Gerbera Breeding

Introduction

- *Gerbera jamesonii*
- Family: Asteraceae
- Gerbera is an important commercial flower grown throughout the world.
- It is a **perennial herb** native to South Africa and Asia.
- Gerbera produces very attractive flowers in **various colours and ranked among the top ten cut flowers.**
- Besides as a cut flower, it is also very ideal for **beds, borders, pots and rock gardens.**
- The gerbera was first discovered in **1878** by botanist **Robert Jameson** near **Barberton** and is therefore referred to as the Barberton daisy or the Transvaal daisy.

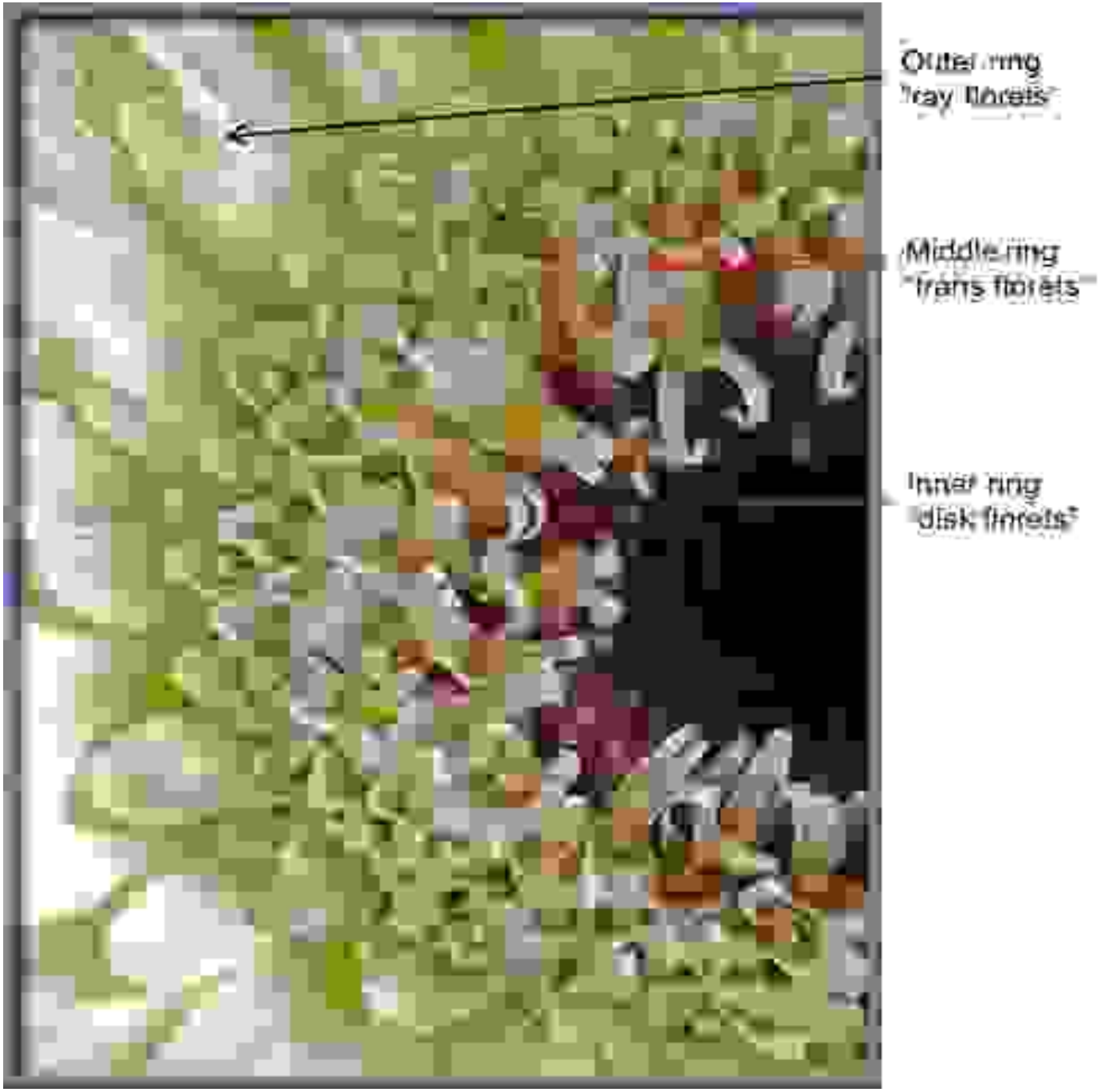

RHODESIA
GERMAN SOUTHWEST AFRICA
BECHUANALAND PROTECTORATE
PORTUGUESE EAST AFRICA
SWAZILAND
ZULULAND
CAPE COLONY
Cape Town
Cape of Good Hope

