



Chimera, owner of Chimera Seeds.



Cuttings, or clones, taken from the same parent and grown under the same conditions are identical.



Male plants grow flowers that consist of pollen sacks.

Introduction

Chimera is without a doubt one of the most dedicated and knowledgeable people working with cannabis today; he brings a passion to cannabis breeding and research not often seen in the industry. Founder of Chimera Seeds, he has produced some excellent varieties of cannabis including 'C4', 'Frostbite', 'Calizahr' and 'Schnazzeleberry'.

Chimera is a well-educated individual, who, for years has tried to understand cannabis and how it functions in the brain. This path has seen him through a B Sc. Neuroscience, and post graduate research in the field of Biotechnology and Plant Sciences. He works on the cutting edge of cannabis research, and will certainly bring many new ideas and technologies to cannabis, over the years to come.

I am very pleased to present Chimera's contribution to this book in the form of this breeding chapter, as he takes the mystery out of breeding and does a great job of simplifying a very complex subject. Thanks, Chimera, for your contributions!

- Jorge Cervantes

This chapter explains the basic biological processes of sexual propagation in cannabis and the formation of a new generation of seed. Armed with the information in this chapter, any grower will be able to design and begin a rudimentary breeding program and create new generations of seed for future use. These new populations make up a pool of genetic material from which superior individual plants can be selected for production (cloning stock) or for use in breeding programs. It is difficult for small growers to breed better varieties than are available from premium seed companies; however, for the many seed-starved growers who reside in prohibitive societies, making seeds for future use is often a necessity.

Cannabis can be reproduced asexually or sexually. Asexual propagation is more commonly referred to as taking cuttings, or cloning. Branches or growth shoots are removed from chosen donor plants and induced to form roots in a separate medium; these rooted cuttings are then used to plant a uniform crop of genetically identical individuals. Most commercial and

many hobby growers propagate their crops asexually to ensure uniformity in growth, yield, and consistency of product in their crops. By planting gardens of genetically identical cuttings from their favorite pre-selected mother plants, growers are able to maintain an even garden profile, produce a consistent, known quality and quantity from each plant, and expect that all plants will mature at the same time. This ensures the same consistent, quality product from consecutive crops, as long as the same high-quality clones are used for each planting. Gardens propagated solely from clones are the most productive and consistent.

Sexual propagation is the process in which male and female sex cells (gametes) from separate parents unite in the female plant to form what will eventually mature into a new, genetically distinct individual. This process occurs when pollen from a male (staminate) parent unites with an ovule within the ovary of a female flower to create an embryo. This embryo, when mature and fully developed, will become a seed.

Each seed is genetically unique and contains some genes from each of its parent plants. Offspring grown from seed are most often different in some way from each other, just as brothers and sisters share some physical qualities of each of their parents, but are rarely identical to their parents or siblings. Because of this variation in plant traits and characters, breeders are able to use sexual reproduction to their advantage by crossing different individuals within a population or family, or hybridizing unrelated lines and subsequently inbreeding the progeny. This results in a phenomenon known as recombination of traits, and it allows breeders the possibility to recover individuals with a combination of the positive traits of both parental lines, all the while selecting plants that do not express the negative aspects. These selected plant stocks are then used as a basis to develop new and improved varieties.



A single male flower on a predominately female plant will release much pollen.



Female plants grow (white) pistils to attract male pollen.

Distinguishing between male (staminate) and female (pistillate) plants is easy. Male plants are distinguished by the appearance of "pollen sacks," or anthers, that grow from branch unions. Anthers look similar to a cluster of grapes or a collection of miniature lobster claws growing upwards and inverted from the branch union. Males typically begin to produce these flowers one to four weeks before the females of the same variety, and often bolt, or stretch, when they enter their floral development stage. Females can be distinguished by the development of two whitish hairs, or stigmas, which develop as part of the pistil—the female flower that appears in branch unions or "nodes."

Cannabis is an interesting species, in that it is one of the only annual plants that produces each of the male and female sexual organs on different individuals. This is a condition known as dioecy; dioecious plant groups contain individual plants that are either male (staminate; stamen bearing) or female (pistillate; pistil bearing). Dioecy is a hallmark of a cross-pollinating species; under normal conditions, cross-pollinated plants (outcrossers) are only able to fertilize other individuals, which has implications we will discuss later.

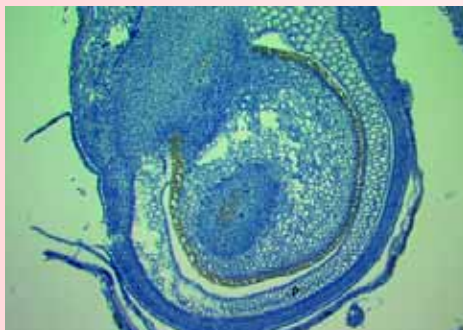
Although dioecy is most common in cannabis, monoecious varieties do exist. Monoecious varieties produce both staminate and pistillate flowers on the same individual.

These monoecious varieties are mainly used for hemp seed production, as they generate the highest yield of seed per acre. Monoecy is not a desirable trait for drug cultivation, where seedless cannabis, or sinsemilla, is sought.

Plants exhibiting both staminate and pistillate flowers are most often referred to as "hermaphrodites" by drug cannabis cultivators but are more correctly referred to as intersex plants. Intersex plants are a problem for growers who wish to produce seedless cannabis for consumption; just as seedless grapes or oranges are more desirable to consume, the same is true for cannabis. Having to remove the seeds from cannabis flowers prior to consumption is an inconvenience, and burning seeds taste bad and can ruin the smoking or vaporizing experience. We will discuss intersex plants in more detail later in the chapter.

The creation of a seed

Cannabis is an anemophilous species; this is a fancy way of saying that it is wind-pollinated. Under natural, or wild, conditions, male plants undergo dehiscence (shedding of pollen) and disperse vast quantities of pollen into the wind. The pollen travels on air currents and, by chance, lands on the stigma or style of a nearby, or not so nearby, pistillate individual. This is the pollination event. Because pollen from many species floats in the air, and there is a significant chance that



Scanning electron microscope photo of the inside of a seed.



The inside of a seed with half the outer shell removed.