Oregon Department of Agriculture and Oregon Association of Nurseries
Nursery Research Grant Proposal 2023

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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. Continued progress on japanese barberry (*Berberis thunbergii*) and spriea included for the first time.

Maples. Oregon is the leading producer of shade trees for the US and maples are among the most 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. Due to the prevalence of verticillium at the Lewis Brown Farm, I have been planting tetraploids and triploids at the Smith Hort Farm (aka Veg Farm) where pressure appears to be low. Previously planted tetraploids have been growing since 2016 and most show little pressure. 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. 2020 cuttings grew on very well and appeared to be a viable means for industry propagation but due to personnel transitions, I am not able to maintain that line of research and we are relying on TC and industry partners to evaluate production feasibility. In spring 2022, a limited number of stage III plants were delivered for production testing. My focus will shift back to developing more triploids with varied and superior phenotypes for testing. All new triploids of susceptible species (Norway and Amur) will be first planted at the Smith Farm for initial trials and propagation before testing for disease resistance.

Amur maple. During 2018, we field planted 157 confirmed triploids of Amur maple and since then we have observed approximately 250 flowering events (a tree flowering during one year is a flowering event) and none have set viable seed. We collect and sow all that hangs on the trees but clearly none is viable. **Our observations are essentially 100% reduction in fecundity**

among our triploids. We have 8-12 accessions that are promising. Six have been propagated in house for evaluation and while all grow vigorously, three are superior in form. Three have been put in TC and are growing well. One genotype was superior in multiplication and was delivered as stage III plants to an industry cooperator for evaluation. 10 selections were submitted to grower cooperator for evaluation alongside NC State triploids and cultivars. In this way, we can identify the best performing triploids to support the industry. I want to emphasize, we are not "fighting it out" – we want to facilitate getting good plants to industry

Trident maple. We have a single trident maple triploid that flowered for the first time in 2020. During 2020, a triploid trident maple flowered and had more than 25,000 seeds based on replicated 100ct weight. After stratification and sowing, we recovered six (6) seedlings. This is germination of 0.02% compared to 25.7% for diploid, which is 0.08% relative fertility or a reduction of 99.92% - these data along with the Amur maple observations provide strong evidence of reduced fertility among triploids. Additional triploids were derived from tetraploids in 2020, and field planted during September 2021. These trees have remained symptom free, whereas nearby Amur maples are highly diseased. I remain optimistic that upon flowering we may recover triploid hybrids of trident x amur maple that may be resistant to verticillium. Thus far I have seen no "winners" that have superior form.

Hedge maple. We also developed tetraploid hedge maples that were fall planted 2020, and remain disease free. As these are the first polyploid seedlings of *Acer campestre*, it's unclear how long before these begin generating triploids. There are two plants with superior form that I hope to recover seedlings from. 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*.

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 (fastigiate, standard, columnar, etc.), and Verticillium resistance; 2) continue testing fertility of our triploids including through more recent plantings at the Smith Hort Farm and via cooperators nationally to help re-introduce to historic markets; 3) continue working with growers to move forward selections we have propagated via stem cuttings and TC. Of utmost importance during the next phase is to distribute plants to New England and upper Midwest for evaluation.

Cherrylaurels. **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 Portugese 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 2020-2022, 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 and observations continued to be positive in 2022. During 2021, we identified novel haploids with low chromosome numbers that may be our best chance at successful crosses. We made several hundred pollinations during 2021 using pollen from some of these plants and recovered 3 seed, but none were hybrids. However, more

haploids (11x) of common cherrylaurel were identified and now have been field planted. None flowered in 2022.

Rose-of-sharon (althea).

We have identified ploidy levels and fertility of most commercially available cultivars – the latter of which is an easy improvement observed among our selections, confirmed by testcrosses from 5x plants that exhibited a 94% reduction in fertility. In 2015 and 2016 we developed hundreds more 5x plants. Selections from our 2017 crosses were field planted in 2020 and we have continued observations and one is being released during 2022 (2023) that is seedless and pink. It will be available for licensing on a non-exclusive basis. 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 and reduced to just under 500 plants that were field planted during September 2021. I discarded any plants that set seed and will continue to rogue plants from the field. 2022 was perhaps the worst year of flowering I have seen since starting this project but they are flowering as of writing and will allow some late selection.

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 four years flowering and obtained no 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. We were unsuccessful in developing new tetraploids from the improved cultivars we attempted during winter 2022. We will collect seed again to try again for 2023. The tetraploid appears to be a viable selection – it is not terribly remarkable but is a decent grower and performs on par with other standard purple-leaf cultivars in my observation. I think it warrants introduction but have yet to commit. I seek more industry input on this. The novel triploid, while it is green, is highly dense in its growth and has been propagated to make a small production demonstration and both will be planted in a replicated row during fall 2022.

Spiraea. I developed tetraploids of 'Goldmound' and 'Little Princess' a number of years ago and then backcrossed these to develop triploids. During 2021, we field planted these and have been making observations. Quite a few are attractive and pending additional observations for aesthetics and seed viability may warrant introduction. Further, these are planted adjacent to many excellent industry introductions that we are allowing to open-pollinate. Hybrid triploids with novel phenotypes being the goal. Finally, following irradiation, I have identified a *S. douglasii* selection that does not sucker and flowers prolifically. This may be an option to current market trends of native plants, pollinator plants, and restoration.

Budget Summary

Salary	
Ivory Knutson (4 months)	$16,479
Other payroll expenses	$10,381
Undergraduate students	$7,000
Other payroll expenses	$840
Services and Supplies	
Growing supplies, lab kits, etc.	$5,000
Total	**$39,700**