Origin and history

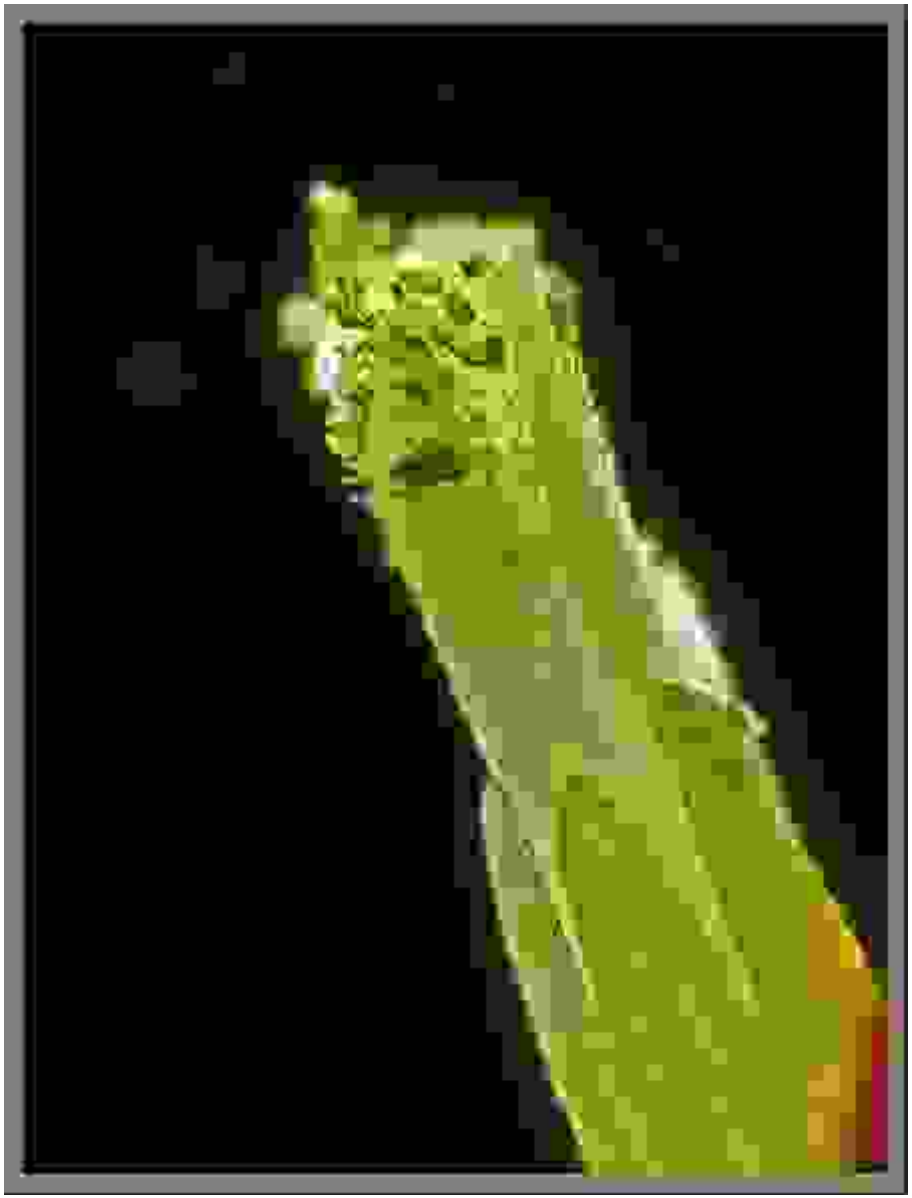
- The **first official description** of the South African species *Gerbera jamesonii* was made **by J.D. Hooker in 1889** in Curtis Botanical Magazine
- The **native distribution** of this genus, comprising of about 30 species, extends to **Africa, Madagascar**, **Tropical Asia** and **South America** (Bremer, 1994).
- In India, *Gerbera* spp are **distributed from Kashmir to Nepal** at an elevation of 1300 to 3200 m.
- It was named after **German naturalist, Traugott Gerber** by Dutch Botanist **Jan Frederik Gronovius**
- ***Gerbera jamesonii***, native to Natal and Transvaal, and ***G. viridifolia*** from Cape were introduced to Botanic Garden, Cambridge in 1887 and crossed by Lynch and the hybrid was named as ***G. cantabrigensis.***
- The breeding work was initiated in Europe, and later, the USA for **cold hardiness in temperate climates which was an early objective.**

