

Oregon Department of Agriculture and Oregon Association of Nurseries
Nursery Research Project Proposal 2021

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TITLE: Developing sterile forms of economically important nursery crops

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BACKGROUND:

Many of the staple nursery crops on which growers and landscapers rely have garnered increasing attention due to their spread from cultivation by seed dispersal. These are often very important crops such as maples, cherrylaurels, and barberries that can make up large portions of growers' sales. Furthermore, in the case of maples, Oregon is the national leader in production. As such, these crops can impact our state's whole industry. We have been developing sterile forms of maples, althea (*Hibiscus syriacus*), and cherrylaurels with considerable progress on all three crops. Emerging progress on japanese barberry (*Berberis thunbergii*) is included for the first time.

Maples. Oregon is the leading producer of shade trees for the US and maples are among the most commonly produced and planted trees across the country. However, several important maple species have been identified as invasive and some have been banned including amur maple in Connecticut and Norway maple in Connecticut and Massachusetts. Norway maple is now considered a noxious weed in New York, as well. Other economically important maple species also produce copious amounts of seed, such as trident maple and hedge maple. These species are not yet regulated but the potential remains unless sterile forms can be identified. I propose that development of sterile forms prior to regulation by government agencies will allow producers to continue to grow and market each of these species.

Norway maple. To my knowledge, we have developed the largest populations of triploids of Norway maples in existence. In 2018 we field planted 47 triploids. We selected five (5) genotypes of Norway to send to a cooperating nursery. In this way, we are simultaneously evaluating nursery production while waiting for these plants to flower. I will further discuss below, but the fields all appear to be highly infested with Verticillium wilt, which has "allowed" us to breed for resistance, as we have strong disease pressure. Further, I secured additional funding through another source and have been working to optimize tissue culture propagation of Norway maple to expedite deploying triploids to the industry as well as providing a means to propagate on own roots to re-introduce to previously banned regions. During 2019 four tetraploids flowered and two tetraploids flowered in 2020. Based on 2016 data, I expect >85% of the resulting seedlings to be triploids. Evaluation is ongoing.

Amur maple. During 2016 and 2017, flowering of tetraploids resulting in 856 triploids. While growing those in containers we selected based primarily on vigor and lack of apparent verticillium symptoms. During 2018, we field planted 157 confirmed triploids of Amur maple.

Trident maple. We have a single trident maple triploid that flowered for the first time in 2020. It has a great deal of seed still on the tree at the end of September. However, during the 2016

flowering season we had 793 seed from a tetraploid and none germinated. This suggests that trident maple may regularly set inviable seed. The positive aspect is the tetraploid trident maples appear to be resistant to Verticillium and continue growing well. During 2018 and 2019 flowering we recovered 9 triploids. We had additional flowering during 2020 from which I hope to recover larger populations of triploids.

Hedge maple. We also developed tetraploid hedge maples that were fall planted 2020. As these are the first polyploid seedlings of *Acer campestre*, it's unclear how long before these begin generating triploids. This brings us to 4 species of maples for which we are making solid progress on developing sterile triploids: *Acer buergerianum*, *A. campestre*, *A. ginnala*, and *A. platanoides*.

The explosion of Verticillium has been a revelation. We have no choice but to breed for resistance and fortunately, we have surviving trees. Our current method of "inoculation" and screening is simply to plant trees and observe mortality or survival. Good news: we have surviving trees that have no symptoms and some that seem very slow to show symptoms. Further encouraging news is that we have two years and 43 triploids that flowered and none of them set seed. These trees are interplanted with many fertile diploids including 'Flame' and many seedlings from our program. We are moving ahead with propagation of selections for Norway and Amur maple that could be delivered for testing with additional growers as early as Spring 2021.

Producing sterile maples on their own roots will be critical for reintroduction into areas where species are now banned. This is because a fertile seedling rootstock presents a danger to escape cultivation, should the graft fail (or scion dies, rootstock outgrowth, etc.). As such, we have been attempting to optimize cutting propagation of superior genotypes of Norway maple. Early tests are encouraging but we have much work to do to make it "production ready" and fit within current schedules. We are establishing hedged stock blocks of Norway and Amur maple to support this effort.

