Interspecific Hybridization within *Penstemon* and their Potential Uses in Urban Landscapes

Sarah Harrison, Bryson Ensign, Mikel Stevens, Dept. of Plant & Wildlife Sciences

ABSTRACT

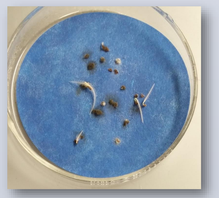
Penstemon, with over 270 different species, is among the largest native genera in North America. Commercially acceptable cultivars of both selections of a specific species and interspecific crosses within *Penstemon* are found in both the North American and European markets; however, these cultivars are almost universally lacking in drought and extreme temperatures tolerance. These characteristics, as well as colorful abundant flowers and foliage, in the native *Penstemon* of the US Intermountain West are of great interest to the urban landscape markets of the desert areas of this region. For example, Utah has over 70 native species of this genus ranging from mat forming to taxon that grow to at least three feet tall and flowers that can be red, blue, white, purple, or florescent pink in different *Penstemon* species. Our research focuses on tapping into these desirable characteristics by using wide crossing within *Penstemon* to develop commercially viable cultivars that are drought tolerant and hardy for use in desert urban landscape environments. As we have worked with *Penstemon*, we have successfully made approximately 30 wide crosses involving 20 unique species which produced seed during the 2015 growing season. Throughout the winter of 2015-2016, we have been attempting germination of the seed, although there has been little success. *We currently have three plants from crosses made in 2015 and two plants from crosses in 2014. We have observed that our 2014 wide cross hybrids predominantly exhibited the mother plant's phenotype. We are currently unsure why this is, however, our future research will be focused on making crosses within the F_1 generation to see if we can, through crossing over of sister chromatids, obtain a composite of phenotypes in the F_2 generation. Unlocking this mystery of how phenotypic traits are passed on will help us see how to better create drought tolerant, disease resistant, and beautiful flowers for commercial landscaping use. *This abstract was written before summer 2016- see the column on the far right for updated information

CROSSING METHODS

- Emasculating of blossoms ensured that no self-pollinating occurred.
- The emasculated blossoms were marked with a purple tag.
- Once the pistil was mature, pollen was brought from another species and used to pollinate the mature pistils.
- The purple tag was then replaced with a white tag stating the specific parents of that cross.
- Once the seed pods had swollen and dried, the seed was collected and saved for later germination.

GERMINATION TECNIQUES

To break dormancy, the seed was placed in 1,000 parts per million GA (gibberellic acid) for approximately 48 hours. The seed was then rinsed to reduce long-term effects of the hormone, then was plated on petri dishes until they germinated.

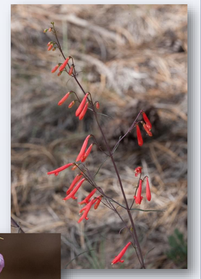


We have not yet attempted this with all the seed, but so far it seems that those with *P. palmeri* (PAL), *P. pseudospectabilis* (PSU), and *P. eatonii* (EAT) as parents are the most successful.

EXAMPLES OF DESIRED CHARACTERISTICS

*Only a few species are shown, but similar species are listed
*Species on left are shown in the pictures on the right

P. barbatus (BAR)
- Red stems, which often indicate disease resistance
- Long red blossoms
- Similar to *eatonii* (EAT)



P. laevis (LAV)
- Bright foliage
- Medium sized purple blossoms
- Similar to *comarrhenus* (CMR)

P. palmeri (PAL)
- Very large bloom with interesting pollen guides
- Powerful sweet scent

P. petiolatus (PET)
- Smaller, more condensed size
- Vibrant pink blooms
- Very drought tolerant

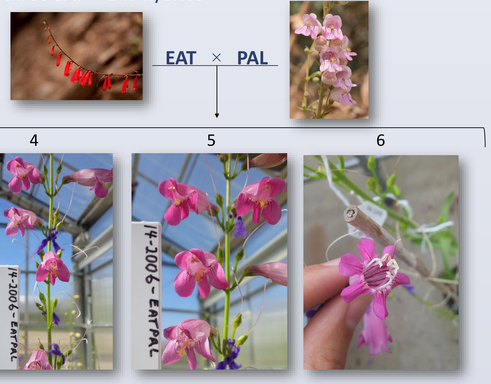
P. pseudospectabilis (PSU)
- Bright foliage with vibrant pink bloom
- Extreme heat and cold tolerance