Floral Biology

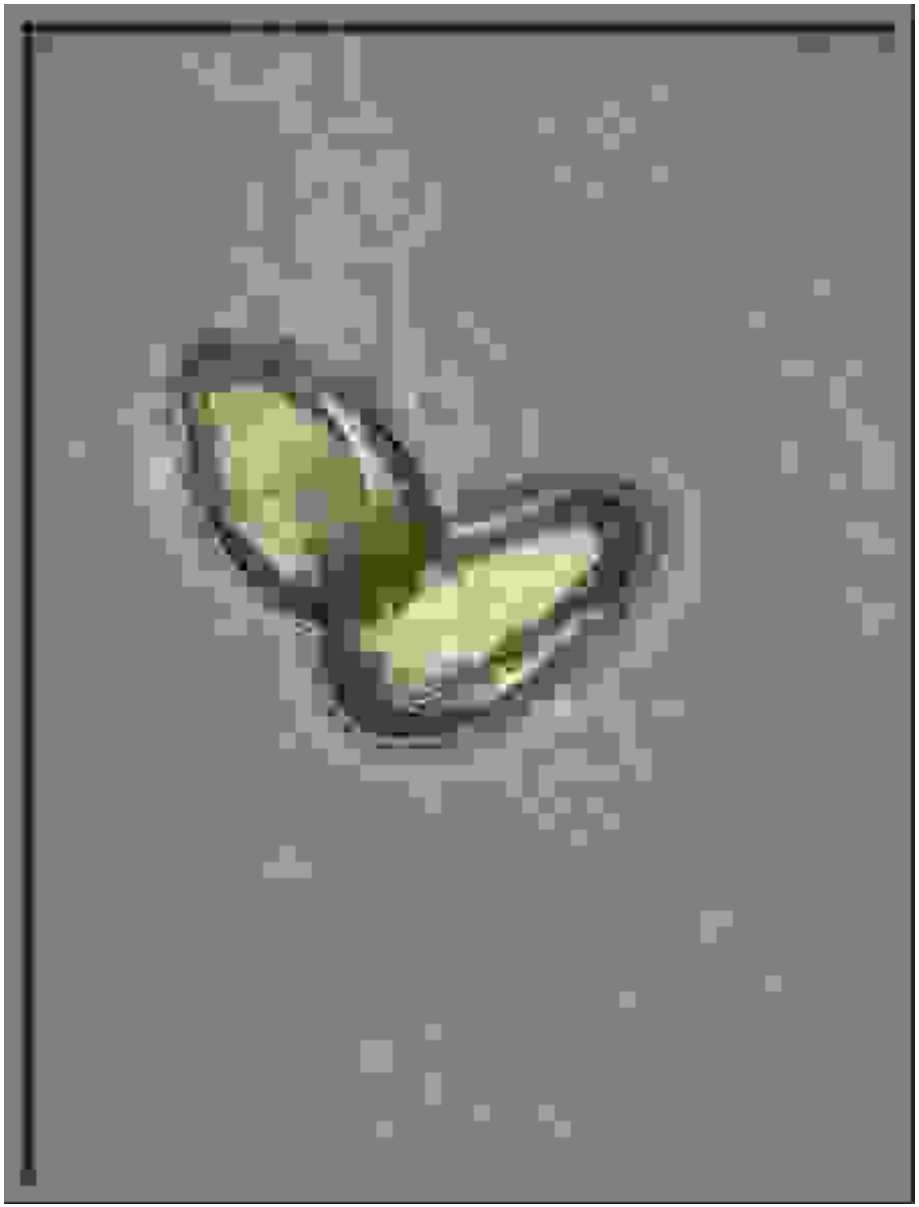
- The **daisy like flowers** are in wide range of colours including **yellow, orange, cream white, pink, red** and various other intermediate shades.
- Inflorescence is head or capitulum- contains ray and disc florets
- Flower head posses out ray florets which are functionally female
- In ray florets three of the 5 petals are joined to form ligula, remaining form smaller lip
- Style long, stigma is forked
- Florets in centre- disc florets which are tubular and functionally male.
- In between disc and ray florets hermaphrodite or bisexual flowers present-called trans-florets
- In bisexual florets- anther liberates first before stigma receptivity- Protandrous. But whole influence is Protogynous
- All flowers are surrounded by surrounded by a hairy structure (Pappus bristles) which later forms a parachute for single seed developing in each flower.


Outer ring
"ray" florets
Middle ring
"trans florets"
Inner ring
"disk florets"

