SECURING SEED PRODUCTION IN MAGNOLIA ACUMINATA AND M. CORDATA

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The cucumber tree, *Magnolia acuminata* L., ranges from the north shore of Lake Erie in Ontario to Louisiana and Georgia, attaining 90 feet in the Great Smoky Mountains. It is the largest growing deciduous magnolia in America, probably second to *M. grandiflora* as a timber source, and one of the hardiest magnolias in the world, succeeding in northern Europe up to southern Norway. It has sometimes been used as an understock for grafting other magnolias, but in recent decades has lost favor particularly to *M. Kobus,* whose seeds seem more readily available from trees in cultivation. With the rise of mist propagation in recent years, relatively few of the deciduous Asian Magnolias now are grafted. *M. acuminata* understocks may still offer the most feasible means of multiplying select clones of the closely related but smaller *M. cordata,* sometimes regarded as merely a variety of *acuminata.* (The Chinese *M. liliflora* is more distantly related, and through it, *M. Soulangiana.*)

Cultivars of *M. acuminata,* itself, have seldom been propagated. A variegated leaf form has been grafted occasionally, but as with so many variegated forms in broad leaf woody plants, the normal green leaf tends to take over. Varieties described by botanists include one, var. *ludoviciana* Sargent, from West Feliciana Parish, Louisiana with broader leaves and larger flowers (3½ - 4″ long, compared to the usual 2½ - 3″ petals.) Ashe described a more pubescent variety from Alabama. Forms with all yellow petals (forma *aurea* Hardin) have been described, and one or more of them now have been grafted a little. In the usual *M. acuminata,* however, the green to greenish yellow flowers that appear after the leaves are not nearly as showy as those of the earlier flowering Asian kinds, nor do they have the fragrance of the later, white-flowered Sweet Bays (*M. virginana L.* and *M. australis* Ashe) and Southern magnolia (*M. grandiflora L.*) It is as a hardy, relatively pest-free, large growing shade tree with gray branches that *M. acuminata* now has its principal landscape use.

It would rate higher as a tree with decorative fruits in late summer, if the August - September maturing dark red gynoecia (or cones) were more consistently or abundantly retained. I believe we now have the knowledge and materials to make this improvement, and also to obtain worthwhile seed crops from cucumber trees.

In cultivation, at least in a wide area of the Midwest, in Tennessee, Alabama and southwest Virginia and probably elsewhere if *M. acuminata* is planted as a single specimen, the trees

usually have appeared to be highly sterile. They flower abundantly, but by mid-August, year after year, all or nearly all their gynoecia (cones) have failed to develop any seeds, and have dropped off without becoming showy. Occasionally we do see a tree with some gynoecia in which one seed or more have developed. It was surprising to me, therefore, after watching this sequence on several trees in and near Champaign-Urbana for ten years, to see an exceptional one, two or three years ago with a heavy crop of seeds for its size, these developing throughout the flowering branches of the tree. After 90 days of stratification, the seeds produced thrifty seedlings. Why should the American native cucumber tree, growing thriftily in good soil, and flowering abundantly after the spring frost season, produce so few seeds on trees in Central Illinois, Indiana and eastern Iowa, where other native American species like *M. tripetala, M. virginiana* and *M. grandiflora* (when it was to free flowering stage) had good seed crops, and where even the exotic hybrid *M. Soulangiana* (presumably partially sterile because of its unbalanced chromosomes) had fair seed crops in most years? What was the particular weakness of *M. acuminata,* or its weak link in regard to setting seed and how had this one particularly fruitful tree overcome it?

I applied a little detective work which is not yet completed, but I think I now have the answer, or a major part of it. It appears that *M. acuminata* trees in general (and this apparently applies to the related *M. cordata*) are incompatible with their own pollen, but will set seeds when properly pollinated with pollen from a different clone of the same species. The one very fruitful tree in Urbana is exceptional, though probably not unique, in being a clone of *M. acuminata* that is fertile when self-pollinated.

The self-fertile condition is usual with most other species of Magnolia grown in Illinois, including *M. tripetala, M. virginiana, M. australis, M. grandiflora, M. salicifolia, M. Kobus* (including its varieties *stellata* and *Loebneri*) and several of the hybrids of the *M. Soulangiana* group. It may not be true with the clones we have of *M. denudata* and *M. liliflora,* which produce very few seeds at Urbana.

American Magnolias in general cannot set seeds on their earliest flowers of the season. Without exception their flowers, so far as I have observed, are protogynous. Their pistils are receptive when the flowers first open, or shortly before that stage, but do not remain receptive for the day or so longer that it takes a flower to begin to shed its own pollen. But later flowers on the same trees, of such species and varieties as are not self-incompatible, can generally receive from their own earlier-opening flowers, pollen carried either by certain beetles, bees and other insects, or even by gravity from flowers higher on the tree.

