Jewels in the genome

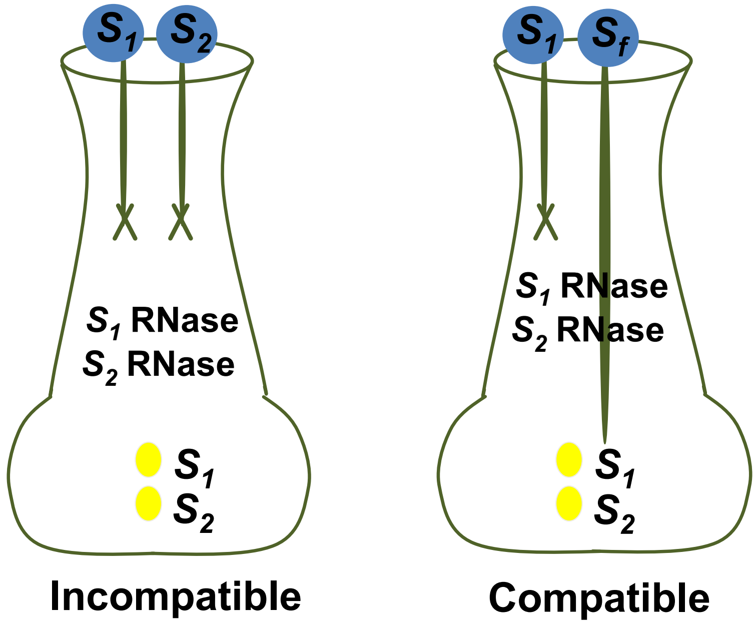
By Amy Iezzoni, Project Director

What is a "Jewel in the Genome?"

- *An individual's genome is the full complement of genetic information that it inherited from its parents. Within this vast repertoire of genetic information, individual genes are being discovered that control critical production and fruit quality traits. As these valuable rosaceous gene discoveries are made and put into breeding applications, we will describe them in this column as "Jewels in the Genome."*

Self-fertility, the ability to set fruit following self-pollination, is an important trait in many *Prunus* species that contributes to higher, more consistent yields. For example, in self-incompatible almond, sweet cherry, tart cherry, plum and apricot cultivars, pollen borne in a flower is unable to grow the length of its pistil and therefore fruit set does not occur. However, in self-fertile selections, the pollen borne in a flower is able to pollinate that flower and successfully grow down the style, resulting in fruit set. Therefore with a self-fertile variety it is not necessary to take up orchard space planting a "pollinator" variety. Additionally, self-fertile varieties characteristically have higher yields than self-incompatible varieties as compatible ("self") pollen is always available at the perfect time.

Incompatible versus compatible pollination: If the *S*-allele in the pollen matches the *S*-allele in the style, that pollen's growth will be arrested in the style. When all the pollen is incompatible, fertilization will not occur and the fruit will not develop. However, when the *S*-allele in the pollen has a mutation that causes it to be self-fertile (S_f), it grows the length of the style, fertilization is successful, and fruit development follows.



For many *Prunus* species such as almond, sweet cherry, tart cherry, apricot and plum, we know the two major genes that control self-fertility! These two genes reside at the *S*-locus on stone fruit chromosome #6. One gene is expressed in the style and encodes a cytotoxic ribonuclease called the *S-RNase*. The second gene, expressed in the pollen, encodes an F-box protein named SFB that interacts with the S-RNase in an allele specific manner. All the self-fertile alleles described to date in these *Prunus* species disrupt either the S-RNase function in the style or the SFB function in the pollen, leading to self-fertility.

Knowledge of the genetic changes in the *S-RNase* and *SFB* that lead to self-fertility has resulted in the development of simple diagnostic tests to screen progeny for self-fertility early in a breeding program. For example, the *S*-allele in the self-fertile sweet cherry varieties 'Lapins' and 'Sweetheart' is called S4'. This allele has a four base pair deletion in the S4 SFB gene that results in the production of a shortened non-functional SFB protein, e.g. S4'. Pollen containing this shortened non-functional protein is self-fertile and compatible on styles of all other cherry varieties. The DNA diagnostic test for self-fertility simply involves differentiating between the S4 and the S4' by resolving the four base pair difference.

Utilizing DNA tests to determine if young seedlings are self-fertile or self-incompatible prior to field planting dramatically increases the efficiency of breeding for self-fertile varieties. Genetic knowledge of which breeding parents contain the self-fertile variants also enables the breeder to select parental combinations that maximize their chances of obtaining self-fertile offspring. Therefore, because knowledge of the self-fertile variants of the *S*-locus will lead to the more efficient breeding of self-fertile varieties of cherry, almond, apricot and plum, it is selected as our fourth featured "Jewel in the Genome."