Stigma and its supporting style

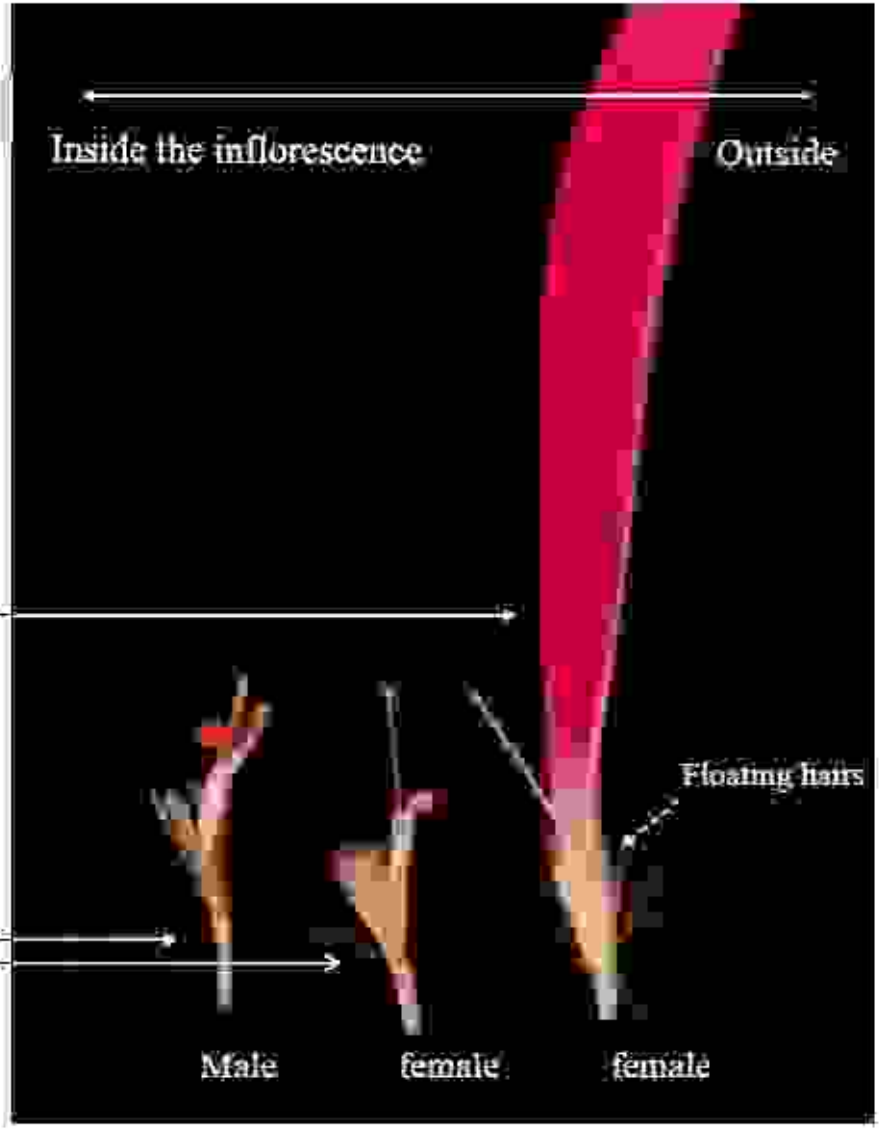


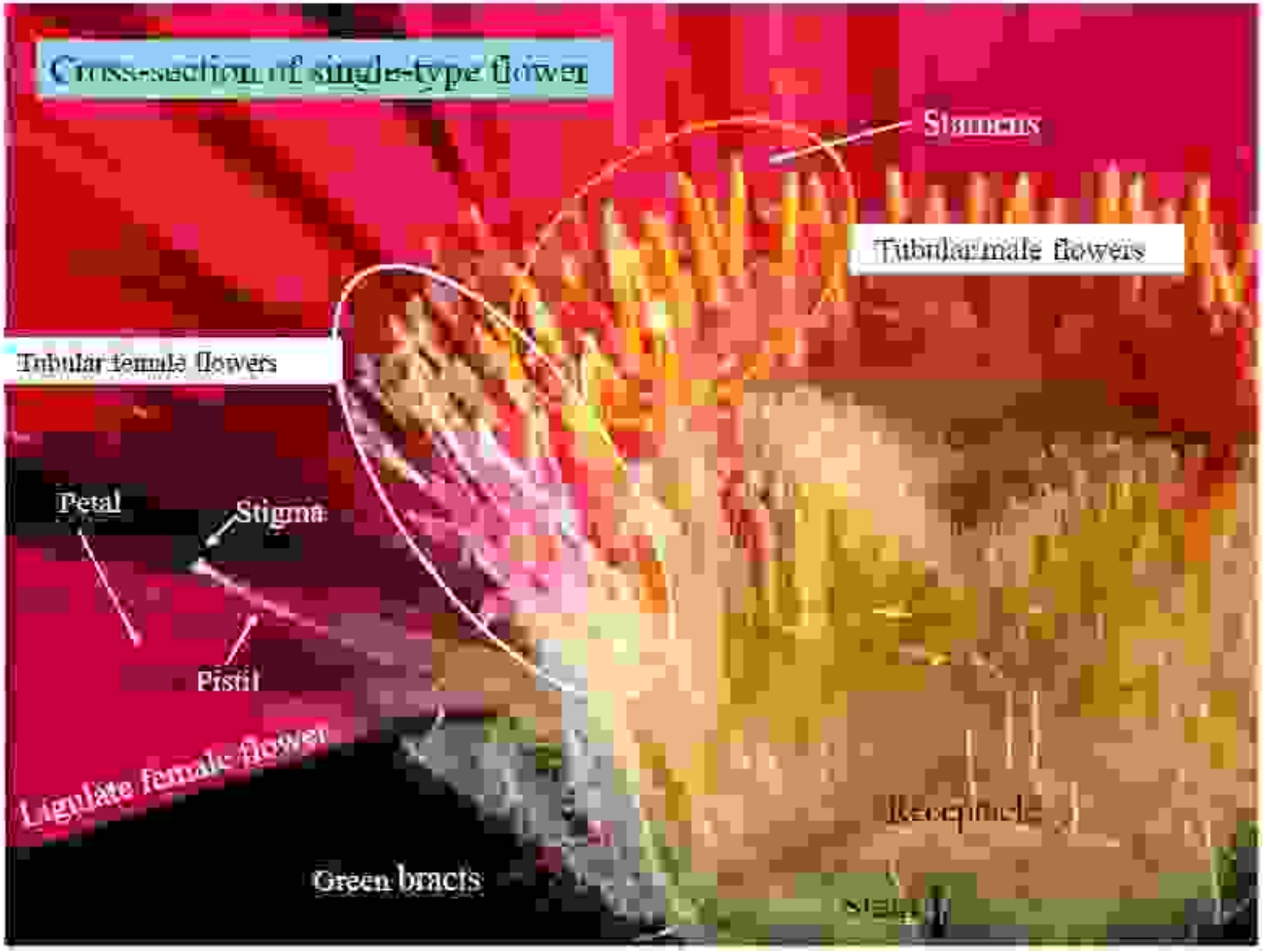
Pollen covered stamens



Ellipsoidal gerbera pollen

Single-type flowers