I bagged a few dozen unopened flower buds on three *M. acuminata* trees in Champaign and Urbana for pollination ex-

periments last spring, and wasted most of them, as it turned out, in attempts to cross with *M. grandiflora* pollen from farther south. (That is a perhaps impossible cross, as two subgenera are represented.) Where the bags were left over the uncrossed flowers through their flowering period, too, no seeds were set. But two of three intraspecific cross-combinations involving these three clones of *M. acuminata* were highly successful. Pollen from tree "K," the self-fertile one, was placed on pistils of one flower of tree "B," the largest in Urbana. That flower developed a gynoecium with 87 good seeds, and those were the only seeds seen on the whole tree this year. Pollen from tree "M," the largest of its species in Champaign, resulted in three nearly as well filled gynoecia from controlled crosses on tree "K". Two that were saved from the squirrels had a total of 137 seeds. On a few flowers of tree "M" where pollen of "K" was applied, nothing developed, and no fruits developed on the rest of that tree, in this or other recent years. My timing may have been off, when pollinating that tree, and I plan to test it more extensively another year.

While conducting a pecan grafting demonstration last spring on the farm of Mr. Roy Vick, near Thebes in Alexander County, Illinois, I noted that his woods contained several small flowering trees of *M. acuminata* which are native in a few counties at the southern end of our state. Mr. Vick was later able to collect for me a quantity of ripe fruits, from which seeds are being germinated. Vick's fruits were smaller than the average gynoecia developed on tree "K" in Urbana, but do indicate that the species is reasonably fertile where a few seedling trees are near enough together that cross-pollination by insects can be effected. Dr. J. Nelson Spaeth, head of our Forestry Department, who formerly was at Cornell, tells me that seedling trees in the Cornell forest planting of *M. acuminata* near Ithaca, N.Y. also were regularly productive of seeds. I have recently heard of another lone *M. acuminata* that is self-fruitful in a Northeastern state.

M. acuminata, though it tends to have large buds and thick pith, can be readily budded by the chip bud method in August, at Urbana, if the buds are wrapped completely over with polythylene plastic. They can be handled thereafter like any dormant bud. I have budded a large seedling in its first year of growth, and also have top worked by this method onto branches of tree "M", which must be at least seventy years old.

While ordinarily we would bud only onto young understocks, it appears that buds of such a self-fertile clone as tree "K" might be worth inserting to produce pollen-source branches high in any seedling *M. acuminata* on which it is desired to increase the production of seeds or ornamental fruits. This particular one, tree "K", might be worth extensive bud propagation in nurseries as it has a good sized flower for the species, with better than usual color; it is known to be fruitful, and its fruits are decorative. At maturity, under Urbana conditions, the

fruits are taken off and the seeds consumed mainly by gray squirrels, which seem to find them both delicious and nutritious.

Coming after hazelnuts and before most of the walnuts, acorns and hickory nuts, an abundance of *Magnolia acuminata* seeds might fill a niche in the food economy of squirrels in suitable woods and many towns where such rodents are encouraged.

Some of my slides show *M. acuminata* trees around Champaign County, Illinois at different times of the year, and indicate variations in growth habit of various clones. Seed harvest by use of a truck-mounted power ladder is shown.

The last few slides show a tree of the rare yellow flowered *M. cordata,* that may be the oldest grafted magnolia, and the largest of its species, now in cultivation in America. It was grafted on *M. acuminata* some 120 years ago, and the graft line is still visible. Donald J. Hillenmeyer showed me this tall tree, which was originally planted at a farm residence outside Lexington, Kentucky. With the growth of the city, the area now is incorporated in Woodland Park. *M. cordata* is not native in the Lexington area. As well as Mr. Hillenmeyer can reconstruct this tree's history, it was probably included in a landscape plan drawn by the naturalist Rafinesque, who taught for several years at Transylvania College in Lexington. The actual propagator may have been a Frenchman who had a nursery at Lexington for several years around 1830-1840.

Michaux, who discovered it, had introduced *M. cordata* to France from the vicinity of Augusta, Georgia about 1880. The Lexington tree very likely is from one of the clones first taken to France and later brought back to America. The species was unknown in the wild for more than a century, until L. A. Berckmans rediscovered it in 1910-1913 at three Georgia and South Carolina locations near Augusta. Still later, some more wild trees were found also in eastern Alabama by W. W. Ashe and others.

Like most of the isolated *M. acuminata* trees, this *M. cordata* specimen failed to produce any seeds in 1963, but Don tells me it sometimes matures a few.

Magnolia cordata was crossed with *M. acuminata* in 1944 by Oliver M. Freeman, and his hybrid seedlings are being grown by the U.S. National Arboretum at Washington. Mr. Freeman, now at Tryon, North Carolina, tells me that he got a good yield of seeds from this cross, and a considerable variation among the hybrid progeny. Both *M. cordata* and *M. acuminata* are tetraploid species, and are much nearer to each other in kinship than to any of the other North American species, which are mainly diploid, except for the generally hexaploid *M. grandiflora.* Their nearest relative is the Chinese *M. liliflora,* also a tetraploid, which is widely cultivated in its variety *nigra.* Further hybridizations, with these and other Magnolias, are discussed in another paper in this volume.