Our goals for maples are 1) to continue developing more triploids from which superior clones may be selected that exhibit various trait combinations such as leaf colors (new growth, growing season, fall color), growth forms (fastigate, standard, columnar, etc.), and Verticillium resistance; 2) continue testing fertility of our triploids; 3) continue optimizing cutting propagation (and explore micropropagation), especially for Norway maple. I will expand our grower trials with superior clones that exhibit acceptably reduced fertility.

Cherrylaurels. Groups such as the Native Plant Society of Oregon are giving more attention to common cherrylaurel as an invasive species and currently consider it a medium-high impact species. Portuguese laurel shares many of the same outstanding characters as common cherrylaurel such as tolerance to sun and shade and pH adaptability but is more tolerant to heat and drought stress and is not susceptible to leaf shothole disease. Fruit development is also prolific in this species and it has started to receive similar attention as common cherrylaurel regarding invasive potential. It is my understanding that any grower shipping to California must strip 100% of fruit from *Prunus* or have the shipment rejected. Developing sterile cultivars would ameliorate this labor cost. **Our goals are to 1) develop sterile forms of common cherrylaurel that exhibit the typical phenotype that consumers are used to and 2) develop sterile hybrids of common cherrylaurel x Portuguese cherrylaurel that exhibit shothole disease resistance that are also sterile.** We have developed polyploids of both species and we had a single inflorescence from a Portuguese polyploid (16x) in 2019. This plant did not flower during 2020, but when it returns to flower we will begin crossing 'Otto Luyken' and

‘Schipkaensis’ with this polyploid. Additionally, some of our ‘Schipkaensis’ induced polyploids have been relatively free of shothole. We make no claims or assertions but this is interesting and perhaps promising for one aspect of the project. Furthermore, there is a wide range in growth forms among the ‘Schipkaensis’-derived plants that show great promise.

Rose-of-sharon (althea). The US National Arboretum introduced four rose-of-sharon cultivars described as sterile triploids including ‘Diana’, ‘Minerva’, ‘Aphrodite’, and ‘Helene’. These cultivars have since been observed to produce substantial amounts of seed. Our breeding program has investigated several aspects of reproductive behavior of these and other cultivars including determining 1) what is the actual ploidy level of available cultivars, 2) what is the relative fertility of available cultivars, and 3) how are ornamental traits such as eye spot, double flowers, and flower color inherited. To a great degree, we have answered all three questions and transitioned the focus to cultivar development based on the scientific knowledge we generated.

We have identified ploidy levels and fertility of most commercially available cultivars. We also have developed many pentaploid (5x) plants – 18 of which were tested in controlled crosses during 2016. Testcrosses from 5x plants developed in 2012 and 2013 were found to have an average of 1.1 seeds per capsule compared to 18 seeds per capsule in 4x plants typically found in the industry. This is a 94% reduction in fertility. In 2015 and 2016 we developed hundreds more 5x plants. During 2018 we made extensive observations of these plants under production conditions and discarded plants that showed seed set. In 2019, we reduced the number of selections and became aggressive in selection. We currently have approximately 20 accessions that are seedless and exhibit a variety of flower types, growth forms, and generally are less chlorotic than industry standards. Even though there are outstanding breeding programs working on althea (e.g. Van Huylenbroek et al. in Belgium) I am not aware of any other programs generating sterile 5x plants. We also have been working at higher ploidy levels (6x, 7x, 8x) to investigate whether these plants have production merit to complement their reduced fertility. In 2019, we made several hundred crosses of 4x x 8x plants to generate more diversity at the 6x level – currently we are limited to ‘Azurri Satin’ and ‘Pink Giant’. These crosses led to a population of ~2,500 hexaploids to be evaluated – I expect them all to be nearly sterile. Release of these plants should represent a competitive advantage for Oregon growers.

Barberry. Other programs including UConn and NCSU have introduced tetraploid barberries prior to us but considering the relative size of the market, we believe there remains opportunity. We have developed tetraploids that we have evaluated for three years flowering and obtained no fertile seed. Additionally, we have grown out a large population of seedlings collected from 2x plants and identified one triploid – a phenomenon previously thought not possible due to the so-called triploid block. Our tetraploids may be viable as releases, but we plan to develop more for testing and include a range of parent phenotypes (dwarf, columnar, spreading, etc.).

Budget Summary

Salary	
Tyler Hoskins (3 months)	\$12,379
Other payroll expenses	\$8,047
Undergraduate students	\$5,000
Other payroll expenses	\$600
Services and Supplies	
Growing supplies, lab kits, etc.	\$3,000
Total	\$29,026