Recent Experiences Developing and Selecting New Cultivars by Hybridizing©

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INTRODUCTION

If you can imagine a plant, it's only a matter of growing enough seedlings and you will find it. Chances are, however, along the way you will find something even better! Random selection from crops of seedlings or tissue culture variants is one way to find new plants. Controlled hybridizing is a way to speed up the process of finding desirable plants. I have been breeding plants for 20 years now. This paper mainly discusses the last 4 years and how a more streamlined system has been developed that could be applied to practically any genus.

WHY BE CONSCIOUS ABOUT BREEDING AND SELECTING NEW PLANTS

Import restrictions on many species mean it becomes too expensive to import something that may or may not do well in our climate. With a "Horses for Courses" approach, better material can be selected for the local conditions. This is important with plants raised from seedling as well as with clonally produced material. Market requirements are always changing; colour preferences, plant sizes, and shapes mean more practical selections will be better suited to modern gardens. Attractive, dwarf, disease-resistant plants for small gardens are more important than ever. Climate change means some forms of a particular hybrid background may be more suited to different areas. Production issues can be improved with selections that make production easier, whether because of bushy habit or disease resistance.

GETTING STARTED

Starting a breeding programme can be as simple as selecting a seedling or a growth variant that already shows some improvement and seeing what it can produce. This selection could be termed a lucky break. Luck plays a big part of any breeding programme, and the best way to stack the odds on your side is by raising more seedlings. Setting out to breed a better plant type of any species may mean starting from scratch. If this is the goal, the right parents, with the most important characteristics need to be selected as a starting point. When doing any cross, whether at the start of the breeding program or further down the track, do the cross both ways if you can. Sometimes it will work both ways, sometimes it will only work one way. Either way, the results can be different.

It is also important to develop a system that is easy to maintain but does not cut corners when it comes to what the plants require. Few individuals or organisations can afford to plough vast resources into any breeding programme until results are ensured. Good records are a must for a successful breeding programme. The records show what the results are, and they can also show trends or tendencies of certain crosses. Good records can also help unravel mistakes or mix-ups further down the track. It is also important, but not imperative, to have all the skills needed to propa-

gate the species you are dealing with, otherwise the project can become quite costly in terms of outsourced skills and resources. Last, but not least, it is important to have a good network to market new plant selections. Some of the biggest selling plants have come out of the smallest nurseries, so marketing must not be overlooked.

DEVELOPING NEW ORNAMENTAL *PRUNUS* CULTIVARS

The cost of importation of new ornamental *Prunus* cultivars makes local selection logical, especially since we live in a relatively mild climate. This makes the goal of raising new cultivars for New Zealand quite attractive. How would you get a weeping ornamental *Prunus* that is suited to warmer areas of the country?

We are limited to about three weeping selections of ornamental *Prunus* that seem to be better suited to cooler areas. Looking in wild populations for pendulous *P. campanulata* type may be a starting point, but in warmer areas these seedlings would easily be overwhelmed by grasses.

Starting from scratch with *P. campanulata* would be easy, but this is a big tree, so starting with *P.* 'Okame' would be better, since this is a smaller-growing hybrid that is more likely to produce a small tree for modern gardens. Being a hybrid, there is already a bigger range of possibilities to be exhibited in the seedlings. In fact, using known hybrids in a breeding programme can produce shortcuts to desirable traits that need to be added to the breeding line.

As luck would have it, the opportunity arose to collect seed of *P.* 'Okame' in some old stock plants where a branch of *P.* 'Okame' crossed over a branch of *P. campanulata* 'Red Vale' and both had set seed (Fig. 1). While not hybridized in a controlled manner, the seedlings raised will be a selection of self pollinations and cross pollinations from both parents, giving a broad range of material to select from. The seeds from both parent trees were collected and have been kept as different groups all the way through, and as they developed there was clearly a mixture of types between vigorous *P. campanulata* and smaller growing hybrids (Fig. 2). There were also a few seedlings that distinctly showed foliage very similar to *P. incise*, which is one of the parent species of *P.* 'Okame'. The stronger seedlings were trimmed up and partially defoliated so that none of the smaller seedlings were lost. The seedlings that wanted to creep rather than grow were supported with little split bamboo canes.