P. scariosus (SCR)
- Smaller, more condensed size
- Variety of blues and purples in blossoms

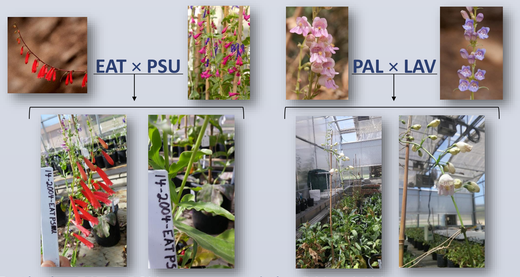
SUCCESSFUL BLOOMING HYBRIDS

*Although we do currently have more hybrids than those shown, the following are those that have bloomed this summer.

1. Height characteristic of both parent species
2. Darker tips characteristic of LAV, with bright magenta color- seems to be a combination of both parents
3. Pollen guides similar to those found on LAV were on one of our three EAT × LAV hybrids



4. Height characteristic of both parent species
5. Pollen guides and blossom shape similar to those found on PAL, although the color seems to be a combination of both species parents
6. Similar mutations of the size, shape, and number of flower parts are seen in the EAT parent



Both the EAT × PSU crosses and the PAL × LAV crosses are exhibiting the female parent phenotype. Although this raises some concerns about whether or not they truly are hybrid species, previous documentation has been made of *Penstemon* crosses that exhibit the female phenotype in the F_1 generation, but exhibit a variety of phenotypes in the F_2 generation. Thus, we hope further crosses will show that these are indeed hybrids.

CURRENT RESULTS FROM 2015 SEASON

Total number of unique crosses attempted in 2015	Almost 200 including reciprocal
Number of unique possibly successful crosses (made in 2015)	Over 25, over 30 including reciprocal
Successfully germinated hybrids (from 2015 seed)	11 unique crosses, most involving PAL, EAT, or LAV as one or both parents
Successful growing hybrid crosses (from 2015 seed)	Three: PAL × PSU (3 plants) LAV × EAT (4 plants) EAT × LAV (5 plants)
Successful blooming hybrid crosses (from 2014 seed)	Four: EAT × LAV (3 plants) EAT × PSU (1 plant) EAT × PAL (7 plants) PAL × LAV (6 plants)

CONCLUSIONS

With the successes in the wide crosses made in both 2015 and 2016, a series of crude "elite" hybrids are now in bloom, with others on the way. These "elites" form what is hoped to be a highly valuable base of our breeding program. Due to the enhanced tendency of these "elites" to hybridize with other species, they could possibly set the foundation for future crosses, both amongst each other and as "bridge" plants for species that have been difficult to make crosses with.[1] As has been identified by others doing wide crosses within *Penstemon*, some putative hybrids exhibit the phenotypic characteristics of the maternal parent in the F_1 generation.[2,3] It is hoped that through selfing of these hybrids the effects of genetic recombination which has been noted by other breeding programs will be apparent. This would lead to a mixture of phenotypic traits in the F_2's and subsequent generations, similar to some of what is seen in our "elite" interspecific hybrid group that has already exhibited hybrid characteristics.

This research not only is helping to develop new material to be used in urban landscapes, it is also helping to determine parentage of certain existing putative natural hybrids, such as *P.* × *jonesii* (right), which is hypothesized to be an EAT × LAV cross. Thus, it is hoped that this research will open doors for additional studies, both in the field and in the garden.

By comparing to photos to the left, we can see that *P.* × *jonesii* is likely not an EAT × LAV hybrid as previously thought.

AUTHORS

Sarah Harrison

Bryson Ensign

Mikel Stevens

REFERENCES

1. *Bulletin for the American Penstemon Society*, 1954. 13:59-61.
2. *Bulletin for the American Penstemon Society*, 1965. 24:95-100.
3. *Bulletin for the American Penstemon Society*, 1973. 32:89-92.