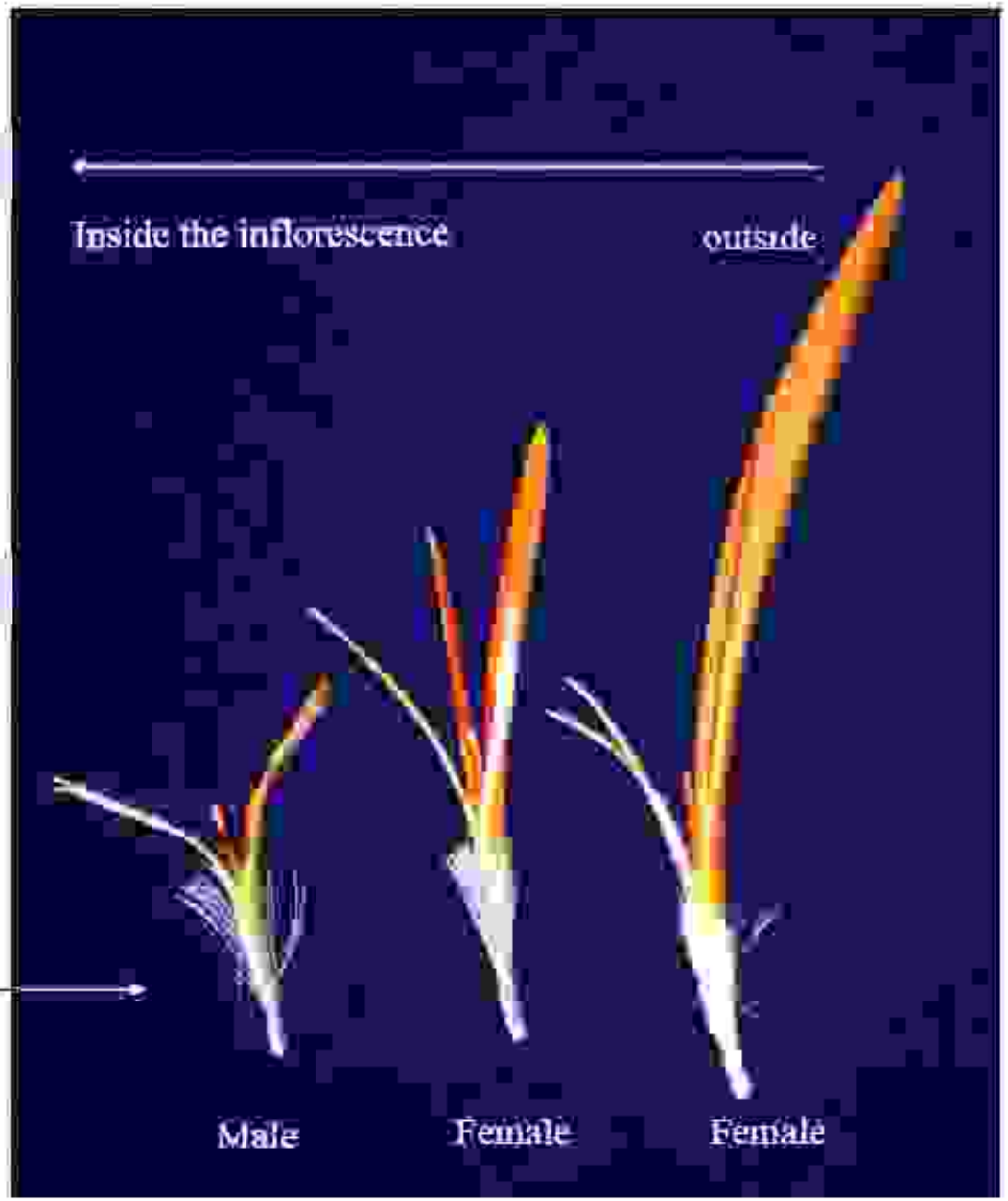



Cross-section of single-type flower
Stamens
Tubular male flowers
Tubular female flowers
Petal
Stigma
Pistil
Ligulate female flower
Receptacle
Green bracts
Stem

