Ornamental Plant Breeding at Oregon State University©

Ryan Contreras
Department of Horticulture, 4017 Agricultural and Life Sciences,
Corvallis, Oregon 97331, USA
Email: contrery@hort.oregonstate.edu

The Ornamental Plant Breeding Program at Oregon State University was established to develop new cultivars, primarily of woody taxa that are adapted to Oregon and beyond. The program is diverse and has active projects in more than a dozen genera. The goals of various projects are as diverse as the taxa and include developing sterile cultivars, improving growth form, or other traits for production and landscape use, novel ornamental traits such as flower color or form, and insect or disease resistance. Examples of projects discussed here include sterile Norway maples (*Acer platanoides*) and rose-of-Sharon (*Hibiscus syriacus*) and mutation breeding in flowering currant (*Ribes sanguineum*) and sweetbox (*Sarcococca confusa*).

INTRODUCTION

I was hired in 2009 with teaching and research responsibilities, specifically to breed new ornamental cultivars for the nursery and landscape industries. The program is broad in scope and includes diverse taxa such as *Acer*, *Berberis*, *Cercidiphyllum*, *Cotoneaster*, *Galtonia*, *Hibiscus*, *Malus*, *Penstemon*, *Philadelphus*, *Prunus*, *Ribes*, *Sarcococca*, *Syringa*, and *Thuja*. Similarly, the goals and techniques used for each project are varied. Main objectives for each project fall into one of four categories: (1) sterility, (2) alternative growth form (e.g., dwarf, fastigiate), (3) improvement of specific ornamental traits (e.g., flower color or form, foliage color), or (4) insect and disease resistance. For brevity, the discussion here will be limited to work being conducted on Norway maples, rose-of-sharon, and two non-targeted mutation breeding projects in fragrant sweetbox and flowering currant.

PLANT BREEDING PROGRAM

Sterility in Norway Maple

Several economically important maple species have been identified as invasive in various regions of the country, particularly New England states. Norway maple (*Acer platanoides*) remains an important species for Oregon growers even though it has been banned in Massachusetts and is officially listed as invasive in Connecticut (USDA-NRCS, 2013). To address this issue we have been working toward developing sterile triploid forms of Norway maple.

In 2011, we treated three genotypes of Norway maple by placing a drop of agar-solidified oryzalin solution on the meristem of seedlings at the cotyledon or first true-leaf stage using a pipette and recovered 113 homogeneous tetraploids. In 2012, we sent 15 selections to J. Frank Schimdt and Sons Nursery to be propagated by budding. In 2013, these selections were tested and 14 of them remained stable tetraploids. Replicates of these selections will be transplanted during Winter 2013-14 to Corvallis for observation and evaluation of fertility when they flower.

Hibiscus syriacus Breeding

The U.S. National Arboretum released four rose-of-Sharon cultivars that were reportedly triploids with reduced fertility including ‘Diana’, ‘Minerva’, ‘Aphrodite’, and ‘Helene’ (Egolf, 1970, 1981, 1986, 1988). These cultivars are still popular in the trade today; however, they have been observed to produce substantial amounts of seed, which is in contrast to their description at the time of release. It is unclear why these cultivars have become fertile. We know that the assumption that rose-of-Sharon is a diploid is incorrect;

its natural ploidy level is tetraploid. This fact has potentially major implications for using ploidy manipulation to develop sterile cultivars.

We have begun a breeding program to investigate reproductive behavior of these and other cultivars, while also working to develop new cultivars. Questions of interest are: (1) what is the 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. If we can determine inheritance of these traits we will be able to use targeted breeding to develop sterile forms with specific phenotypes.

We made controlled crosses in 2012 to evaluate fertility. 'Aphrodite', 'Diana', and 'Minerva' did not have reduced fertility, either as a male or female parent, compared to the other cultivars included in this study (Table 1). Of note was the substantially reduced fertility of 'Flogi', Pink Giant® rose-of-Sharon; this corresponded to the fact that it was a hexaploid and was the only cultivar in this study that was not a tetraploid (Table 2). Our observation that reduced fertility is associated with variation in ploidy level indicates that ploidy manipulation remains a viable option for developing sterile rose-of-Sharon cultivars. Nearly 600 seedlings from 2012 crosses were field planted in 2013 and will be evaluated for flower color, eye spot, and double flowers.

Mutation Breeding

Flowering currant (*Ribes sanguinuem*) is native to the Pacific Northwest and is a favorite of proponents of native landscapes. It is attractive in spring when flowering and attracts pollinators. It tolerates poor soils and drought. However, flowering currant tends to be leggy and has a poor form in the landscape. There are varied forms with regard to flower color but our goal is to develop a line of cultivars that are compact and exhibit the range of flower colors available from white to pink to cherry red.

