored areas.
Philodendron selloum	Lacytree philodendron	M	Marginal and interveinal chlorosis; streaked green veins on yellow background produced a pattern somewhat like *P. panduriforme* above but less pronounced. Water-soaked lesions appeared along the margins of older leaves, later dehydrated to a white, crisp tissue.
Pilea cadieri	Aluminum plant	L	Slight general chlorosis of young leaves.
Plectranthus australis	Swedish ivy	VL	No visible damage.
Pteris cretica 'Albo-lineata'	White-line cretian brake	H	Pinnae on oldest fronds lost color and turgidity. Brown necrotic areas developed toward apex. Older fronds withered, mid-aged leaves burned.
Pteris cretica 'Mayii'	May cretian brake	H	Development of dry, brown necrotic areas paralleling midvein between base and apex of pinnae. Loss of color and turgidity of oldest fronds.
Pteris ensiformis 'Evergemensis'	Evergemen table fern	H	Pinnae on older fronds browned and shriveled, with loss of color. Older fronds burned leaving papery tissue; similar but less burn in mid-aged leaves.
Rhoeo discolor	Moses-in-the-bullrushes	M	Tip and margin leaf scorch. Enhanced purple coloration on underside of leaves associated with fluoride exposure.
Sansevieria trifasciata 'Hahnii'	Sansevieria	L	Gray water-soaked lesions developed first in the interiors of older leaves, then the margin.
Syngonium podophyllum 'Green Gold'	Nephthytis or arrowhead vine	L	Slight marginal chlorosis.
Vriesia splendens	Flaming sword	VL	No apparent effect in 3 weeks exposure time.
Zebrina pendula	Wandering jew	L	Slight marginal chlorosis. Fluoride effects were slow to develop.

[z]Class of susceptibility to economic damage by air-borne fluorides: VL = very low, L = low, M = moderate, H = high, VH = very high.

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Identification of Four Red Maple Cultivars with Scanning Electron Microscopy[1]

Charles R. Krause[2]
Science and Education Administration, Federal Research, U.S. Department of Agriculture, Delaware, Ohio 43015

Additional index words. Acer rubrum, "finger printing"

Abstract. **Four cultivars of red maple (*Acer rubrum* L.) which could not be distinguished by classical identification techniques were differentiated on the basis of foliar surface characteristics of cuticles and trichomes. Intraclonal variation due to environmental and genetic influences of ages of individual plants was negligible.**

Accurate identification of cultivars, though important, is often difficult or impossible when classical gross morphology is used. Chemotaxonomy, a useful identification tool at the species level, is now being used to separate cultivars (6,7,9). Standard chromatographic techniques are usually limited by time-consuming extraction and quantitation techniques. Asen (1) has suggested that high pressure liquid chromatography be used to detect flavonoid chemical markers as a quick and easy alternative method for cultivar identification.

Scanning electron microscopy (SEM), an already valuable tool in plant research, also may be used to identify cultivars. Differences in cuticular ultrastructure and cracking susceptibility of fruit were shown in apple (2) and nectarine (4,5) clones. Fogle used SEM to characterize pollen morphology and identify clones of *Prunus* and *Malus* (3). Krause used SEM to identify 2 American elm clones (*Ulmus americana* L.) on the basis of combined microtopographical foliar characteristics (8).

Red maple cultivars, valued for fall coloration and specific growth habits,

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[2]Research Plant Pathologist, Nursery Crops Research Laboratory.

are often difficult to identify. The objective of this study was to determine if any microtopographical foliar differences exist among four red maple cultivars.

Plant Material. Beginning in July and August, 1976, 1 to 8 year-old field-grown *A. rubrum,* 'Red Sunset', 'October Glory', 'Autumn Flame' and 'Armstrong' were sampled once, on site, in nurseries at Columbus, Georgia, Princeton, NJ, and Boring, Oregon. In Delaware, Ohio, 5 replicates of each cultivar that were grown in liner beds and 5 replicates of each cultivar that were grown in a greenhouse were sampled monthly during the growing season (May to Sept., 1977). Plants that were grown in a greenhouse were exposed to a 16-hr photoperiod (incandescent and fluorescent, 6.5 klx), watered as needed and fertilized weekly (20N–8.6P–16.6K).