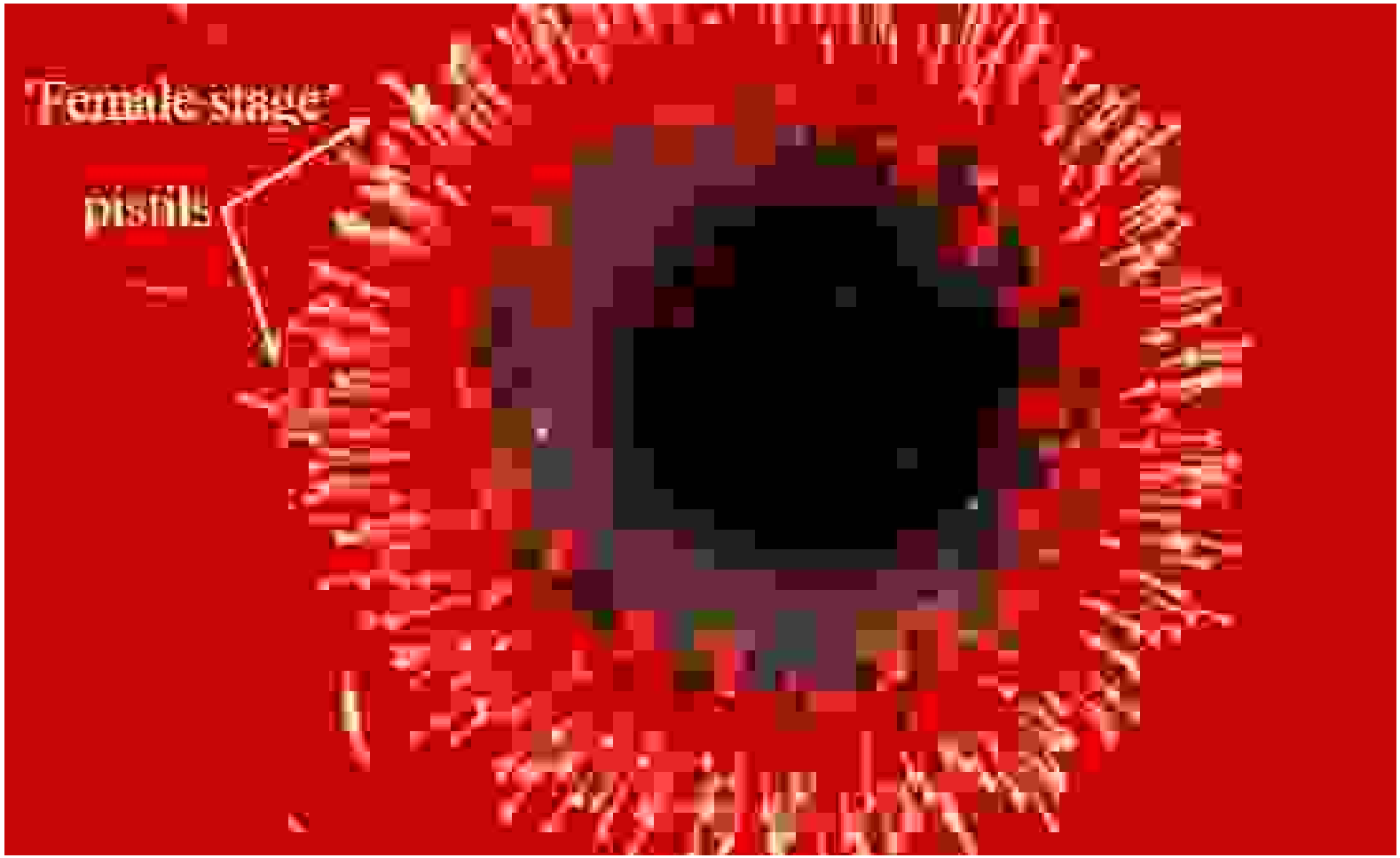
Double-type flower

Semi-double flower

Ligulate flowers

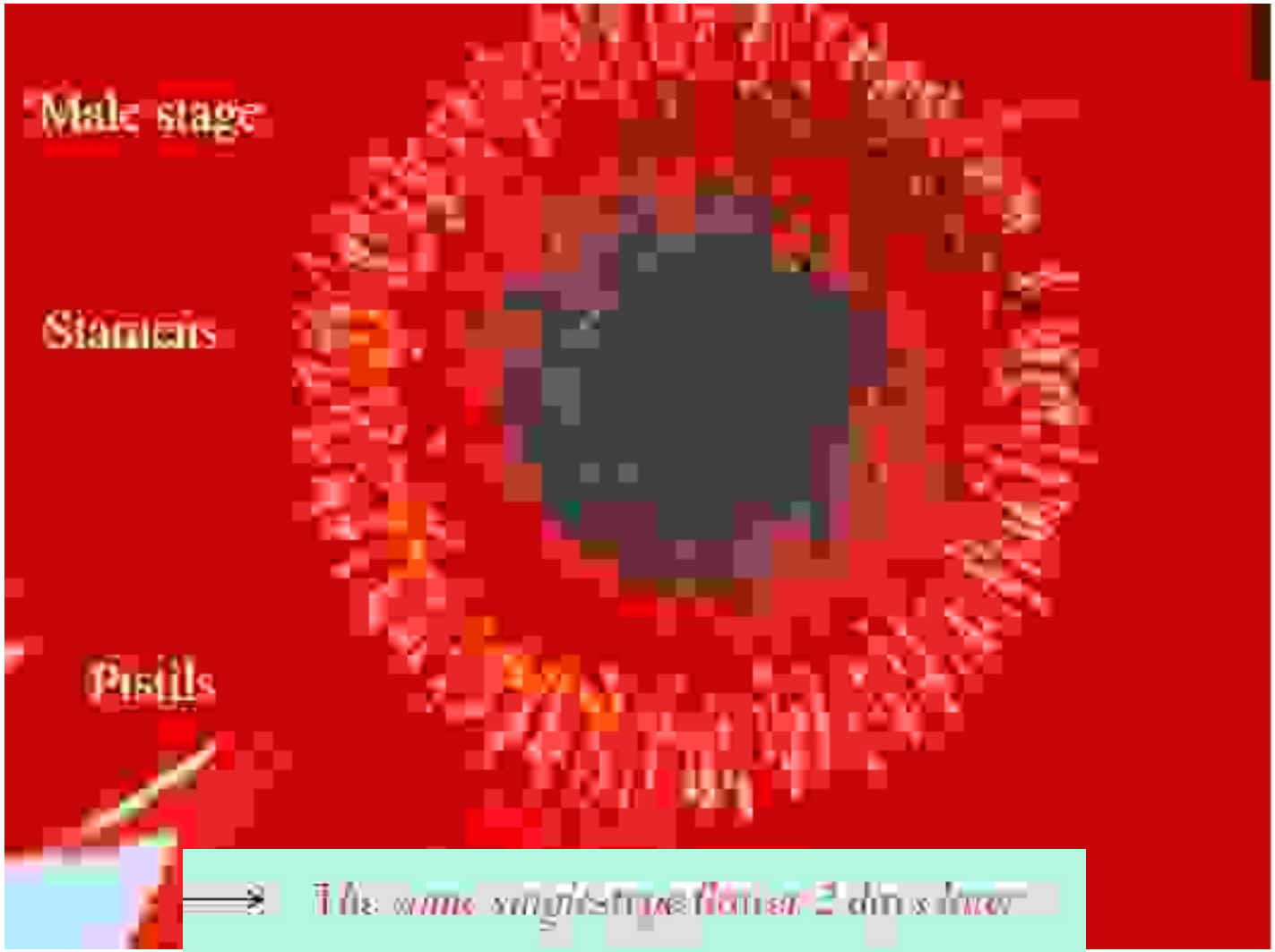


Female stage of single type gerbera



Only pistils are seen the stamens are not visible yet.

Male stage of single type gerbera



Species

- There are about 40 spp. of Gerbera of which *G. jamesonii* is cultivated.
- All species are half-hardy and perennial flowering.
- *G. jamesonii*: The plants are hairy throughout, base woody, leaves lobed, many solitary orange scarlet heads, 7.5 – 12.5 cm across, borne from Nov – Feb.
- *G. kunzeana*: A himalayan sp. With scarce opening of flowers
