

Ornamental Plant Selection Using the “Shotgun Technique”: a Complex Process Simplified[©]

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Currently there is very little commercial ornamental crop development in South Africa. There is unfortunately little stimulus or incentive to develop this industry and this in part this is due to the fact that floriculture is not offered at any tertiary institution in the country. Yet, South African plant genera are of the most commercialised in the world. Plant breeding can be a complex and daunting process, so the purpose of this paper is to introduce a simple low-tech method of multi-generational plant selection which can produce very rewarding results.

“Indigenous” often has the unfortunate reputation of being dull and difficult to grow, often because there has been little or no selection on the plant before its release onto the market. As a result, unselected and unbred wild plants will always pale in grandeur against the highly bred petunias, pansies, and practically every other plant you will find in a commercial nursery nowadays. One of the objectives of the horticultural operations at Kirstenbosch Botanical Gardens is to promote indigenous plants by introducing new selections into the industry. Horticulturists at Kirstenbosch have undertaken limited plant breeding projects, like *Plectranthus* ‘Plepalila’, Simply Beautiful[®] Mona Lavender *plectranthus* PP13,858 for example, but generally the gardens don’t have the capacity to undertake in-depth plant selection programmes. There are a few commercial nurseries in South Africa that breed on a very limited scale, and there is the odd back-yard breeder, but generally there just isn’t the commercial incentive to invest in large scale breeding operations in this country.

There are two important but slightly different processes involved in developing new commercial floricultural products:

- 1) Plant breeding — (usually interspecific hybridising between two or more different species). When executed properly, breeding can be a very complicated process. Hybrid vigour often initially leads to strong plants with strange and wonderful characters but if not done carefully can lead to inbreeding depression (crossing brothers and sisters) often leading to harmful mutations causing weak and disease-prone plants.
- 2) Plant selection — (a natural process of selecting the best and eliminating the worst). This is usually a part of the breeding process but can also exist as a stand-alone process in directed intraspecific crossing.

For the record, there are two types of ornamental plant products: seed products and vegetative products. The breeding processes required for each, although there is some overlap, are quite different (Table 1).

Table 1. Comparison of the two types of ornamental plant products.

Seed products	Vegetative products
Uniform germination	Quick and easy to develop
Vigorous growth and larger flowers	Less vigorous than seedlings
Can be stored by grower	Smaller flower size
Easy distribution to growers	Limited shelf life
Virus free (in most cases)	More expensive to produce
Cheaper to produce	More expensive to buy
Cheaper to buy	Expensive to eliminate viruses
Longer and more complicated to develop	
More expensive to develop	

For the purposes of comparison and illustration, the conventional breeding process is elaborated here.

CONVENTIONAL BREEDING PROCESS

Seed Products

Seed products are derived from conventional plant breeding processes. The correct process of true plant breeding involves ideally starting with a large and varied gene pool of parent plants (often of different species). Through a process of carefully directed and well-recorded cross pollination, the desired hybrid can be developed.

Then using similar but not identical parents, a breeder will attempt to repeat this whole process numerous times with the aim of breeding a number of identical offspring hybrids, say perhaps 10, (these are called parent lines). These are the equivalent of very distant identical cousins. Then by mass cross pollinating these genetically different but identical-looking parent lines, large quantities of commercial seed, all with identical characteristics, will be produced. This process of only crossing distantly related plants will avoid inbreeding depression; all offspring will be genetically sound and strong. This process, however, can take many years, and requires dedication and patience, which is the reason why it is seldom done outside of large commercial ornamental plant development companies, like Ball Horticultural Co. for example.

Vegetative Products

The process dealt with in this paper will be to do with breeding a vegetative product, i.e., a product that will ultimately be reproduced via conventional means of asexual propagation. Breeding a vegetative product requires far less time than a seed product, and is relatively easy to do. Although not as profitable, the short turnaround time and low investment factor make it the more attractive option.

At Kirstenbosch, we prefer to focus on naturally developing pure wild species rather than hybridising different species. Quite simply there are more than enough beautiful pure species to develop without the of need resorting to hybridization.

THE “SHOTGUN” PROCESS

As was mentioned, there is still a need for some plant selection to make a wild plant more marketable. So, through the following very simple and natural process, by exploiting the natural variation that exists between individual plants, one selects combinations of desirable plant traits to produce ornamental “winners.” The “shotgun process” gets its name from the analogy of somewhat crudely firing a shotgun in order to hit a tiny target; in a similar way the larger the pool of genetic characters one has to choose from in a population of wild plants, the higher the chance one will have of finding the winning plant.

From an ethical point of view, the question that could be asked is whether or not this plant could have naturally occurred in the wild? If the answer is yes, the process gets an ethical tick. This process is essentially entirely natural — nothing artificial. The process is called natural selection, except now the process has been sped up and the traits being selected for are purely for ornamental benefit.

