LEAF FORMS IN SASSAFRAS IN SOUTHEASTERN MICHIGAN

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[Editor’s Note: This paper dates from 1996. It was found among Professor Wagner’s effects by Florence Wagner; the file included detailed reviewer’s comments and a provisional acceptance by the then-editor. The typescript also had pencilled notations in the author’s hand. Richard K. Rabeler and Anton Reznicek, both of the University of Michigan Herbarium, North University Building, Ann Arbor, MI, 48109, requested that the present editor incorporate the reviewers’ comments and Herb’s emendations into a corrected and updated version; what follows is, I hope, faithful to the author’s intent.]

Sassafras (*Sassafras albidum* (Nutt.) Nees, Lauraceae) is a common woody plant that ranges from Maine to Michigan and south to northern Florida and Texas. A similar species (*Sassafras tzumu* Hemsley) occurs in mainland China, and a third species, *Sassafras randaiensis* (Hayata) Nakai, is endemic to Taiwan. In the Great Lakes region, *S. albidum* is unknown north of Chicago (a population from Kenosha County, Wisconsin, just over the Illinois border, was long ago extirpated). The species is otherwise unknown for Wisconsin and Minnesota. It is common in lower Michigan north to Benzie County.

In the open, it forms compact clones of small trees, because new stems are readily formed from root sprouts, but under a forest canopy it develops as solitary or well-separated tall trees; it may attain a height of 40–50’ in Michigan (Smith 1997), and further south to 80’ (Taber 1937). Sassafras tea, made from the steeped, reddish roots, is a popular item among wild food buffs. A search of the worldwide web using the keyword “sassafras” will reveal a great many sites devoted to the food values of the plant. The aromatic sassafras leaves, together with those of the other Michigan member of the Lauraceae, the spicebush (Lindera benzoin (L.) Blume) are important (but not exclusive) foods for the larvae of Spicebush Swallowtail (*Papilio troilus* L.) and the giant silkworm moth, Promethea (*Callosamia promethea* Drury) (Tyler 1975 and Ferguson 1972, respectively).

Platt (1953) pointed out that “Sassafras is famous for its three types of leaves on the same branch.” These leaf forms are often referred to as entire (i.e., without lobes); mitten-shaped (with one large lobe and one small, lateral lobe); or three-lobed (with one central and two lateral lobes (Barnes & Wagner 1981). Voss (1985) commented, “Some leaves have a characteristic ‘mitten’ shape with one lobe as a ‘thumb,’ others have two ‘thumbs,’ and others are unlobed; all three shapes occur on the same plant, often even on the same branch.”
Some authors mention that sassafras may have 4- or 5-parted leaves (those who do include Illick 1927, Taber 1937, Gleason & Cronquist 1991, Barnes & Wagner 1981, and Harlow et al. 1991).

For simplicity and consistency, I simply classify the blade types according to the number of tips, as shown in the figures. Figure 1 at the top shows blades entire or unlobed, which I score as a “Type 1.” Figure 1 at the bottom shows blades with one lateral segment plus one central segment, making two segments altogether; these are scored as “Type 2.” Figure 2 at the top shows blades with one central segment and two laterals, giving three altogether; these are scored as “Type 3.” Figure 2 shows at the bottom leaves with four segments, scored as “Type 4.” Figure 3 shows “Type 5” at the top, with five segments, and at the bottom “Type 6,” with six segments.

We studied these different types in southeastern Michigan clones. Two clones
were studied in detail, these occurring side-by-side north of M-36, west of Ham-
burg, in section 16, Hamburg Township, Livingston County. The study began in
1982; on a later visit to the site, my assistants and I found that the clones had
been destroyed, as the area is under development.

To study the sequence of increasing complexity of segmentation, the leaves
from a given clone can be arranged in a morphological sequence from base to tip
of the year’s twig, starting with Type 1. As more segments appear in the series,
the central segment always remains the largest, and the lateral segments become
progressively smaller in relation to the central segment, as the number of later-
als increases, until we reach Type 6, with very small ultimate laterals (Fig. 3).
This is well illustrated in the mitten form, in which one segment, the morpho-
logically central segment, is always larger than the other, the “thumb” (Fig. 1).
In some of the Type 3 and in the central three segments of Types 4 and 5, the lengths may be nearly equal, but there is always at least a slightly greater development of the middle segment.

Maximum sinus formation in Types 2 and 3 generally reaches less than half of the total blade length, but in Types 4, 5, and 6, it is commonly more than half, and the sides of the sinuses become more concave. Concomitant with increasing segmentation, the angle of the blade base increases from 50–70° to nearly 100° (compare Figs. 1 and 3). Leaf Type 3 is intermediate.

Although there are clearly six types of leaves (perhaps more, although we have not yet found forms with seven or eight segments), intermediates do occur, as can be demonstrated in a long series of specimens. For example, the silhouette immediately after number 2 in Fig. 1 actually marks an intermediate between Types 1 and 2. Likewise, the specimen following number 4 in Fig. 2 marks the transition between Types 3 and 4. The beginnings of the next-following stages are thus represented by small marginal segments, only a fraction as

FIGURE 3. Sassafras leaves of maximal lobation (blade Types 5 and 6). Note angle of the sides of the lower part of the blade (see also Fig. 1).
large as the laterals in that position, and often merely little projections at the edge of the blade.