- *G. asplenifolia*: Leaves are narrow, 10-15 cm long, deeply lobed, leathery, glossy above, lobes roundish, concave, margins revolute. Flower heads purple on a hairy scape
- *G. aurantiaca*: Leaves lanceolate to long, acute 12.5 – 15 cm long, entire/toothed. Flower heads orange with yellowish anthers
- *G. viridifolia*: Leaves elliptical/ oblong/obtuse green on both sides and smooth or nearly so. Flower heads dirty white and small.

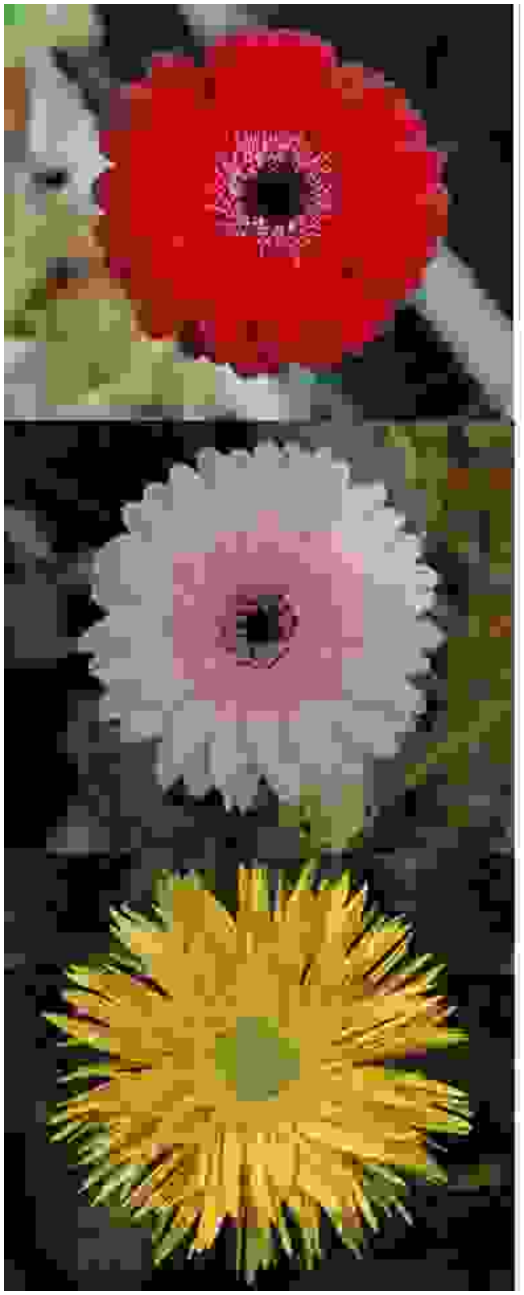
Classification

Based on flower heads

- Single: One or two rows of ray florets on the periphery of disc and rest are disc florets. Many colours available
- Double: More than two rows of florets, very attractive, highly priced, with innumerable colours Commercially, doubles are more in demand than the singles.

