

## Plant Breeding Primer<sup>®</sup>

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### INTRODUCTION

During the course of this article the author hopes that the reader is informed regarding the basics of plant breeding related to ornamental plants. But more importantly, the author hopes that the reader is inspired to pursue breeding plants in the future.

Many interesting and valuable ornamental plants have been hybridized by skilled, knowledgeable, and passionate amateurs. These breeders should be credited for elevating the quality and variety of ornamental plants being propagated and grown throughout the world. In fact, the bulk of the new plants introduced yearly are from amateur, yet skilled hybridizers. Ornamental horticulture is truly indebted to these talented individuals.

The interest and desire for superior plant selections in our industry has elevated the demand for these special plants. It is an exciting time to produce innovative and valuable plants.

### PLANT BREEDING BASICS

For the sake of clarity and example, we will present the hybridization of a solitary plant, the rose (*Rosa*). Besides being an extremely popular flowering ornamental woody shrub, roses are sold and used for cut flowers, colorful pot plants, ground covers, and climbing plants.

In order to hybridize plants, a basic understanding of sexual plant reproduction is necessary. The process of producing seed from flowers is sexual reproduction. Pollen from a select individual plant bloom is placed on the stigma of a flower from a select parent that will form the hybrid seed.

Roses have perfect flowers. Functional male and female parts of the blossoms are present in every blossom. The male parts or stamen, are found as an outer ring inside the bloom. The numerous stamens bear the anthers which ultimately ripen and bear the pollen. The female parts or pistil, are located in the center of each flower. The tip of the pistil is the stigma. When pollinated the pollen grains stick to the stigma and then fertilizes the ovules found at the base of the stigma inside the blossom. These fertilized ovules ripen and become seed.

The hybridization of roses begins with stating goals for the breeding program. Success for the breeding program begins with the end in mind. Perhaps the goal is to produce roses with novel colors, increased disease resistance, powerful fragrances, plants that have quick repeat bloom, or increased plant hardiness.

In order to achieve your clear goals, proper identification of the parents to be used is critical. Not all roses are successful female or seed parents. Some roses are unable to produce seed and are only useful as pollen parents. It is important to choose parents that have the ability to either set good amounts of fertile seed or have potent pollen. In addition to choosing fertile parents, it is critical to select parents that possess the traits that you hope will be passed on to the seedlings that you raise

from the breeding efforts. Some roses are able to pass these desirable traits more easily than other roses. Success is more certain if the breeder is able to identify this and then to continue utilizing these superior parents. Only worthy seedlings result from using superior parents.

Roses are hybridized during their first bloom cycle. This is done to ensure that the seed will have enough time to ripen properly. Remove the petals from blooms that are only partially open. After removing the petals, the unripe stamens are severed from the blossom. For the pollen parent, the stamens are collected in a small container and later dried indoors overnight. For the seed or female parent, the stamens are removed and discarded. Be careful not to injure or severe the pistils when emasculating the bloom.

Successful cross fertilization of the seed-bearing flowers depends upon placing the pollen of the select male parent on to the stigmas of the seed parent at the proper time. The stigma is receptive when it is sticky and is easily observed with a hand lens. It is at this time that pollen from the male parent should be applied to the stigmas. Many rose breeders use sable artist's brushes for applying pollen. The brushes should be sterilized with alcohol to prevent cross contamination of pollen. A cotton-tipped swab is also a good applicator and can be discarded each time you change to pollen of a different rose parent. A second pollination with the same pollen may bring about greater success if done 8 to 24 h after the first pollination.

The cross-pollinated bloom is labeled with the proper parents. The name of the seed-bearing parent is first, followed by an "X" with the pollen parent name last. Place a label under the immature rose hip beneath the blossom. The label and writing should be weather resistant. The pollinated bloom may be covered for a few days with white paper to protect it from being cross pollinated.

The developing fruit or hip is harvested in the early autumn or when night-time temperatures reach 30 °F. It is usually best if the seed parent has four months to ripen the seed. In many cases when the hips turn color, they should then be harvested.

### **HANDLING THE SEED**

Once the hips are ripe they can be collected, brought inside, and the seeds (or technically achenes) removed. It is very important to retain the correct labels of each ripened lot of seed. It can be disappointing to harvest your rose hips and misplace a label or mix it with another! The seed should be extracted from the hips as soon as possible. Don't let the seed remain in the rose hips. It's best to shell the seed and wash or remove all trace of the fleshy hip pulp. Be careful not to wash your seeds down the drain of your sink!

Place your cleaned seed for each labeled cross in a container filled with clean, pure water. Some rose breeders use a very dilute laundry bleach solution instead of water. After 12 days at room temperature, the seeds are drained and removed from the water. Don't discard any seeds at this time. Some propagators recommend that you discard the floating seeds. But several species roses have fertile rose seeds that actually float. Place your clean and moist seed into zip-top plastic bags filled with moistened perlite. The recommended amount is about 100 seeds to 2 to 4 tablespoons of moist perlite. Write the rose cross on the outside of each bag with a black waterproof pen.

