The struggle is real (but fun!): long-term breeding at a public university©

R. Contreras[a]

Department of Horticulture, Oregon State University, 4017 Agricultural & Life Sciences Bldg., Corvallis, Oregon 97331, USA.

The nursery industry releases a lot of new plants every year, with an abundance of branding programs. There are hundreds of new annuals, perennials, and woody shrubs there are released annually, but relatively few new trees in comparison due to the longer time required for evaluation and greater land requirements.

Oregon State University has a breeding program that tries to address long-term goals, which in turn requires evaluation of traits for many years to ensure stability. Often, we have a six- to ten-year generation period, so our program is a long-term proposition.

Plant breeding, at its core, is a numbers game—if you grow 1 million seedlings, the crop is likely to contain some real winners. Unfortunately, I cannot grow the numbers that the large nurseries can grow and select from. So why did the industry push to have a plant breeder at Oregon State University?

My goal is to support the industry by three main mechanisms. First, when the breeding effort would be too costly or too long-term for a nursery, or there is some technology or technique that I can apply in a laboratory situation or greenhouse-growing situation, that is where I come in. Below, I will discuss some of our work on maples and this is a great example of a project that may have significant impact on the nursery industry but, in the meantime, is costly to run and requires expensive equipment and careful attention to the scientific process. Second, I am here to train students who will become the next generation of horticulturists and plant breeders. Third, I am also here to contribute to the scientific knowledge base, for example, to assess the genome size of the entire genus *Acer*. This activity often does not result in a direct transfer of information or deliverable to the nursery industry, but it provides a foundation for me and other University breeders on which to build. Of course, I also have fun by doing things that I am passionate about!

Maples make up a major part of almost any urban canopy in the temperate USA. Maples currently constitute 31% of the U.S. shade tree market. Oregon is the number one shade tree-producing state in the U.S., producing 36% (worth more than $63 million) of the maples sold in the nation. Due to their importance in Oregon, regionally, and nationally, maples are a priority in my program. We have been looking at Norway maples (*Acer platanoides*) because they can escape cultivation. Weediness of Norway maples has led to a decline in sales. Some growers have reported more than a 90% decline in sales of Norway maples during the last decade. Some of this decline may also be attributed to urban managers diversifying the species planted in the urban canopy, but at least some of the reduced sales can be attributed to regulation of Norway maple as a weedy/invasive species in New England states, which historically have been a solid region for distribution.

My goal is to reduce or eliminate the weediness of Norway maple, while maintaining the species as a crop our growers can grow and our urban managers can plant. Therefore, our objective is to develop triploid Norway maples that will be sterile by crossing diploids with tetraploids. We create tetraploids by treating seedlings at the first true leaf stage with a 150 µM solution of oryzalin with 0.55% agar for five days. Of course, the process is not perfect, and triploids of some plant species (such as pear, *Pyrus*) can produce viable seed. Therefore, we must extensively test the triploid seedlings for many years. In the field, we interplanted tetraploids with diploids and collected the seed from the tetraploid plants. We have observed low germination percentages from tetraploid seed with 14% germination in 2017. In our first year (2017), 89% of our Norway maple seedlings were triploid and 84% of

[a]E-mail: ryan.contreras@oregonstate.edu

Amur maples (*Acer tataricum* subsp. *ginnala*) (another species with issues of weediness/invasiveness) were triploid. Of course, any new selections must also be production-worthy trees, so we are continuing to increase the population sizes of these and other triploids. We expect these populations to start flowering in 2019, after which time we will make critical observations on fertility with replication over years and locations. Further replications of trials with nurseries may begin as early as 2022, and we hope to have one or two good selections for full release by 2025, but it is hard to predict.

We are also working to varying extents on several other woody genera:

Berberis (looking to develop sterile triploids)
Celtis
Cercidiphyllum
Cotoneaster (looking to develop improved forms, fireblight resistance, and pink flowers)
Deutzia
Galtonia
Hibiscus (looking to develop new flower forms and growth habits)
Hydrangea
Ilex
Malus
Nyssa
Phellodendron (looking to develop sterility and variable forms)
Philadelphus (looking to develop flower fragrance, flower power and duration, and form)
Prunus
Quercus (looking to develop powdery mildew resistance in English oak)
Ribes
Sarcococca
Spiraea
Syringa (looking to develop better reblooming with disease resistance)
Thuja
Vaccinium
Zelkova (looking to develop new forms)

QUESTIONS

Voice: Do you ever get mixoploids?

Ryan Contreras: We absolutely do get mixoploids. We try to treat the tiniest meristem that we can, but it is challenging to treat a single cell. The other term for mixoploid is cytochimera, which refers to a single plant that has some cells that are diploid and some cells that are tetraploid. Some of these plants will stabilize at the diploid level and some will stabilize at the tetraploid level, and there are some that will stabilize at the mixoploid level.