To illustrate the differences between individual whole branches and the locations of the leaves on the year’s shoots, we took the lateral branches from each of two clones growing side-by-side at our Livingston County site. They represented the most extreme types that we encountered, and they were growing under altogether similar site conditions, so that the differences would presumably be genetically controlled. Of one clone (labelled “Clone A”) almost all the branches showed at least one Type 4 or Type 5 leaf. Branches lacking either or both of these were infrequent. Of the other clone (labelled “Clone B”) the branches had very few segmented leaf types. Almost all the leaves on Clone B were of Type 1—leaves entire and unlobed. In the following chart, the leaf types are arranged strictly in order of their position along 18 branches per clone, from the base (at left) to the top (at right):

<table>
<thead>
<tr>
<th>Clone A with many lobed leaves</th>
<th>Clone B with mainly unlobed leaves</th>
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</table>

The average lateral branch has nine leaves, with a range from six to thirteen. The central or leader branches are generally the larger ones and have more leaves. Because of the great variability, as illustrated here, and because of the changes in incidence of the different leaf types from the lower branches to the crown (discussed below), statistics for their occurrence were not calculated. However, rough estimates in the field involving all ages and sizes of clones indicate that Type 1, the simple, entire-bladed form, comprises at least three-fourths of the total leaf population, and Types 2 and 3 together make up practically all the rest. Leaf Types 4, 5, and 6 are rare, comprising less than one percent. Type 6 is very sporadic, and we have seen only a few examples. Whole clones like Clone A with numerous Types 4, 5, and 6 are rare. Where there are
Types 2 and 3 and higher-level blades, the Type 1 leaves are commonly found as the first-formed leaves of the season, i.e., the lowest ones on the twig, as shown in Clone A above; the morphogenetic transition between Types 1 and 3 is usually abrupt, however, so that there are far fewer Type 2 leaves than either of the others. Overall, there are less than one-tenth as many Type 2 leaves as Type 3 leaves. The transitions between 3 and 5 are common. Indeed, there were over half again as many Type 4 leaves as Type 5 leaves.

In any one clone, the leaves on average appear to become progressively more unlobed the higher on the plant they are produced. Thus a clone with a substantial incidence of Type 3 on the branches below four meters may have only a few Type 3 on branches above 5 meters. Most of the Types 2 and 3 (as well as 4 and 5) are on lower branches and leader shoots, and on suckers.

To gain some picture of the differing positions of leaf types in different clones, we surveyed by car an area including adjacent parts of Lyndon Township, Washtenaw County; Waterloo Township, Jackson County; and Unadilla township, Livingston County. An arbitrary limit of 100 clones of all sizes was examined. We classified them according to the blade types of the crowns. Those with almost exclusively Type 1 leaves were made one category, those with one-third or more Type 3 a second category, and those that did not fit either were put in an intermediate category. The intermediate category comprised 24 percent of the clones we sampled. Of the remaining clones, 47 percent had mainly Type 1 leaves, and 29 percent had numerous (one-third or more) more lobed leaves. The Type 3 leaves were mostly from older plants. Four of these older plants had Types 4 and 5 blade forms on the lower shoots; in two of them, these blade forms were rare, in one frequent, and in one common. This last was a clone of low stature, the ramets only up to 3 m tall. Thus, even though in the total leaf population of all sassafras plants, the Types 4 and 5 probably constitute less than one percent, of whole clones as many as four percent may have some of these more divided leaf types, but it may take careful searching to find them. If one limits the scoring of clones to large-sized ramets five or more meters tall, the fraction of mainly simple leaves becomes larger, but that too varies from clone to clone.

Sassafras leaves thus show a considerable instability, varying as they do from no lobes at all to several lobes. The primitive condition is surely shown by the unlobed form, which is typically the state prevalent in the Lauraceae, as well as its related families, such as Magnoliaceae, Illiciaceae, Annonaceae, Aristolochiaceae, and Piperaceae. Leaf lobation in sassafras is a fine example of a derived character or apomorphy that is only variably expressed. Beyond a purely morphological description, it is intriguing to consider whether the lobation of these leaves is adaptive. With present information, however, it appears that the lobed condition is an evolutionarily neutral character state.

Our survey of Sassafras clones in southeastern Michigan leads to the following conclusions: (1) Relative incidence of the various leaf forms differs from clone to clone. (2) The presumably primitive state of non-lobed leaves is most common, with a few extreme exceptions such as Clone A described here. (3) The order of relative abundance of these leaf types, common to rare, is approximately 1 – 3 – 2 – 4 – 5 – 6, with a quick drop-off between 2 and 4. (4) Correlated with
the change from unlobed through 6-lobed is a strong widening of the angle between the two sides of the lower one-third to one-half of the blade.

It should be interesting to determine whether character states similar to those described here for southeastern Michigan occur as well in other parts of the wide range of sassafras.

For their aid in studying these populations, I acknowledge with thanks William Brodowich, Robert Masta, and Steven Kobylarz.

LITERATURE CITED


REVIEW

Emanuel D. Rudolph’s STUDIES IN THE HISTORY OF NORTH AMERICAN BOTANY, with an appendix on the relationship between science and religion. Ronald L. Stuckey and William R. Burk, editors. September, 2000. Sida Botanical Miscellany No. 19. (ISSN 0883-1475, paperback; ISBN 1-889878-05-7, paperback.) xxx + 376 pp. $45 (+$3.71 for Texas residents) + postage $4.50 for first copy, $1.00 for each additional copy to the same address; postage outside the USA $8.00 for first copy, $2.50 for each additional copy to the same address. Check or money order payable to BRIT Press; Visa, MasterCard, or purchase order accepted: BRIT Press, 509 Pecan Street, Fort Worth, Texas 76102, USA.

This is a tribute and memorial to Emanuel D. Rudolph, just “Rudy” to the thousands whose lives he touched during his long tenure in Botany at the Ohio State University. It is richly illustrated with over 200 b/w and colored photographs. The color cover features hollyhocks, to honor Rudy’s observation that their introduction from Europe serves “to remind us of man’s attempt to preserve the familiarity of his surroundings.”