A plastic box is useful to hold all the bags of labeled seed. Place this box filled with plastic bags of rose seed in an area that is undisturbed and at constant room temperature for 6 weeks. After 6 weeks of room temperature, the bags of seed should be placed in a refrigerator held at a temperature of approximately 40 °F for an additional 6-week period. The bags of seed should be examined weekly during this 12-week period of warm and cool temperature stratification.

Often seeds from temperate trees or shrubs require a cool moist stratification period. This period may vary from 30 to 90 days for germination to begin. Roses vary in their need for a stratification period. The length of this stratification period may vary if species roses are used as primary or secondary parents in your breeding work. Some species have been reported to require cold stratification periods for 4 to 6 to even 10 months! Once seed begins to germinate, during this stratification period, it can be sown. Seed lots should germinate within days to a few weeks. Some crosses may germinate in the bags. If they do, you can transplant them to potting soil. Be sure to cover the seedling to retain some humidity around the young plant. And don't forget to label them!

Most rose breeders use a peat moss and propagation (or horticultural) grade perlite (1 : 1, v/v) as their germination mix. Trays are filled and leveled with this mix. Remove the stratified rose seeds from the refrigerator when your flats are filled with moistened mix. Most breeders sow all of their rose seed in rows. Others choose to scatter their seeds. In order to prevent utter chaos and confusion, if you choose to scatter the seed, you should only put seed from one cross per flat! Regardless of whether you sow in rows or scattered, plant your seed about 1/2 inch deep into the sowing mix. Cover the germination mix with a light covering of fine vermiculite or moist plug grade perlite. Insert a tag that includes the cross, your cross number, the date, and anything else that you may feel is important. Perhaps you may want to even include your special code number or the amount of seed that you planted. Lightly water the seed in, cover the flats with a piece of clear plastic (to conserve water), and place the flats in a brightly lit area.

Many breeders germinate and raise their seedlings under fluorescent lights. If you chose to do this, place a double tube shop light about 8 to 10 inches over the seed trays. Roses require high light. Be aware that a 2-ft-wide by 4-ft-long shelf of flats will need two shop light type fixtures to provide light for that space. Expose the seedlings to a 16-h photoperiod.

Check the sown rose seed regularly. Be sure that the soil doesn't get dry. You may need to water 1 to 3 times per week. Dryness or drought can sometimes send the seed back into dormancy. In a few weeks you will notice that your rose seeds are germinating. It is exciting to have your seed from your crossing efforts sprout! Normally, rose seed will sprout in 2 to 6 weeks. Germination can proceed for another 8 weeks. Remove the plastic covering from the flats. The young seedlings hardly look like roses. The first green leaves are the seed leaves or cotyledons. They will eventually wither away. The first set of true leaves will normally be trifoliate, but very rose-like in appearance. It is at this stage that it is recommended that you transplant these seedlings into their own pot or container. Some growers use a label or small knife to carefully lift out the young plants from the germination mix. The plants are then potted in a container filled with moistened peat moss and perlite (1 : 1, v/v) mix. Be sure to label the transplant!

About 2 weeks from transplanting, begin to feed the young potted-up seedlings. It is recommended that you use a water-soluble balanced fertilizer appropriate for young seedlings. Be careful not to over-feed the young plants. I've seen too many roses over-fertilized and the foliage burnt from high fertilizer salts.

Young rose seedlings tend to bloom at a very young age. Often seedlings from garden hybrids and repeat-blooming roses will be the first to bloom. If your rose seedlings bloom young enjoy them! Now is the time to start making notes on the characteristics of your new seedlings. Take digital pictures of your seedlings. It can be invaluable for data collection. Many will bloom at a very young age — record the size, number of petals, and colors of the flower. Are the petals wide or narrow. Are the flower buds pointed? Is there any fragrance to the tiny blossoms? What kind of fragrance is it? Are the plants thorny or thorn free? Is the new growth red or green? Are the internodes close or wide? Is the foliage glossy or matte? The data you collect now for each seedling, will allow you to better understand what traits change as the seedlings mature and which do not. It will also help you decide in the future which seedlings you may choose to discard at an early age.

When the rose seedlings are large enough, prepare them for either being potted up and placed in the greenhouse or moved to an outdoor location for further evaluation. Observe and evaluate your blooming seedlings as much as possible during the first few seasons. Discard all that do not meet with your approval. Those with distorted blossoms, not enough petals, poor bloom form, inferior color, poor petal substance, poor plant habit, poor foliage, and those very susceptible to disease should be discarded.

So ends our example of the breeding of one ornamental plant, the rose. Much of what you learned here applies to the breeding of nearly any plant. If you choose to begin hybridizing a plant, do it with a plant that you have a great passion for. I encourage you to work with a genus of plants that you will enjoy learning much more about than you can imagine right now. Part of the excitement of hybridizing plants is discovering what you will ultimately produce from your efforts. The exhilaration and joy of finding that exceptional plant or bloom for the first time from your breeding efforts is a special time. And these special times happen every time the next lot of hybridized seed is germinated! You will no doubt be amazed and rewarded for many years ahead with the great satisfaction of producing something very special, worthy and unique.

### **ADDITIONAL READING**

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