

GROWERTALKS

Corr on Cannabis

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The Complexity of Cannabis Breeding

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During my career, I've been fortunate to know many plant breeders. As a graduate student, I rubbed elbows with flower, vegetable and fruit breeders (and was on tasting panels when the Honeycrisp apple was developed—my very minor contribution to the development of a great apple).

Working with PanAmerican Seed, Ball FloraPlant and Syngenta Flowers, I got to hang out with talented plant breeders developing petunias and snapdragons and geraniums and angelonias and chrysanthemums and so many more plants that brighten our lives. However, when it comes to plant breeding, the cannabis world is different, as it is in so many ways.

Cannabis “breeding” in its simplest form has been going on for millennia. We humans have developed cannabis to suit our purposes. Some cannabis grows very tall with long, strong fibers for rope, paper, canvas, etc. The word “canvas” is derived from the Latin word *cannabis* or Greek *kannabis*. Cannabis (hemp) was the first plant humans cultivated for fiber, with examples of hemp-based cloth dating to 8000 BCE. Some early hemp farmers no doubt selected the best plants with the best fiber and saved seed for subsequent crops.

Chinese history recounts Emperor Shen Nung, the Father of Chinese medicine, describing cannabis as one of the dominant plants in Chinese medicine as early as 2700 BCE. Native populations of cannabis tend to have low concentrations of THC, so maintaining plants with medicinal THC levels required selection pressure, another simple form of breeding.

These early selection processes, in combination with the environmental pressures of the regions across the globe where cannabis was grown, resulted in a wealth of landraces, which to some degree still exist. However, prohibition and other restrictions were put in place on cannabis cultivation and genetic bottlenecks developed. Whenever genetic resources are limited, the “founder effect” can result in crops with genetic limitations to potential.

For example, during the 1970s and '80s, limited accessions of Afghani landraces were smuggled to the United States and Europe and used to breed new cannabis cultivars. The breeders at that time were primarily interested in the psychotropic effects of the plant, so the primary objective was enhanced THC content. However, the Afghani landraces had developed in regions with low humidity and were very susceptible to botrytis. Because of the limited introduction of Afghani genetics four decades ago, many of the cannabis cultivars grown today have inherited this undesirable trait.

Another reason for the predominance of traits from Afghani landraces in current cannabis cultivars is that these landraces tended to be shorter and earlier flowering than the often field-grown cultivars that were common at the time. Short stature and early flowering are useful traits for clandestine growing, further cementing the Afghani

genetic material in our current cannabis cultivars.

When selecting for cannabinoids, most breeders could only select for THC, since it can be detected by a human “assay” (smoking the plant). Other cannabinoids require lab equipment for accurate analysis. As the importance of other cannabinoids becomes more evident, breeders have incorporated lab assays for conscious development of cannabis rich in anti-inflammatory cannabidiol (CBD), as well as other cannabinoids.

Plant breeding—as we normally think of it, with directed crosses, population evaluation, back crossing, etc.—isn’t easy in cannabis. One of the steps taken in plant breeding is self-pollination (selfing) to fix desired traits. Cannabis plants are predominantly dioecious, meaning male flowers and female flowers are on separate plants. Selfing requires special treatment to induce male flowers on plants that would otherwise be female.

The diversity of cannabis strains (cultivars) that are available today are a testament to the efforts of hundreds, if not thousands, of small-scale cannabis breeders. Many, many individuals working on individually small-scale breeding programs have collectively made significant improvement.

Cannabis breeders often knowingly or unknowingly use breeding techniques that increase heterosis (hybrid vigor). Heterosis results from crossing dissimilar cannabis cultivars. Hybrid vigor is generally a positive thing—fast growth and bigger plants. The downside of this approach is that unless efforts are made to create relatively inbred parents, the resulting seeds from a cross have significant genetic differences from one seed to another.

Cannabis cultivars/strains are sometimes named after the female parent, sometimes without considering the male parent. This has led to cultivars with the same name yet different genetics. The effort required to develop a cultivar that comes reasonably true to type from seed is beyond the scope of most cannabis breeders, although some breeders have made the effort. For example, the development of the cultivar Skunk No. 1 reportedly involved nine generations and growing tens of thousands of plants to make selections.

A Honeycrisp apple has the same genetics, whether purchased in Minnesota or Oregon or New Zealand. In contrast, not all cannabis with the same cultivar name is necessarily genetically identical. However, with legalization increasing across the world, cannabis breeders are getting more opportunities to practice their craft. Cannabis breeders, especially those outside the United States, are incorporating not only traditional breeding techniques, but also molecular techniques to improve cannabis, just like breeders do with petunias, snapdragons or even apples.

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