Electron Microscopy. Leaf samples were cut into 2 mm squares, fixed in 3% glutaraldehyde (in 0.1M phosphate buffer at pH 7.2) washed in phosphate buffer (3), post-fixed in 1% osmium tetroxide (in phosphate buffer), washed in phosphate buffer (3), dehydrated in 35, 50, 85, 95, 99% and absolute ethanol (3) for 5 min each, placed in amyl acetate and critical-point dried (CPD) with liquid CO_2 in a Samdri PVT-3 (Tousimis Research Crop., Rockville, MD). Specimens were attached to aluminum stubs with conductive cement, sputter-coated with 400 Å Au in a Hummer V (Technics Corp., Alexandria, VA), and examined on Hitachi S-500 SEM (Perkin-Elmer Corp., Mountain View, CA) set at 20 kV, 5mm working distance and 40° tilt. Uncoated. fresh samples as well as uncoated, fixed, dehydrated, CPD samples of each cultivar were also mounted and examined as standard control treatments.

Adaxial leaf surfaces. Examination with SEM revealed smooth epicuticular surfaces with multicellular trichomes, less than 100 μm in length, and the absence of stomata. However, differences among cultivars were not detected on adaxial surfaces.

Abaxial cuticles. Downy epicuticular wax and simple trichomes covered the cuticles of all cultivars examined with SEM. Cuticles of 'October Glory', 'Autumn Flame' and 'Armstrong' appeared tufted and uniformly convex (Fig. 1, 2, 3). The cuticle of 'Red Sunset' also was tufted but had numerous curved, crested pits (Fig. 4).

Abaxial trichomes. Distinct differences in trichome surface characteristics were revealed with SEM. 'October Glory' trichomes appeared to have smooth surfaces with slight nodulations (Fig. 5). Trichomes of 'Autumn Flame' had smooth surfaces with striated nodulations (Fig. 6). However, 'Armstrong' trichomes had coarse, nonstriated nodulations (Fig. 7). Trichomes of 'Red Sunset', the cultivar with pitted abaxial culticles, appeared to be moderately nodulated (Fig. 8). Variations were not observed within any cultivar due to genetic and environmental influences or the ages of individual plants. Tissue preparation procedures did not contribute artifacts when compared to unfixed and uncoated specimens.

