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What Do Plant Breeders Do?

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INTRODUCTION

It all starts with an idea – or a curiosity and the question; "What if?" Figure 1 illustrates in a simple way what a plant breeder goes through to get a product to market. Because horticulture is simply a reflection of fashion or fad, breeders have to be one step ahead of the game or be lucky enough to cash in on serendipity. Sometimes we're the windshield, sometimes we're the bug.

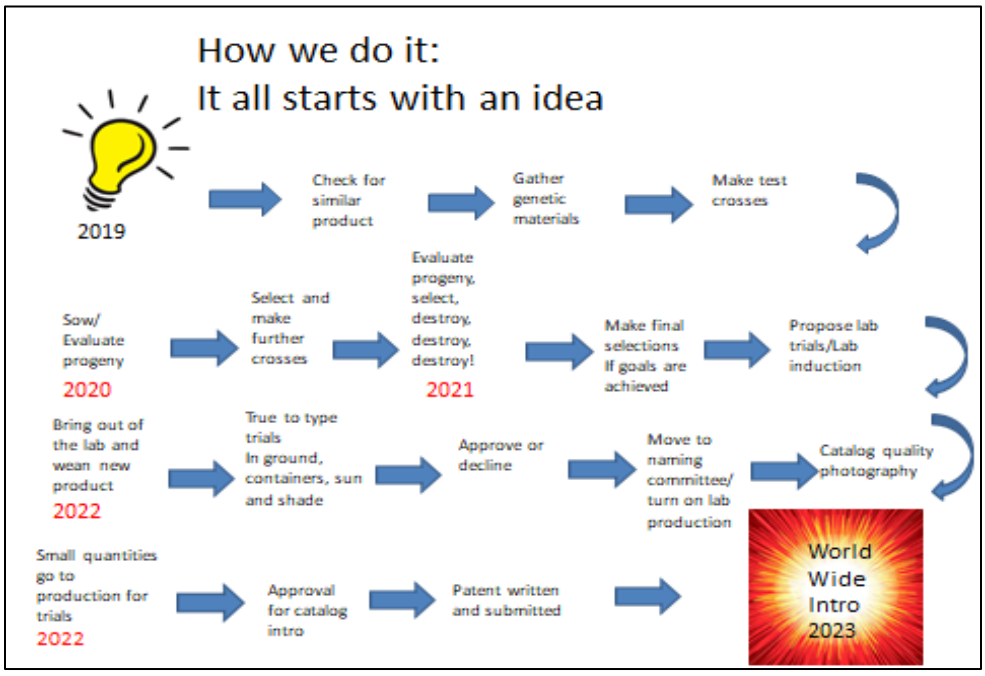

Figure 1. Conceptualization of the process involved in getting a new horticultural product to market.

Terra Nova relies on traditional breeding methods and the creative mind to bring out new products. However, but we're not afraid to use and have used most genetic manipulation tools to increase our chances of developing novel products.

With ploidy manipulation, we are able to restore fertility in some infertile hybrids. We are also able to increase flower or plant size or make a plant more stiffly upright in order to support the weight of relatively larger flowers. We have also made a few bi-generic crosses possible by raising the ploidy level of a distantly related plant.

Our most famous bi-generic plant; *xHeucherella*, a cross between Heuchera and Tiarella. Another up-and-comer is *xMukgenia*, a hybrid between *Bergenia* and *Mukdenia*. *Mukgenia* came about by reading phylogenies and plant family theories formulated by Dr. Doug Soltis, formerly of Washington State University.

Ploidy manipulation is one of my favorite methods of conversion of plant material. Doubling the amount of genes material leads to both interesting and not-so-interesting novel plant material. It is our job, as breeders, to weed through the plant material and destroy it. If you are not throwing out plants, then you are not a breeder, you are a hoarder - plain and simple.

Irradiation is a total roll of the dice. Deciding the Gy rate of gamma radiation to supply is sometime difficult. We work with genera that have little to nothing published about them, and so we have to make educated guesses about them based what are they related to, where they sit on a phylogeny tree, etc.