How the Process Works

1. The First Step. Select a plant species or form of that species that naturally already has the potential to be a winner — i.e., it must already have numerous good traits. Genes cannot magically appear, so if they’re not there in the population to start with then they’re probably not going to magically appear during the course of your selection — e.g., if neither of the parent plants contains the genes for blue flowers, the offspring are almost certainly never going to exhibit blue flowers. General rule of thumb: Pretty parents generally make pretty children. Ugly parents, however, very rarely make pretty children!

2. What Traits Would One Typically Look For and Select For? Here is a list in order of priority for herbaceous or woody perennials:

Ease of Propagation. This is essential right off the bat. If you can't propagate it, it will always struggle to take off as a commercial product, no matter how pretty it is.

Flower Size. Bigger flowers are generally better but not always if there are a lot of them, so generally overall flower cover is important. It should pass the 90 mile per hour test — i.e., it should catch your eye if driving past at high speed!

Flowering Period. Longer is better, particularly if flowering at times of the year when other things are not — mid winter is good! Plants that flower for only 2 weeks of the year, as stunning as they may be for their 2 weeks, have minimal appeal for the 50 weeks of the year when they're not in flower!

Good in a Pot and Good in the Ground. This is surprisingly not always the case for both. Some plants do very well in containers but fail dismally when planted in an open bed situation, and others that do very well in the open ground can sometimes make very weak and unshapely pot plants.

Habit. Neat and compact is generally better than long and lanky.

Drought Tolerance. In South Africa which is generally considered an arid country this is very important, particularly with the trend towards waterwise gardening. So, the more the better.

Nice Foliage. This is especially when not in flower.

Good Branching. This is better than sparse and twiggy.

Not Deciduous or Having "Off Periods". A bare twiggy leafless shrub will not sell in a nursery.

3. A Good Seed Bank of Wild Seed Is Essential. This will have the highest variability of traits. Seed originating from unknown horticultural origins is usually genetically very limited, and often has gone through a genetic bottleneck at some point resulting in homogenous or inbred plants. One could manually harvest vegetative cuttings of forms of wild plants too, but cuttings generally have less vigour than seedlings and to collect a thousand genetically different plants is somewhat impractical.

4. A Trial Ground. Preferably not in the Natal midlands or in Contsantia, actually the harsher the conditions the better. If something performs well under unfavourable and highly selective conditions, the better chance it has of doing well in a domestic garden. Examples of conditions to look for in a trial ground are:

- Poor soils.
- Strong winds.
- Extreme temperature variability (preferably freezing on occasion).
- Low moisture, etc.

These are all good conditions for doing selections. Often what grows well in a Kirstenbosch glasshouse is not necessarily going to thrive out on the Cape Flats or in Wellington, or Upington for that matter.

5. Sow and Germinate Your Wild Seed. Just selecting the first 1,000 that germinate out of 10,000 is already a selection for easy-germinating forms (Fig. 1).

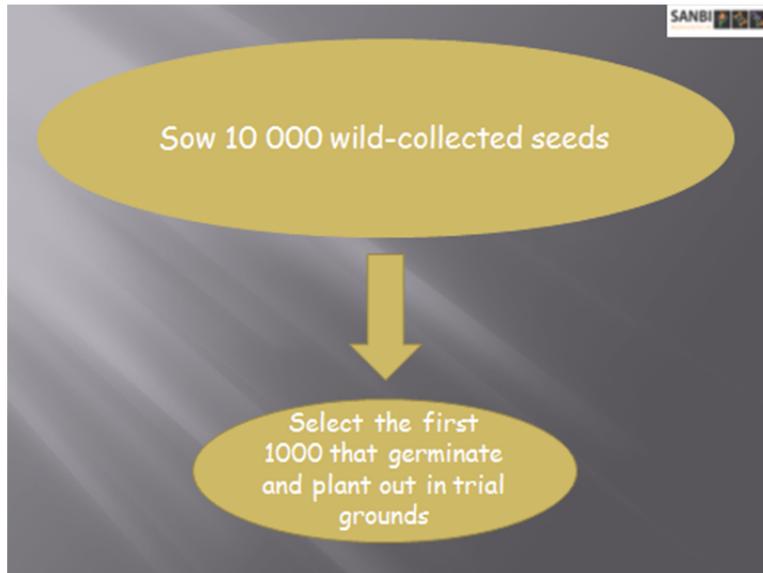


Fig. 1. Ornamental plant breeding — starting the process.

Plant them out in your prepared trial ground, well spaced and in manageable rows (Fig. 2).



Fig. 2. Planting out the first 1,000 selected seedlings.

Use flags of different colours to flag plants with good traits, i.e., first to flower from seed, good flower size, good habit, etc. Drip irrigation is better than overhead watering — it minimizes weed growth and saves having to use herbicides. However, hold back on the irrigation to test for drought tolerance. Those that produce better tap roots will probably survive better.

