

Acer saccharum subspecies nigrum:
MERITORIOUS MIDWESTERN MAPLE

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ABSTRACT. --Black maple (Acer saccharum Marshall subspecies nigrum Desmarais) refers to populations of drought-resistant sugar maples most abundant in Iowa and nearby states. Because of their morphological and physiological adaptations to the rigorous climate of the Midwest, these maples are recommended for more widespread planting in cities in the eastern U.S.

Sugar maple (Acer saccharum Marshall) is a tree of rich hardwood forests throughout most of the eastern United States and southeastern Canada. This species is also commonly used as a shade tree on the streets of towns and cities within its natural range. In the Midwest it is commonly included on lists of recommended trees for street and park planting.

My interest in variation among sugar maples began years ago on a hot August day at a nursery at Noble, Oklahoma, where a pioneer Oklahoma nurseryman, C.E. Garee, showed me two side-by-side rows of small trees. The leaves of one row had scorched to a point of almost complete brownness. The leaves of the maples of the other row were dark and shiny, with only scattered disfigurements and scorch-spots, despite the heat and drought of the Oklahoma summer. Mr. Garee explained that the maples with the badly scorched leaves had come from seeds collected in eastern Oklahoma and that the green-leaved maples had come from seeds from isolated populations of maples growing in several small canyons in Caddo County, 50 miles west of Oklahoma City and more than 150 miles west of the western border of the main range of sugar maple. The canyon maples have persisted in special sheltered microclimates in a grassland region far west of the deciduous forest border. Mr. Garee's leather-leaved maples have come to be known as Caddo maple and are today planted as street, park, and campus trees throughout Oklahoma and Kansas. Splendid large specimens may be seen on the University of Oklahoma campus.

The successful use of Caddo maple as an urban tree in Oklahoma and Kansas provides basis for reasoning that this highly drought-tolerant maple might be worthy of greater use farther east. However, the local natural sugar maple populations of Missouri, Arkansas, and Iowa seem to provide satisfactory trees for urban plantings in this general region. In view of the prevalence of urban sugar maple problems in states farther east, the satisfactory performance of sugar maples in towns and cities west of the Mississippi River warrants closer investigation.

The shade tree evaluation study of Chapin and Kozel (1975), indeed, does not show sugar maple in the summary list of trees recommended for use along streets in Ohio. Susceptibility to leaf scorch is given as a major shortcoming. Moreover, all four of the sugar maple cultivars tested in the study were given relatively poor overall ratings. All were described as intolerant of both excessive soil wetness and dryness.

How then does one explain the apparent success of sugar maple as a street tree in Illinois and Iowa where the summers are hotter and drier than in Ohio? A possible explanation is that most of the planted sugar maples in Illinois and Iowa originate (via commercial nurseries) from seeds of indigenous trees; these indigenous trees are genetically different from indigenous trees farther east. Sugar maple has such an extensive geographic range that populations in areas with markedly different climates show markedly different qualities. Iowa populations would be expected to show physiological and morphological qualities that attune them to the fluctuating and relatively severe climate--especially the hot summers--of the Midwest (Ware 1977). In contrast, New England populations should be adapted to cold winters and cool or only moderately warm summers.

Banfield (1967) explained sugar maple decline in New England as developing from a set of mostly man-made environmental alterations that depart from the optimal conditions present in natural hardwood forests. Intactness of humus and organic soil were given as requirements for healthy root systems. Factors dominant in the ecology of declining trees were listed as: drought, inadequate soil moisture, high evapotranspiration, high air and soil temperature, low humidity, and full exposure to sun and wind. Banfield suggests that New England sugar maples have a certain fragility that makes it difficult for them to adjust to disruptions in the microclimate of the forest environment. Westing (1966), Mader et al. (1969), and Ruark et al. (1983) have also described specific examples of detrimental environmental changes involved in sugar maple decline.

Kriebel (1957) described three genetic groups, or ecotypes, of sugar maple based primarily upon drought resistance, resistance to winter injury, and susceptibility to leaf injury under high insolation. He recognized first a northern hardwood ecotype characterized by low drought resistance and high resistance to winter injury. This type also is susceptible to leaf injury during warm and droughty periods. Another feature is a high degree of apical dominance. Second, a central ecotype has high resistance to drought and moderately high resistance to leaf scorch, the latter increasing in a continuous trend from east to west. There is also high resistance to winter injury and a high degree of apical dominance in this central ecotype. Third, a southern ecotype has a high resistance to drought and leaf scorch, susceptibility to winter injury, and poor form characterized by a tendency toward repeated forking and branching of the main and lateral shoots.

