



A gerbera plant (teleflora.com)

Hi. My name is Krishna. I am a PhD student in ornamental breeding and genetics program led by Dr. Zhanao Deng at Gulf Coast Research and Education Center, Wimauma, Florida. My research is on identifying genes involved in powdery mildew resistance gerbera daisy. As a part of my research I make crosses between two gerbera lines and self-pollinate the individual lines to advance the generation.

The objectives of today's activity are:

1. To introduce gerbera plant briefly
2. Demonstrate how to cross-pollinate between two gerbera lines
3. Demonstrate how to self-pollinate a gerbera plant

Let us start with the introduction of gerbera

Gerbera is a flowering plant in an Asteraceae family which is also known as daisy family. Asteraceae also comprises sunflower and lettuce many other flowering plants along with gerbera. Gerbera is a diploid plant with 50 pairs of chromosomes. It is fifth most important cut flower plant and is being increasingly used in gardens and landscape. IT is also grown in pots as indoor and patio plants. In most part of the country, gerbera is grown as seasonal annuals however in Florida, it can be grown year-round. Gerbera is grown for large bright colored flowers (sometimes with combination of multiple colors in different florets) that are available in wide range of colors. Once the flowering begins these plants can profusely flower for a long time.

### **History of gerbera breeding**

Breeding of gerbera started during the end of the 19<sup>th</sup> century in the Cambridge Botanical Garden, England by R. I. Lynch with a goal to extend the range of color by making a cross of two African wild species, *G. jamesonii* and *G. viridifolia* developing a hybrid known as *Gerbera X cantebriensis* which had new color combinations in ray and disc flowers and relatively easy to grow than *G. jamesonii* and known in today's world as *G. hybrida*. First data keeping and breeding work for color was known to be done by Adnet by making crosses between the plants developed from the seeds received from Lynch and recording the frequencies of color classes among the progeny. Varieties developed from Adnet's breeding program were exhibited in

Berlin, London and Paris and it was the first time when growers received his materials that was later focused on breeding doubled flowers and the breeding programs were started in New Zealand, Italy, the Netherlands and Belgium. The breeding program of Italy and the Netherlands had genetic resources from South Africa and Tasmania respectively. Although, most of the cultivars of gerbera that are commercially available have been originated from these two wild African cultivars and their crosses, natural hybrids between these two species haven't been found (Hansen, 1985). Modern gerbera daisy could possibly have also been developed by crossing of other species of *Gerbera*, however, there is no information to support this speculation. *G. jamesonii* is reported to be introduced to the United States in 1897 by an immigrant gardener from England who grew gerbera in New Jersey. Another English, Frank Brunton, also grew gerbera in Newport, Rhode Island around 1900 however, the source of the plants were not mentioned by them and assumed to be from the Cambridge Botanical Garden. It has been speculated that the narrow genetic base of gerbera is due to its introduction from a few plants of the collection of the botanical garden. Initiation of hybrid production of *G. jamesonii* and *G. viridifolia* in the US has not been clear since the hybrids were recorded in a company's catalog in 1911 however the first report of hybrids was mentioned by Zimmerman and Hitchcock in 1934. In the US commercial production of gerbera was reported to have been started by 1930s and by 1940s, it spreaded in various parts of the world like Italy, Germany, The Netherlands, New Zealand, South Africa.

## **Botany**

Gerbera plants comprise of roots, crown, petiole, leaves, peduncle and flower. There is no stem in gerbera and therefore leaves and flowers arise from the crown region. Flowers of gerbera are unique and hence gerbera is a model plant to study flower development. Let's talk about flower of gerbera. What we see as one flower of gerbera (show the flower) is an arrangement of many flowers in an inflorescence. There are three types of flowers in gerbera: ray, disc and trans. Disc flowers are male fertile whereas the ray and trans flowers are male sterile but female fertile.

Gerbera has different flower type: single, semi-crested (semi-double), large crested (double) and spider (laciniated). Early cultivars that were developed were like that are available in the wild with one or two whorls of ray florets, several whorls of short, inconspicuous trans and disk florets. This kind are known as single flower. Flowers with more than one whorl of ray florets are known as duplex type. Crested types are characterized by addition of multiple rows of enlarged trans florets varying in size. In other, double flower type is defined by the number of petals produced in a flower. However, in gerbera, length of conspicuous trans florets in the capitulum determines the extent of flower doubling. Spider flowers appear fringed due to split corolla lip.

## **Pollinating gerbera flowers**

Self-pollination: making a cross within same flower or flower of the same plant or genotype

Cross pollination: using pollen from one plant and pollinate it on the stigma of another plant of different genetic background

## **Why do we pollinate gerbera flowers?**

We make a cross to develop hybrids that contains the desired qualities from both parents used to make a cross. Let's say we have a gerbera plant that has excellent flower quality but it is susceptible to a disease called powdery mildew. Now we want that plant to have powdery mildew resistance. So, we take another gerbera plant that has powdery mildew resistance however it might not have good flower traits. Therefore, we combine better flower traits with disease resistance by making a cross between these two plants.

We self-pollinate gerbera to advance the generation. Pollinating stigma with the pollen from the same flower increases the homozygosity. This helps in developing breeding lines that can be used to develop hybrids.

Gerbera is a cross pollinated plant with allowing minimum self-pollination. Ray and trans florets in gerbera flowers contain stigma that are receptive to pollen grains however, in trans florets, stamens are absent and in ray florets, although stamens develops normally in the earlier stage of flower development, they abort as the development progresses leaving only stigma to develop completely. The central disk flowers contain both stigma and stamens but the primary role of disc flowers is to produce pollen to fertilize the stigmas of ray and trans florets. One of the primary reason for reduced self-pollination is due to temporal difference in synchronic maturity of anther and stigma. In gerbera, stigma matures earlier than anthers and therefore stigma would have already lost its ability to capture pollen and assist in pollination when anther matures and releases the pollen grains. In the absence of any interference in pollen movement, there is no pollination, fertilization and seed development in gerbera. To make cross pollination which is used breeding programs to develop new traits, controlled open pollination is done by using pollinators like bees or by hand pollination. Because of self-infertility and inbreeding depression, emasculation is not recommended while making cross pollination. Selfing in gerbera however, is a challenging task and success rate can be low depending upon the genetic makeup of the parental lines. To self-pollinate the flowers, pollen from a gerbera line is collected and stored at room temperature (25 °C) until the stigma in another flower of the same plant is ready. This is cumbersome because of the protogynous, stigma maturing before the production of pollen grains, nature of the flower. Once the stigma of another flower in the same plant is ready, stored pollen from the same plant is gently brushed on the stigma that are sticky to receive pollen grains. Seed formation and germination of self-pollinated seeds are significantly lower than that developed from cross pollination. To obtain increased seed-set, the process of brushing pollen on the stigma is repeated next day or two since all stigma will not mature on the same day. After one-two weeks, the petals should be removed and the capitulum should be bagged by using a net bag to contain the seeds before they dislodge from the receptacle and fall on the ground. two-three weeks depending on the time of the year, seeds will set and the seeds can be manually separated from the rest of the dried flower parts. If the seeds are not dried completely, they can be dried in the shade with lot of air movement and stored in an air-dry place. These seeds if sowed will germinate in one – two weeks after sowing.