After a full growing season in the seedbed the seedlings that were between 10 cm and 1.2 m tall were planted out into polythene mulched beds. After the second growing season, the bigger seedlings were lined out as part of the landscape in the garden we are developing. Some of the smaller creeping seedlings have been grafted to get them onto a standard on *P. avium* × *P. pseudocerasus* 'Colt' rootstock and are starting to show a weeping habit. Other seedlings are still too small to provide grafting material, but where there is life there is hope!

DEVELOPING NEW *MAGNOLIA* CULTIVARS

When I started hybridizing magnolias there were several magnolia breeders in New Zealand already, but even when dealing with the same species plant breeders will often tend to follow down different avenues and breeding lines for a number of reasons. They have different ideas based on their personal tastes, as well as different raw materials in the way of plant selections to work with. Their work is

Figure 1. *Prunus campanulata* 'Red Vale' and *Prunus* 'Okame'.

Figure 2. *Prunus* hybrids in the seedbed.

Figure 3. *Magnolia* 'Sweet Simplicity'.

based on different selections, which leads to different breaks or quantum leaps in improvements, and therefore the outcome is more varied.

I have always been attracted to the clean, formally sculptured form of different species such as the *Magnolia campbellii* types, as well as the well-formed *M.* ×*soulangeana* types. The early hybridizing I did while working at Duncan and Davies Nurseries between 1987 and 1993 was somewhat of a sweeping approach, covering the field quite widely. Essentially I was testing the water to see what was possible. You can learn something from every cross, even if the lesson is not to do it again. One of my favourite breeder plants was *M.* 'Sweet Simplicity' (Fig. 3), which is so named because of its simple, yet crisp form. It has been summarized by some magnolia experts as degenerate but it has two key features in that it flowers easily and produces well formed flowers. The flowers only have small sepals, which makes it look sharp in outline. In many hybrids, the sepals can be quite variable in colour and shape, making some blooms look untidy.

Originally 'Sweet Simplicity' was purchased from a garden centre under the name of *M. sieboldii*, but was clearly a *M.* ×*soulangeana* type. It was root bound in a bag and had still managed to set flower buds, so it had to be good. I saw the results possible with 'Sweet Simplicity' and realized this was a breakthrough on the road to developing a line of smaller growing, free-flowering garden plants. This line is still improving with each successive generation.

In the late 1990s I crossed *M.* 'Sweet Simplicity' with *M.* ×*soulangeana* 'Jurmag1', Black Tulip™ magnolia to continue the breeding line I had started while working at Duncan and Davies. This cross has produced a range of growth habits from medium-sized bushes to timber trees. The first seedling flowered at 2 years from

Figure 4. *Magnolia* 'Genie'.

seed and showed a great deal of promise, so it was hybridized immediately with another breeder plant (*M.* 'Sweet Simplicity' × *M. liliiflora* 'Nigra'). This first seedling was named *M.* 'Sweet Valentine' due to its interesting glowing red colour. This cross has produced some good reds which subsequently flowered 2 years from seed. *Magnolia* 'Genie' (Fig. 4) is the first result from these hybrids, flowering in 2003. *Magnolia* 'Genie' is real break in the breeding line for sheer volume of flower. In the second flowering season it had 100 flowers! A subsequent batch of hybrids crossed in 2003, including *M.* 'Genie' as seed parent and pollen parent are beginning to show promise. A good percentage of these seedlings are setting flowers at 2 years from seed. Some 2-year-old seedlings have started with 12, 14, or 22 flowers for the first flowering! *Magnolia* 'Genie' is currently being trialed in the U.S.A., Europe, and Japan through a plant marketing network.