Scanlon (1976) recorded survival rates of sugar maples in a 27-year-old plantation in eastern Tennessee.' The maple plantation contained trees grown from seeds originating in a number of states, all east of the Mississippi River. He noted that the percent of survival of trees from western Tennessee and southern Illinois exceeded that of the trees of local origin (eastern Tennessee). Few trees from either Michigan or New England survived, and limited numbers remained from those groups originating in New Jersey or Ohio. Survival rates of trees originating in nearby West Virginia and Kentucky were similar to survival rates of trees of eastern Tennessee.

Scanlon's observations suggest that for planted trees from sources somewhat to the west, there is greater survivability than for trees of local origin in Tennessee. Schmid (1975) suggested that some cities in the eastern United States may have microclimates that more closely resemble regional climates of the Midwest than the climate of the countryside surrounding the city. Because the tree planting sites of cities are so greatly artificial and often inhospitable to tree growth, trees indigenous to the driest part of the natural range of a species may provide the most suitable material for urban planting. However, winter hardness is also an important consideration.

In a study involving mass collections of leaf samples, Desmarais (1952) described six subspecies of sugar maple: saccharum, nigrum, floridanum, leucoderme, schneckii, and grandidentatum. Dent (1969) concluded that natural populations of subspecies grandidentatum in the Rocky Mountains were markedly distinct from the populations of A. saccharum

that he studied in Oklahoma. Santamour and McArdle (1982) 'also opined that subspecies grandidentatum should not be placed in the A. saccharum complex.

Desmarais demonstrated a strong association of his subspecies with well-delineated geographic regions by using leaf characteristics, including size, shape, pubescence, number of teeth, and stipules. Subspecies nigrum has a large leaf not very deeply lobed, with sinuses between the lobes forming angles of usually more than 90 degrees. The yellowish-green lower surface is usually covered with short erect hairs. Subspecies nigrum ranges over a large part of the range of subspecies saccharum (common sugar maple), but is abundant only in the western part of the range of the latter. In Iowa, the range of subspecies nigrum extends beyond the range of subspecies saccharum. The populations of western Iowa have the highest representations of three useful diagnostic features: pubescent leaves, erect hairs on undersides of leaves, and stipules. Other authors (Hightshoe 1978; Steyermark 1962) have listed additional characteristics, noting that the leaves have a tendency to droop at the edges. The foliage turns color and leaves drop earlier; leaves are thicker and more leathery; and lenticels on the twigs are more conspicuous than those of common sugar maple. Some of the features of the Iowa maples suggest adaptation to dry, droughty summer conditions. Thick, leathery, and well-cutinized leaves that have a tendency to droop at the edges are features that appear to provide some drought resistance. The long list of distinctive attributes is the basis for some authors to consider this entity a separate species (Fernald 1950; Gleason and Cronquist 1963). The common name "black maple" is often encountered.

Medium to slow growth during early years is noted by Hightshoe (1978), suggesting the possibility of an extensive root system developing before height growth begins-to increase. Indeed, the development of extensive root systems associated with slow growth of shoots and branches is a feature of nursery stock of subspecies nigrum growing at the Morton Arboretum. Trees indigenous to the driest and droughtiest part of the natural range of sugar maple can generally be identified as nigrum. Populations in Missouri intergrade into Desmarais' subspecies schneckii which appears to be just as drought and scorch resistant as nigrum. However, schneckii seems to have more dramatic carmine-colored fall foliage. The promising new cultivar 'Legacy' appears to exhibit qualities quite similar to those of maples indigenous to Missouri and 'Legacy' may very well have come from progenitors that originated in Missouri. Thus, both nigrum and schneckii populations can provide drought and scorch resistant material for urban plantings farther east.

The sugar maples of the forests of the Morton Arboretum and the surrounding region show mixtures of the features of the subspecies saccharum and nigrum. The leaves of these Illinois maples generally have fewer teeth than do the leaves of New England maples; leaf undersides have greater numbers of hairs. Drooping borders of leaves are sometimes seen. The maples of northern Illinois are generally intermediate between the subspecies saccharum and nigrum, but it is possible to select trees with good drought tolerance and scorch resistance that still display leaf outlines suggesting affinities with eastern sugar maples.

In summary, *Acer saccharum* subspecies nigrum is a taxonomic and ecological entity that is not simply and easily separable from other sugar maples, yet it represents a way of designating the populations of maples in Iowa and nearby areas, for it is from natural populations evolutionarily adapted to recurring environmental adversities such as summer drought that we can select trees for adverse urban sites.

There is need to test sizable numbers of trees (from seeds of known provenance) of both subspecies nigrum and schneckii in urban situations in states east of the Mississippi River to determine whether their inherent tolerance of drought and chemical soil adversities is satisfactory. There is further desirability for determining whether periods of excessive soil wetness produce unforeseen problems. Meritorious trees showing such things as vigorous growth, good form, freedom from leaf tatter, and rich fall color can be selected in very few years. Then, clonal selections can be made from trees being tested on the streets.

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