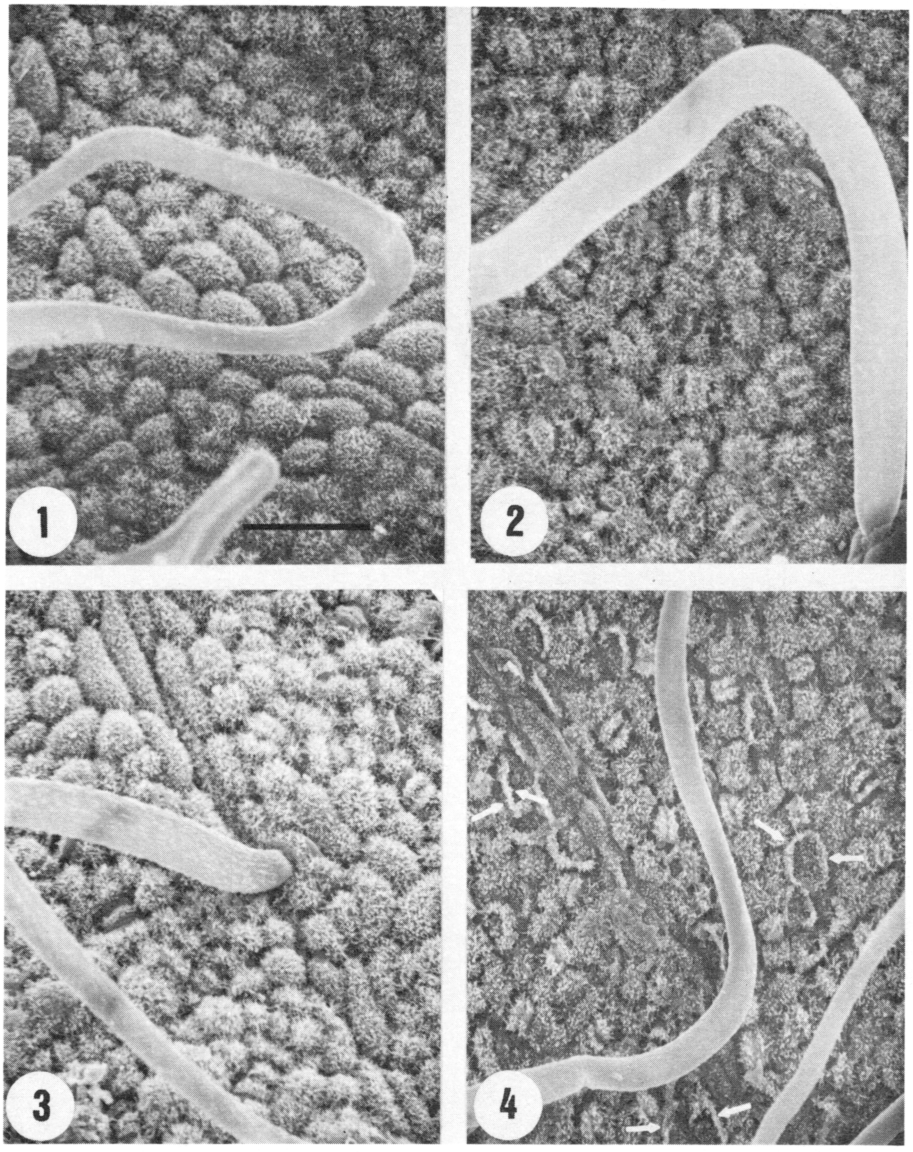

Fig. 1–4 Scanning electron micrographs of *Acer rubrum* abaxial cuticles. Fig. 1–3, 'October Glory', 'Autumn Flame' and 'Armstrong', respectively, all appearing tufted and uniformly convex. Fig. 4, 'Red Sunset' tufted cuticle with numerous curved, crested pits as shown by arrows. Scale line equals 50 μm for Fig. 1–4.

"Plant fingerprinting" with SEM can become a valuable supplement to conventional taxonomic methods currently used to separate red maple cultivars. Since foliar characteristics described in this study (i.e. trichome and cuticular surfaces) were stable with both immature and mature red maple cultivars, sampling was not limited by the ages of individual plants. In contrast, the use of pollen or fruit surfaces for SEM cultivar identification is restricted to mature plants for a limited period during each growing season.

"Fingerprinting" micrographs obtained with SEM provide unique information that is not easily obtained with any other technique. A repository of micrographs of cultivars within each species studied could be kept for reference to be compared to new cultivars as they are introduced and to identify unknowns. With improved SEM preparative techniques and increased availability of SEM expertise, "plant fingerprinting" with SEM could have widespread application for scientists, nurserymen, consumers and legal areas arising from such things as plant patent questions.

