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# POLLINATION & REPRODUCTION IN SUGAR MAPLE TREES

The pollination mechanisms of maples in general are poorly understood...

Various researchers and authors have wrongfully reported that sugar maple pollination is done solely by insects - technically called entomophily. However, a few have mentioned the possibility of pollination by wind - anemophily, or mixed pollination i.e. by both - ambophily.

Clues as to the pollination mechanisms can be seen in the floral structures. If the flowers are small, greenish and dangle in the wind - such as in Manitoba maple (*Acer negundo*) - wind pollination can be inferred. If the flowers are larger, perhaps more colourful, and are held closer to the twigs on which they are borne - such as in striped maple (*A. pensylvanicum*) or mountain maple (*A. spicatum*) - then entomophily or ambophily can be suggested.

Even though the way flowers grow on sugar maple (*A. saccharum*) is highly indicative of wind pollination (Figure 1), the existing scientific literature is confusing and some of it clearly wrong. The scientific literature has stated multiple times that insect pollination

(A) and (B) Model 95 Rotorod® airborne particle sampler used for sampling pollen grains found in the air at our field sites. (C) Two I-Rods® shown in the upright position in the I-Rod holder that is part of the spinning arm of the sampling apparatus.



is the sole way pollen moves from the male (staminate) flowers to the female (pistillate) flowers within the same tree or between sugar maple trees. Our experiments have demonstrated that the pollen of sugar maple travels up to about 150 metres, and probably more, from a pollen-source tree on the wind, at least in southern Ontario. Additionally, our in-depth surveys never documented an insect visitor to a sugar maple flower and previous studies list none either.

Some additional experiments are needed to pound the final nail into the coffin of the idea that entomophily is the mode of pollination for sugar maple and demonstrate that indeed anemophily is the true mode of pollination for sugar maple throughout its range. Because our pollination studies were limited to southern

Ontario, we cannot rigorously assess the situation elsewhere. Although the other researchers, namely in the U.S.A., report entomophily as the only mode of pollination, they did not make experiments to prove that idea, nor do they report which insects they observed, if any, on sugar maple flowers. Observations and experiments done in other locations within the range of sugar



Inflorescence of sugar maple (left). Staminate - male sexual phase - showing the stamens and pistillate - female sexual phase showing the two pistils - flowers of *A. saccharum* (above).

maple would put to rest the question of how sugar maple is pollinated in other places. Experimental manipulations of the complex inflorescences (flowering clusters) need to be made.

Again there is confusion as to whether or not the inflorescences of sugar maple may be bisexual or unisexual (mostly the former), as one researcher has even reported the existence of unisexual trees. For bisexual inflorescences and bisexual trees, self-pollination is a possibility. But would that result in self-fertilization with production of viable seeds and vigorous seedlings? No-one knows. We suspect that sugar maple is self-incompatible. Experiments to test that hypothesis are conceptually simple, but practically difficult to execute. Two kinds of bags need to be placed over inflorescences: one type excludes all pollen whether carried by wind or insects; the other with more open mesh weave allows wind-borne pollen to enter but keeps insects out. Within the bags, inflorescences need to be sexed - male, female, bisexual - and some trimmed to be unisexual to test if automatic self-pollination and self-fertilization occur or if cross-pollination - left to nature's devices and experimentally done by hand - is required for viable seeds to be produced.

Why did we not do those experiments? We made all preparations in 2007, but nature and the sugar maples conspired against us. Over the entire period of our study (2006 - 2011), we had only one year (2011) when the sugar maples bloomed in enough profusion to entertain such experiments and when the major opportunity came, the wind study took priority. Sugar maple is notorious for infrequent and unpredictable rapid mass flowering and mass seed production. We hope to have our experimental equipment waiting to jump on the next mass flowering event. Another item of information that would be useful to understanding the sex life of sugar maples would be a comprehensive data set on the

sexiness of the trees. We did not find any strictly unisexual trees, but we did find from a small sample that some trees release pollen before their female flowers are open, others reverse the order of sexual function, but for most of the blooming period they were bisexual. If there are interested readers who would like to contribute to maple sex data set, please contact us. More data from a larger geographical area would be invaluable for us to test the general validity of our findings.

## How does knowing about the sex life of sugar maples help arboriculture?

There is great interest in the conservation of our national Canadian tree. The roadside avenues of sugar maples are in decline, parks and recreation areas want new trees, the maple sugar producers value high yielding trees for sap tapping, the timber trade values hard maple wood, the urban horticultural demand is rising and the invasive Norway maple (*A. platanoides*), once a darling of the trade, is becoming increasingly recognized as a menace. Sugar maple is readily propagated by seeds (when they are available) and it is known that individual trees differ with various desirable characters (salt and pollution tolerance, esthetic growth form and foliage, sap quality and yield, timber, etc.). Seeds, seedling and saplings with parentage expressing desirable traits would have great value. Controlled pollinations are the mainstay of plant breeding and selection. The processes and mechanisms of pollination must be more fully understood to move onto that step for sugar maple improvement and conservation.

**Reference:** Roussy, A.-M. 2014. *The Sexual and Vegetative Propagation of Sugar Maple and its Threat from Norway Maple*. Ph. D. dissertation, University of Guelph available at <https://atrium.lib.uoguelph.ca/xmlui/handle/10214/8065> funded in part by ISA's Tree Fund.