Oregon Department of Agriculture and Oregon Association of Nurseries
Nursery Research Final Report 2013

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Title: Induced polyploidy in six maple species to breed for sterile triploids

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Background:

Oregon is the leading producer of shade trees for the US. Much of this material is shipped to New England and upper Midwestern states. Maples are among the most commonly produced and planted trees across the country. Several economically important maple species have been identified as invasive in various regions of the country, particularly New England states. Several of these species have been banned or otherwise regulated due to their weediness including amur maple (*Acer ginnala* syn. *A. tataricum* ssp. *ginnala*) in Connecticut, Norway maple (*A. platanoides*) in Connecticut and Massachusetts, and sycamore maple (*A. pseudoplatanus*) in Connecticut and Massachusetts (USDA State and Federal Noxious Weed Lists; http://plants.usda.gov/java/noxComposite). Other economically important maple species, not yet identified as invasive or noxious weeds, also produce copious amounts of seed. These include trident maple (*Acer buergerianum*), hedge maple (*A. campestre*), and paperbark maple (*A. griseum*). These species are not yet regulated but have potential to become banned or otherwise regulated 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.

Sterility in triploids, plants with three sets of chromosomes, is well established and is the basis for seedless watermelons and bananas among other fruits and ornamentals such as the Expressionistic™ series of tutsan (*Hypericum androsaemum*) from NCSU. The chromosomes of diploids (two sets of chromosomes) are doubled to form tetraploids (four sets), which are then backcrossed to diploids and the resulting progeny are triploids. These plants are sterile because of unequal segregation of chromosomes during meiosis (3 cannot be equally divided by 2; plants are not fertile with 1.5 sets of chromosomes).

Objective:

The goal of this project is to develop polyploids of trident maple, hedge maple, amur maple, paperbark maple, Norway maple, and sycamore maple. These polyploids will be used to backcross to diploid plants to develop sterile triploids.

Methods and timeline:

We will use two primary techniques to develop polyploids. First, we will treat seedlings at the cotyledon stage with a solution of oryzalin (trade name Surflan) solidified using agar. Previous research has shown that treatment on 5 consecutive days is effective in inducing polyploids and to date we have identified more than 40 tetraploids of Norway maple. We will continue this treatment on all species. The second technique involves stratifying seed and allowing the radicle to emerge before incubation in an oryzalin solution for 24-hours. This technique will allow us to treat larger numbers than our previous application, which was labor and time intensive and only allowed treatment of 100-200 meristems. After treating, seed will be sown and allowed to grow. When two sets of true leaves have developed and fully expanded, they will be tested for induced polyploidy using flow cytometry.

Seed of each species has been collected and placed in stratification. We will continue to observe and hope to begin applications by mid-fall to early-winter 2011. We expect that surviving plants should be screened by summer 2012; potentially in time to propagate via budding with a collaborating nursery.

Progress:

We continued treatments of Norway maple using the 5-day droplet method and ultimately treated 540 seedlings that resulted in 50 mixoploids and 113 tetraploids (Table 1). Budwood of 15 selections of the tetraploids were sent to J. Frank Schmidt nursery for propagation in August 2012. Of these, 14 selections were stable tetraploids. At least one plant of each accession will be transplanted to Corvallis during fall/winter 2013-14. Remaining tetraploids will be transplanted during winter 2014-15.

All mother plants continue to be maintained at the Lewis Brown Horticulture Research Farm in Corvallis and material will be available for propagating at additional cooperating nurseries. These plants were potted into #25 pot-in-pot containers during fall 2013. Due to our success using the 5-day droplet method and the high mortality of treatments to induce polyploidy in *Acer truncatum* (data not shown) using the incubating method above, we treated all species using the droplet method. Results were more modest with other species; however, we have recovered tetraploids of *A. ginnala* and *A. buergerianum* (Table 1). Scion from tetraploids of amur maple will be sent to a cooperating nursery in 2014. We will propagate trident maple from stem cuttings in 2014, due to its difficulty to propagate by grafting.

Germination of *Acer campestre* was sporadic and most of the seedlings died. We recovered no mixoploids or tetraploids from treated seedlings. After consultation with industry representatives and based on poor germination overall, it was decided not to pursue efforts to develop sterile paperbark maple (*A. griseum*). This species is not a threat to invade native ecosystems since it is difficult to germinate even under ideal conditions of nursery production. Approximately 1,500 seeds of sycamore maple (*A. pseudoplatanus*) were sown but very few germinated. A second source was used and, again, we had very poor germination. This species is an invasive threat in some parts of the country; therefore, another alternate seed source of confirmed viability will be pursued.

Table 1. Results of treating four species of maples with antimitotic agents to induce polyploidy for developing sterile triploids.

Species	No. Treated	Diploids	Mixoploids	Tetraploids
Acer ginnala	198	140	5	5
Acer buergerianum	243	201	15	9
Acer platanoides	540[z]	172	50	113
Acer campestre	35[z]	10	0	0

[z]Numerous seedlings died during and after treatment, therefore the number treated is different than the sum of diploids, mixoploids, and tetraploids.