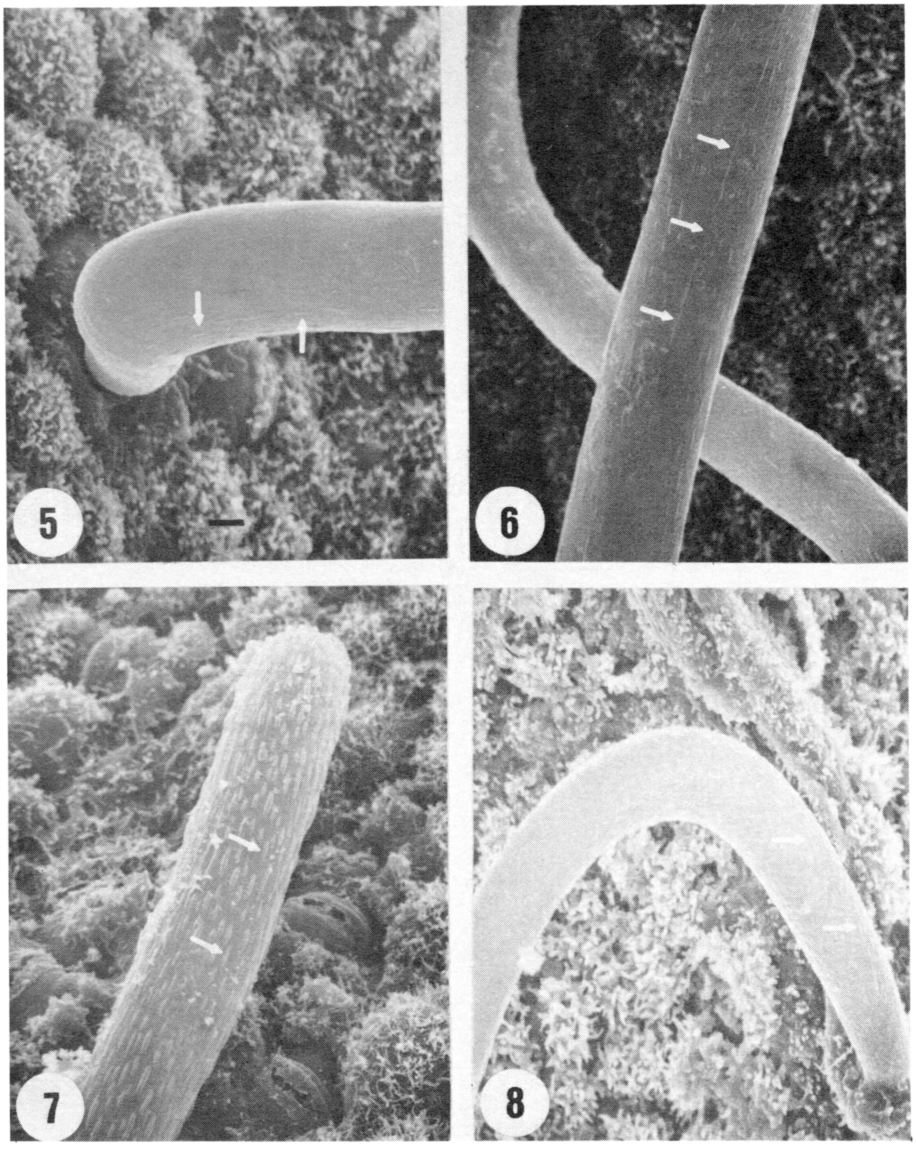

Fig. 5–8. Scanning electron micrographs of *Acer rubrum* abaxial simple trichomes. Fig. 5, 'October Glory' trichome with smooth but slightly nodulated surface (Arrows). Fig. 6, 'Autumn Flame' trichome with smooth but striated nodulations (arrows). Fig. 7. 'Armstrong' trichome with coarse, non-striated nodulations (arrows). Fig. 8. 'Red Sunset' trichome with a moderately nodulated surface (arrows). Scale line equals 5 μm for Fig. 5-8.

Literature Cited

1. Asen, S. 1977. Flavonoid chemical markers as an adjunct for cultivar identification. *HortScience* 12:447-448.
2. Faust, M. and C. B. Shear. 1972. Fine structure of the fruit surface of three apple cultivars. *J. Amer. Soc. Hort. Sci.* 97:351-355.
3. Fogle, H. W. 1977. Identification of clones within four fruit tree species by pollen exine patterns. *J. Amer. Soc. Hort. Sci.* 102:552-560.
4. _____ and M. Faust. 1975. Ultrastructure of nectarine fruit surfaces. *J. Amer. Soc. Hort. Sci.* 100:74-77.
5. _____ and _____ . 1976. Fruit growth and cracking in nectarines. *J. Amer. Soc. Hort. Sci.* 101:434-439.
6. Fretz, T. A. 1976. Preliminary studies on plant fingerprinting of creeping Juniper cultivars. *Acta Hort.* 63:153-160.
7. Grant, W. F. 1973. Chemosystematics in the classification of cultivars, p. 293-302. *In* G. Bendz and J. Santesson (eds.) Chemistry in botanical classification. Nobel Symposium 25. Academic Press, New York.
8. Krause, C. R. 1976. Surface characteristics of American elm clones for identification by scanning electron microscopy. *HortScience* 11:386-389.
9. Werner, D. J. and K. C. Sink, Jr. 1977. Possible use of chromatographic analysis of poinsettia cultivar identification. *HortScience* 12:449-451.

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Phenotypic Correlations between Senescent Leaf, Dormant Bud Scale, and Flower Color in *Rhododendron japonicum* [1]

W. L. Ackerman and J. L. Creech[2]
U.S. National Arboretum, Washington, D.C. 20002

Additional index words. deciduous azalea

Abstract. **A screening method based on senescent leaves and dormant bud scales was developed to predict flower color among segregating seedling populations of *Rhododendron japonicum* (Gray) Suringar.**

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[2]Research Horticulturist and Director, U.S. National Aboretum, respectively.

Rhododendron japonicum is a large-flowered deciduous azalea native to Kyushu, Honshu, and Shikoku, Japan, which inhabits grass and shrub-wooded moorlands. It is placed in the subseries Luteum, which includes *R. molle* (Bl.) G. Don of China, *R. luteum* Sweet. of southern Europe and all but 2 of the deciduous species of the U.S. (4). *Rhododendron japonicum,* a stoutly branched shrub to 2 m. tall exhibits a range of flower colors from yellow through yellow-orange and orange-red to pink and red. This species has potential in breeding for hardier plants of the Ghent and Mollis types (1, 3). In the native habitat of Japan, flower color apparently is correlated with latitude and habitat. (Fig. 1). Yellows and oranges predominant in the southern areas of Kyushu and Shikoku, while brick red forms dominate the northern limits of the species in Honshu as a distinct biotype (2).

Vegetative propagation of *R. japonicum* is difficult and frequently unreliable for large scale commercial operations. Although cuttings may be rooted in the early summer, they will not break dormancy the next spring unless forced into growth immediately after rooting. Growth can be forced by increasing the photoperiod with artificial lights, but the cuttings should