Kathy Navarez: Yes, we dip the whole cutting into the bleach. I'm not sure of the bleach percentage, but it was just a few drops in a bath of water.

Chris Cotting: Do you start fertilizing cuttings immediately or do you wait until you start seeing root growth?

Kathy Navarez: I start fertilizing right away using our new fertilizer injection system and it really helps my percentage.

Mimulus aurantiacus: Taming the Sticky Monkeyflower for Everyday Gardens®

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For 18 years, ongoing collections of *Mimulus aurantiacus* have been bred and backcrossed to overcome numerous horticultural challenges. Breeding goals and strategies have progressed from garden survival, water tolerance, and hardiness to developing compact and branching growth habit.

INTRODUCTION

Plants with a long history of cultivation fill the world's gardens. Explorers, enthusiasts, and nurserymen continue to offer selections from wild populations. Sadly, difficult care or propagation soon cause many beautiful introductions to be lost.

This paper describes the process of transforming the native California sticky monkeyflower (*Mimulus aurantiacus*) into a dependable subshrub for everyday gardeners. In the years since 1986, as each set of challenges has been overcome, others have appeared.

EARLY MIMULUS AVAILABILITY

Initially, I wanted only to have a few monkeyflowers in my own garden. Native plant specialists and native plant society sales at that time offered few *Mimulus* (or *Diplacus*, as they were then known) taxa. Those soon died when planted out.

In late spring *Mimulus* are common from Mexico to Oregon, from the sea to the mountains. Since wild *Mimulus* might be tougher than their potted-up cousins, I often collected a few stems. Dipped in rooting hormone and stuck into perlite, these rooted easily. But on potting up most soon died. Summer water killed!

Open-cross seed from survivors pollinated by hummingbirds readily sprouted in January. Most seedlings died before the sixth true-leaf stage. Perhaps 10% survived to flower and in the first years no more than 5% set seed, which was replanted that winter.

In the 1980s David Verity (1993) studied *M. aurantiacus* genetics and flower colors, growing several thousand liners in raised beds with sterilized soil. However, his large-flowered hybrids had the reputation of being difficult to keep alive.

SURVIVAL AND HORTICULTURAL CHALLENGES

Although a native Californian familiar with dry summers I was not aware of the many ways native plants have adapted to this Mediterranean climate over thousands of years. *Mimulus* were described as requiring good drainage. I did not understand why this was important and was very perplexed that a plant so widespread in the wild was so difficult in the garden! Although a sterile medium might increase survival, reliable low-care garden performance was more important. Successive liner crops grown in commercial soil mixes gradually became stronger.

So far I had only attempted to grow for myself. My goals were good colors and lots of flowers. By 1994 *Mimulus* bloomed in my garden from May to September! In 1995 several native plantsmen saw my results. They liked the bright flowers and long blooming period, but said that monkeyflower's well-known water intolerance, leggy growth, poor branching, and doubtful hardiness would block general acceptance by the nursery trade.

INCREASING WATER TOLERANCE

In the wild, *Mimulus* grow vigorously during the cooler, wetter months. As soil moisture becomes less available, growth slows, seed is set, and plants lose their leaves and become dormant.

Water for liners was a problem only during warm weather. From May on, 5% to 10% of most crosses died each week. Root and stem pathogens were obvious causes.

Perhaps *Mimulus* dormant in the baked dry environment of summer had developed little genetic resistance to the attacks of garden microorganisms that thrive in warmth and moisture. Perhaps reduced soil oxygen in warm, waterlogged soils hindered root function. Or on hot, windy days roots or the stem transport system might not be able to support the transpiration needs of extended aboveground growth permitted by continuous moisture.

Plants were challenged by overhead watering to simulate nursery conditions rather than by careful hose or drip irrigation. Sometimes water was deliberately withheld until leaves wilted. These stresses eliminated plants, which could not tolerate excessive or uneven watering. I mixed soil from plants that had died into the growing medium to increase disease resistance selection pressure.

MAKING GROWTH MORE COMPACT

Mimulus aurantiacus often grows in brush or in the midst of poison oak (*Toxicodendron diversilobum*), which sometimes made collecting problematical. Such clones grown in Alameda were leggy. It became clear that plants that had adapted to compete for light and pollinator visits would not be compact in a garden. There, freed from competition, the genetic tendency to upward growth made stems and branches thin and weak.