In Spring 2007 we wait for the first flowering on approximately 35% of the 400 3-year-old seedlings planted out. Out of the 2003 batch of 18 successful crosses, about 30% have *M. campbellii* 'Sir Harold Hillier' as pollen parent. *Magnolia* 'Genie' × *M.* 'Sir Harold Hillier' has a couple of seedlings flowering 3 years from seed, which is really young for a *M. campbellii* type.

HYBRID PRODUCTION

The *Prunus* programme so far is a limited project with only a few hand crosses programmed for the future. The *Magnolia* programme is the ongoing focus, with a few crosses each year and every 4 or 5 years a major hit when another break appears. The production system outlined below with dry or shaded cloches allows any species to be added if the opportunity arises (Fig. 5). I have experimented with *Libertia* and *Nerine* and intend to experiment further with cactus seed and *Aloe* hybrids.

Figure 5. Sowing seed in the open ground seedbed.

Once seed is set, it is treated and stratified in the appropriate way for the species, then sown mid-September (early spring) in outdoor beds (Fig. 5), which are raised either by building up the soil with a tractor and molding frame, or by putting timber sides down to hold the sowing medium. The seed is sown in a medium of granulated pine bark, with slow release fertilizer (15N-4P-8K 8–9 month) having been added into the soil below. It is important to apply the sowing medium to freshly raked soil to allow the medium to blend with the soil below. Soil that has had rain on it will form a barrier that roots hesitate to cross. After sowing, the beds receive an appropriate fungicide drench to discourage any damping off diseases. The beds are then shaded with 30% shadecloth over cloche frames and kept damp, with water applied twice daily at magnolia germination time to assist the cotyledons to shed their membranes and open properly. The shade also helps conserve water by keeping the wind off the seedlings. The cloth is lifted to one side of the cloche frames to protect from the prevailing wind. It is useful to have on hand in case of hail, which we had in late December 2006. One of the main pests in this system is sciarid fly (*Lycoriella* species), which is controlled with granular lawn insecticide (diazinon), which also controls other soil-borne insects. This is sprinkled in the bed with the seed before the final layer of bark is added to cover the seed. By using this open-

Figure 6. Magnolia hybrids in the first season planted in polythene beds.

ground method, I can minimize production cost as the hybrids become another crop in the rootstock nursery where 20,000 plus seedlings are grown for rootstocks each year. In 2006 approximately 900 m of bed 0.5 m wide was sown in total and 16 m^3 of bark was wheel-barrowed down the rows to do it.

After a full growing season the seedlings, which are between 10 cm and 70 cm tall, are planted at final spacing into polythene-mulched beds (Fig. 6). This is laid by a tractor-mounted machine from a roll of polythene 70 cm wide and produces finished beds 35 cm wide, slightly raised, and about 1 m apart. The seedlings are spaced according to parentage with minimum spacing 40 cm and maximum 120 cm. Every second bed is planted with seedlings to give a final spacing between the rows of approximately 2 m. The beds between the seedlings have a 1- or 2-year crop planted as part of the cost recovery system. During the first year a supplement of slow-release fertilizer of approximately 15N-4P-8K 8–9 month (the same one used in the seedbed) is given individually to each plant with a dispenser at about 15 g per plant. In the second year similar NPK crop fertilizer is scattered along the ground between the beds as by this stage the roots are out in the ground beyond the polythene mulch. The seedlings are grown with as little trimming as possible to maintain their natural shape as well as the juvenile growth to ground level. This