Seed were treated in late-2011 with ethyl methanesulfonate (EMS). This generation (M1) was field-planted in Spring 2013. We have selected several forms that have potential for release including a cut-leaf form that has been distributed to eight Oregon nurseries for trialing. We have begun selecting the most highly branched and compact plants from the M1 and will continue in the M2 generation. With an additional year of field data, I hope to release the cut-leaf form in late 2014 or 2015.

Fragrant sweetbox (*Sarcococca confusa*) is a shrub prized for its ability to thrive in dry shade, an exposure most plants will not tolerate. It has few pest and disease problems and requires little maintenance. Fragrant sweetbox produces white flowers during winter and glossy black fruit later in the year that are persistent. It is more fragrant than *S. hookeriana* and more cold-tolerant than *S. ruscifolia* (Dirr, 2009). Fragrant sweetbox also does not spread by rhizomes; therefore, it will not spread into unwanted areas of the home garden and can be maintained more easily. The major breeding opportunity for fragrant sweetbox is the lack of diversity in this species. We have initiated a mutation breeding program to induce variation. A particular goal is to identify more compact forms that would serve as an intermediate between *S. confusa* and *S. hookeriana* var. *humilis* but would not spread as in the case of the latter.

Seed were treated at the same time using the same method as the flower currant described earlier. All plants were field-planted in Spring 2013 under shade for long-term evaluation. Fruit were collected from a subset of the population and are being grown to evaluate the M2 population. The most compact plants from M1 generation were propagated in 2013 and are being evaluated. A number of selections show great promise as introductions that exhibit compact growth and alternate leaf shape that is much more narrow than the wild type.

ACKNOWLEDGEMENTS

I would like to thank Mara Friddle and Jason Lattier for technical assistance and the Oregon Department of Agriculture/Oregon Association of Nurseries, Agricultural Research Foundation, and the J. Frank Schmidt Family Charitable Foundation for funding support.

Literature Cited
Dirr, M.A. 2009. Manual of woody landscape plants. 6th ed. Stipes, Champaign, Illinois.
Egolf, D.R. 1970. *Hibiscus syriacus* 'Diana', a new cultivar [*Malvaceae*]. Baileya 17:75-78.
Egolf, D.R. 1981. 'Helene' rose of Sharon (althea). HortScience 16:226-227.
Egolf, D.R. 1986. 'Minerva' rose of Sharon (althea). HortScience 21:1463-1464.
Egolf, D.R. 1988. 'Aphrodite' rose of Sharon (althea). HortScience 23:223.
USDA-NRCS. 2013. Introduced, invasive, and noxious plants. 24 Sept. 2013. <http://plants.usda.gov/java/noxComposite>

Table 1. Results of crossing study conducted during 2012 to estimate the relative fertility of nine rose-of-sharon (*Hibiscus syriacus*) cultivars.

Cultivar	Flowers pollinated	Seedlings	Seedlings per pollinated flower
As female parent			
Aphrodite	42	423	10.1
Blue Satin	59	318	5.4
Diana	97	155	1.6
Flogi	39	3	0.08
Lucy	34	27	0.8
Minerva	24	44	1.8
Oiseau Bleu	36	66	1.8
Red Heart	74	212	2.9
Woodbridge	70	180	2.6
Mean	52.8	158.7	3.0
As male parent			
Aphrodite	74	55	0.7
Blue Satin	44	443	10.1
Diana	55	186	3.4
Flogi	50	25	0.5
Lucy[z]	-	-	-
Minerva	66	222	3.4
Oiseau Bleu	54	212	3.9
Red Heart	66	154	2.3
Woodbridge	66	131	2.0
Mean	59.4	178.5	2.9

[z]'Lucy' is a double-flowered cultivar that does not produce pollen, therefore could not be assessed as a staminate parent.

Table 2. Mean relative holoploid genome size (2C) estimates ± SEM and inferred ploidy levels of nine cultivars of rose-of-sharon (*Hibiscus syriacus*). Estimates were performed by analyzing DAPI-stained nuclei using flow cytometry using *Solanum lycopersicum* 'Stupicke' (2C=1.96 pg) as an internal standard.

Cultivar	2C	Ploidy level
Aphrodite	4.7±0.04	4*x*
Blue Satin	4.6±0.03	4*x*
Diana	4.7±0.06	4*x*
Flogi	6.8±0.05	6*x*
Lucy	4.6±0.01	4*x*
Minerva	4.6±0.05	4*x*
Oiseau Bleu[z]	4.6±0.04	4*x*
Red Heart	4.7±0.00	4*x*
Woodbridge	4.6±0.06	4*x*

[z]'Oiseau Bleu' is also sold in the trade as 'Blue Bird' and 'Bluebird'.