McMinn (1951) and Beeks (1962) gave numerous *Mimulus* occurrence sites, where I sought out better branched, more compact clones. Short internodes were good predictors of compactness.

Environmental dwarfing (notably, plants from exposed locations which did not long retain rainfall, and thus limited active growing periods) often was not seen when adequate water permitted continuous growth. Branches on such collections usually became unhardened and weak during extended spring and summer growth.

COLLECTING FOR HARDINESS AND WATER TOLERANCE

Winter temperatures in most of monkeyflowers' range are rarely below –5 ºC. However, in the Sierra Nevada Mountains *Mimulus* become dormant at 1800 m under a several-months'-long blanket of snow. In the high deserts and mountains of Southern California actively growing *Mimulus* may experience sudden nightly lows of -20 ºC. Crosses from these populations added cold resistance.

By 1996 my goal had become colorful plants that would be "bombproof" for the consumer. They would produce abundant flowers over a long blooming season. They would not require special conditions, such as "sharp drainage," or be suitable only for xeriscapes where they would be dormant in the dry season. But my *Mimulus* were still not happy with summer water.

In further collecting forays I searched roadside ditches and hillside seeps for plants that tolerated or enjoyed wet feet, crossing them into my general breeding stock. Annual or moisture-adapted perennial *Mimulus* were not used.

COMMERCIAL TRIALS AND INTRODUCTIONS

Skagit Gardens trialled a number of my *Mimulus* in Mount Vernon, Washington, and selected eight for introduction in 1998 as the "Kids" series. Unfortunately, mother plants under the low light levels of their Puget Sound winters did not reliably produce vigorous cuttings for early spring sales.

Since 2000, The Flower Fields has offered three of my patented cultivars as the "Jelly Bean" Series; they are conducting field and bench trials in the U.S.A. and Europe to extend the line. A grower in Regina, Canada, is now propagating "Jelly Bean" *Mimulus*, expecting that good winter sunshine and supplementary illumination can produce a reliable cutting crop.

PLANT FORM AND GROWTH HABIT

My original vision of an azalea-like shrub with a 6-month bloom season has not matched standard large-scale production schemes. In spite of beautiful trials, the nursery trade didn't want a new azalea. "Early blooming plants filling a six-inch pot with no more than one pinch" was the commercial growers' request.

From crosses of branching plants, I now select seedlings at the six true-leaf stage with sturdy stems, short internodes, and a strong branching tendency. Although closely examining tiny plants is time-consuming, potting up only those that meet selection criteria early on saves much labor, space, and materials. Evaluation at blooming is less complicated when there are fewer culls to examine and dispose of. At flowering I also check each liner for stickiness and cross plants without this trait to those with floriferousness and good growth habit.

DISEASES AND PREDATORS

Shrubby *Mimulus* appear not to be significantly attacked by snails, slugs, mildew, or other common nursery problems. Leaf miners and aphids are sometimes active during the early growing season. Scans have shown no susceptibility to common greenhouse viruses. All plants are grown outdoors, without spraying. Cultivars able to withstand unprogrammed challenges by local predators and existing weather conditions will be stronger and more reliable for gardeners.

RESULTS AND CURRENT STATUS

Hand crosses (750 per year) yield about 20,000 seedlings and 3000 liners. Of the 2000 liners flowering by July some 250 are selected for trial or further crossing. To more rapidly enter international markets, in 2003 I arranged for seeds to be grown and plants evaluated in Spain. Discarding weaker plants is easier when shared!

SUMMARY

Numerous, improved *Mimulus* cultivars have been created by repeated cycles of becoming aware of and correcting previously unconsidered discrepancies between the wild plants' nature and the requirements of cultivation. After simple survival was achieved issues of water intolerance and dormancy were faced. Growth habit now meets the desires of the nursery industry.

CONCLUSIONS

Wild plants' performance in nursery and garden environments can often be predicted by relating their native habitats and environments to expected horticultural or trial conditions.

We tend to see the responses of the plant to cultivation as deficiencies. If these can be understood as the **plant adapting to its new environment with its own inborn genetic toolbox** we can develop new breeding or collecting strategies to overcome them.

Those who appreciate this process will do more than recognize a particularly attractive example of a wild plant. They will have developed the insight to understand and visualize how this plant will perform away from its native environment, and will select more plants that can be the parents of superior garden performers.

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