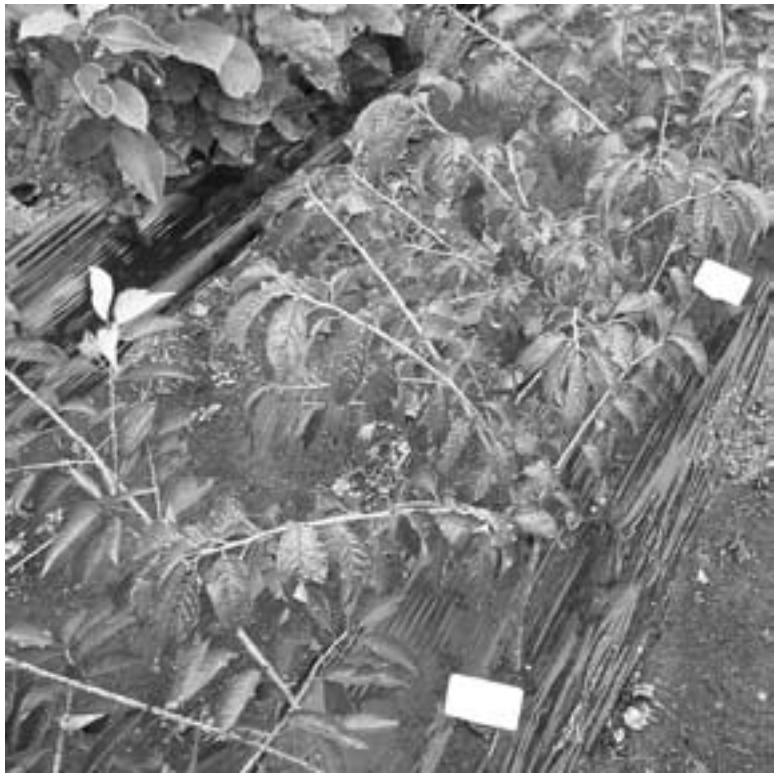

Figure 7. Shows first grafts of some promising weeping *Prunus*.

allows cuttings to be taken to establish own-root plants for evaluation as soon as a seedling shows promise. Lax branches are removed to avoid herbicide contamination during weed control. Weed control is mainly with applications of glyphosate at normal rates. Some pre-emergent herbicide is used in spring to help control spring germination of weeds.

Once a seedling shows promise, five or ten buds are put out onto rootstocks either as dormant spring buds or summer buds as stage one of the evaluation process (Fig. 7). Summer cuttings of magnolias are also taken to evaluate rooting percentages and propagation options for the new clone. Magnolia seedlings which are to be discarded are reworked by top grafting to produce more wood of promising clones, or worked with clones of selected seed trees. Magnolia seed is not reliably produced in New Zealand, so another medium term goal is to establish our own seed orchard with hand-set seed from espaliered trees on windbreak fences. Currently we drive 4 h north in late summer to collect magnolia seed from a series of trees for rootstock production. Flowering cherry seedlings may be used for landscaping if they perform well.

I have a couple of magnolia crosses with seedlings that consistently produce flowers on a majority of the crop in their second year. This enables many seedlings to be raised for rootstocks which are then summer budded or spring budded after flower-

ing, and any seedlings showing promise can be kept back for further evaluation without undue expense. This is a very practical way to learn more about magnolia hybridizing by watching many seedlings of a particular cross. If a white-flowered seedling appears with flowers in the second year from seed, this will be a quantum leap, as pure white-flowered magnolias all tend to take several years to settle into flowering.

WHERE TO FROM HERE?

As with any breeding programme it helps to not only start with the best parents available, but occasionally review where it is headed. When my wife and I went to the United Kingdom and continental Europe in April 2006, one of the goals was to see what was out there and what I should be hybridizing magnolias with. Up until this time I was working with the limited view of what the New Zealand market was wanting. In reality the market is worldwide so the focus needed to be broadened. We came back with some fresh perspectives on hardiness and small garden plants. There is also a broad range of hybrid seedlings flowering now with which a more scientific approach involving back crosses to reach specific goals may begin.

SUMMARY

It has taken 20 years and several lucky breaks to get the magnolia breeding programme to where it is today. The life cycle has been brought down to a reasonably economic 3 to 5 years through selective breeding. With a gene pool of medium-sized heavy flowering magnolias now developed, the next step is to add large flowers along with hardiness into the breeding line. Colour breaks into yellows, rich purples and possibly blue are also another step. Remember, anything is possible when using the right breeding parents and raising as many seedlings as you possibly can will stack the odds in your favour.