6. Based on the Flagged Selections of Your Initial 1,000 Plants, Select No More than about 20 of the Very Best Individuals (Fig. 3). It will be tempting to select more but any successful plant breeder will tell you that the secret to success lies in getting rid of the runts! These 20 are all now superior in some way over your remaining plants.



Fig. 3. Making the first selection of the best 20 plants.

7. Now, Bring Your 20 Plants into Close Proximity and Let them Mass Cross Pollinate and Set Seed, Either Naturally or by Hand Pollination. You may need to propagate these plants and grow them out again side by side in order to do this (Fig. 4). The reason we chose a reasonably big group of 20 is that you lessen the risk of inbreeding depression later on. These again will be very distant cousins.

8. Harvest This Now Genetically Improved Seed and Start Your Process All Over again.



Fig. 4. Repeating the process over again for the second time.

Sow your seed, plant out your first thousand germinating seedlings in your trial ground and through the same selection process flag the next best 20 individuals (now significantly better than your originals). Discard all the unwanted plants and repeat the pollination process amongst this selection of 20 and harvest their seed.

9. Now Repeat the Process All Over again for the Third Time. Sow your seed and plant out the first thousand germinating seedlings; flag them in just the same way as before. These should all look substantially more improved upon than your original crop.

10. Now, Carefully Select Your Very Very Best Individual which Incorporates All the Characters You Are Looking for Good Flower Colour, Good Habit, Good Flowering Period, Good Drought Tolerance, etc (Fig. 5). This plant should be significantly better than what you had to start with, yet at the same time could quite easily have naturally occurred in the wild.

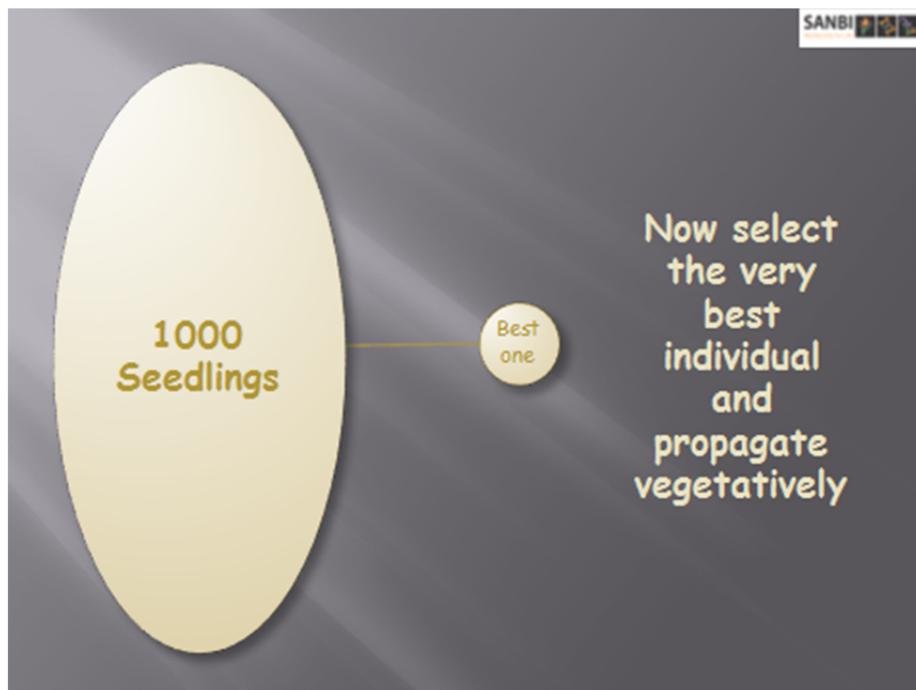


Fig. 5. The end of the process with selection of the best individual.

11. Propagate your plant with sterile implements and produce a number of clean mother stock plants, preferably kept in two or more different geographic locations to prevent viral cross contamination infection.

The following three images show a *Petunia* selection trial in California (Fig. 6) and a *Selago villicaulis* selection trial (Fig. 7) and final very best *Selago villicaulis* selection (Fig. 8) at Kirstenbosch Botanical gardens.



Fig. 6. Comparative trial grounds of *Petunia* selections in California, USA.



Fig. 7. Trials of *Selago villicaulis* at Kirstenbosch Botanical gardens.



Fig. 8. Selected ornamental winner *Selago villicaulis* ‘Purple Turtle’.

South Africa has over 20,000 plant species, about 10% of all the plants on earth, many of which have ornamental value. There is huge potential in this country to develop our indigenous flora locally before it gets plundered by abroad. This simple guide will hopefully stimulate more activity in the local floriculture industry and hopefully will be improved on by future growers and breeders.