Chemical mutagens, such as E.M.S. (ethyl methanesulfonate), are useful for producing a wide range of results. Point mutations, insertions, and deletions are possible with this and several other chemical mutagens. EMS has also earned the name "Ethyl Methane-nasty-stuff" because of its extreme toxicity. Fortunately, it has a very short half-life, and can reach it within hours.

Embryo rescue is a method that can be used to intervene in the life of a seed. We often make crosses with divergent chromosome numbers or crossing two genera together. Pollen grains may germinate and grow down the style to the ovary. Ovules may form but are aborted due to some incompatibility between mother and embryo. Sometimes, only hours after making a cross, we will harvest the ovary, excise the ovule, and, rescue the resulting embryo – all done painstakingly under a microscope. After harvest, we will sterilize the embryo, and plate it on replication media in the lab. Weeks later, the embryo grows and begins to form a plant. To achieve the colors in our *Echinacea* plants, we had to rescue thousands of embryos. After several more generations of *Echinacea* breeding, incompatibility was not much of an issue, which allowed for the resumption of traditional breeding.

And then, there is the internet. It has been an incredible tool for research. However, one does have to sift through cubic yards of debris to find a nugget of information, and a lot of what used to be free information is now sold by universities and publishing houses.

And, then there is CRISPR, which stands for Clustered Regularly Interspaced Short Palindromic Repeats. I do not have an opinion on this yet, but the genie is out of the bottle.

Mutations! We love mutations! Some of our best plants have come into commercial culture due to spontaneous mutations. 'Obsidian', the world's best-selling black foliage *Heuchera* mutated to 'Midnight Rose'. (We pay tens of thousands of dollars annually to the finder, Behnke Nurseries.)

'Georgia Peach' begat 'Georgia Plum'. The unique thing about 'Georgia Plum' is that the mutation is an *extra* layer of

pigment on the exterior of the plant. One mutation gave a purple coat to the entire plant. Foliage, petioles, stems, and even the flowers are purple. This mutation proved very valuable in breeding.

Heuchera 'Marmalade' lost a leaf layer in a mutation and became 'Lime Marmalade'. *Heuchera* 'Amber Waves' may be the most influential mutation at Terra Nova. A chimera mutation of the variety 'Whirl Wind', 'Amber Waves' was nothing more than a streak of color in the petiole of one leaf. We did a tissue pull from the petiole, cultured it, and turned it into a plant. From this plant, all pink-, coral- and red-colored selections originated. This plant made it possible.

Heuchera 'Snow Storm' provided the seed money (no pun intended) for Terra Nova. This *Heuchera* sold by the millions in Great Britain. One of my *Begonia* hybrids, COCOA™ 'Enchanted Evening', sported 'Enchanted Moonlight' *Heucherella* 'Solar Power' sported 'Solar Eclipse'. Heucherella 'Buttered Rum' sported 'Mojito' and 'Mojito' sported HAPPY HOUR™ 'Lime'. 'Buttered Rum' also gave us 'Firecracker'.

Discovery, research, and trial and error are our best friends and worst enemies. Whenever possible, we start from straight species, make selections, make crosses, and then throw out thousands and thousands and thousands of plants annually.

Our *Echinacea* selections started from almost nothing. Today, they are regarded as some of the world's best.

Our *Heuchera* selections are the world's best. That's why almost every other "breeder" in the world uses our genetics. Primrose Path Nursery in Pennsylvania may be the only one not to use ours. And we do not use theirs. The only two named cultivars in our breeding are 'Montrose Ruby' and 'Palace Purple'. The rest are species accessions from North America, and lots of careful breeding. With that said, we really had drab stuff to begin with.

Terra Nova is one of the most prolific coleus breeders around and perhaps the only breeder of genetic dwarf, non-flowering *Coleus* (or *Solenostemon* or *Plectranthus* (as they are now known)).

Our *Begonia* selections are some of the world's most exciting and the hardiest. Creating all new hybrids from the best and hardiest species give our plants excellent heterosis. We find they have great vigor, color, and ease of growth.