Based on size and shape of flowers

- Standard
- Spider
- Mini



Cultivars

Innumerable varieties available

- **Standard Gerbera:**

  Aida Aquila, Arosa, Blue boy, Cabana, Camilla, Citrella, Dalm, Eclips, Gloria, Golden Gate, Goliath, Magnum, Nevada, Optima, Pink Elegance, Rubion, Rosalin, Sangria, Sunanda, Savannah, Sunset, Thalssa, Super ario, Zemla

- **Spider Gerbera:**

  Chili, Kontiki, Punky, Spanky, Twnny , Vicky

- **Mini Gerbera:**

  Alami, Bentley, Goldy, Red Huwaii, Jimmy, Nikky, Rosemary, Snoopy, Tiffany, Tweety, Victory

Genetics

- *Gerbera jamesonii* is 2n = 50.
- Increased plant as well as flower size was reported in tetraploids
- The plants of gerbera are grouped into three categories, viz.,

  (i) Completely self-sterile

  (ii) Plants with distinct differences in seed set when pollination takes place within an inflorescence, and

  (iii) When pollination takes place between neighboring inflorescence on the same plant and plants in which these differences are less pronounced.
- The third category of plants are less **favorable for production of large amount of hybrid seed**, since occurrence of selfing within the inflorescence

Inheritance of flower colour is controlled by four factors:

- **Gene A:** causing intense red colour
- **Gene a:** causing dull red colour,
- Gene **H**: causing *A* and *a* to be lighter in colour, and
- Gene **B**: which became evident in the absence of *A*, causing ivory or yellow colour

- Self fertilization resulted in production of less number of viable seeds and of a high proportion of plants with poor characteristics.

Breeding objectives

- Improved vigour of plant
- Improved size of flower
- To create uniform and compact plants
- To breed variety with profuse and continuous blooming
- To induce earliness in flowering
- Improved vase life
- To create attractive & novel flower colours, forms
- Long, uniform, upright sturdy peduncles,
- To evolve varieties resistant/tolerant biotic and abiotic stress.
- Resistant to wilt, powdery mildew and white flies

Breeding Methods

- Clonal selection
- Hybridization
- Mutation breeding
- Application of biotechnology

- **Clonal selection:** Introduction of exotic varieties and selection of elite types among them.

Hybridization

- Breeding of gerbera started at the end of 19th century in Cambridge by R. I Lynch who crossed *G. jamesonii* and *G. viridifolia* & named hybrid as *G. cantebrigienesis* (Now known as *G. hybrida*)
- Majority of present commercially cultivated varieties originated from crossing of these two species.
- With continuous targeted breeding and selection, strategy, there was continuous increase in flower size, yield, improved shape and colour became more luminous
- Numerous cultivars of gerbera have been evolved **through hybridization**.

- **Muller (1959):** attempted to evolve varieties for flower form and colour, stem length and stiffness, keeping quality, period of flowering and yield, resistance to biotic and abiotic factors.
- **Danhardt (1966):** Hybridization and selection resulted in the development of 12 cultivars of which cultivars Aktur, Migar and Atair showed high resistance of *Phytophthora cryptogea.*
- **Cantor (1993):** reported that the gerbera clones G110 and G44 are useful material for breeding.
- **Leffring (1968):**
  - crossed several modern cultivars with wild species to develop a dark centered large flowered hybrid.
  - Further selection and back crossing stabilized the dark centre and seedlings were true to type.

- **Schiva (1980):**
  - Attempted to evolve varieties for low temperature.
  - Genotypes adapted to cool temperature were crossed with 20 genotypes having good floral characters in pairs to give 10 full sub families.
  - Progeny was raised and assessed for floral attributes.
- **Byrne *et al.* (1987):**
  - found that the estimates on genotype x environment (GE) interaction was as much as half of the genetic variance for cut flower yield in gerbera and attributable to GE interactions.

- **Penningsfeld *et al.* (1976):** Flower yield of 60 clones, including breeding lines ranged between 19 for cv. Adrie and 55 for line No. W.30
- **Buivids *et al.* (1992):**
  - Chose parent forms on the basis of combining ability and heritability values for cut flower quality and yield.
  - Inbred lines were produced from 52 cultivars and clones.
  - Inbreeding depression was marked in Aime, Bille, Lelde and Teiksma.
  - No segregation for flower colour was seen in Ede (dark red) and Delphi, Symphonic and clones 35-5, 55-3 and 83-6 (all white).

Mutation breeding

- Walther and Sauer (1986) studied in vitro mutagenesis with X-ray doses between 10 and 25 Gy immediately after cutting off from in vitro derived microshoots.
- Shoot productivity increased with time.
- Similar results were also recorded by Walther and Sauer (1992) using in vitro cultures of 5 lines and one cultivar with 10-30 Gy X-rays.
- X-ray irradiation (20 Gy) of explants propagated in vitro produced a 10 per cent mutation rate in foliage (number, size and form of leaves) and flowers (stalk length, flower diameter, number and shape of the petals).
- High intensity of irradiation suppressed the plant growth (Walther and Sauer, 1985).
- Ethyl methyl sulphonate (EMS) was more effective than sodium azide in inducing single gene mutations in seeds.

- Increasing the EMS concentration from 1% to 2% and that of sodium azide from 0.1 mM to 1 mM and the time decreased germination, growth, survival, frequency of flowering plants and seed setting and number of seeds in the M1 generation and the mutations occurring the M2 generation.
- Schiva *et al.* (1984) obtained a large non-lethal M2 population using low concentration of EMS at shorter duration.
- Jain *et al. (1998)* discussed possible approaches for creating genetic variability for the selection of useful plants, with reference to gerbera using mutagenesis, somaclonal variation and genetic transformation.
- Somaclonal variation may arise due to genetic or epigenetic changes.

Biotechnology

- Nagaraju *et al.* (1998) developed an agrobacterium mediated genetic transformation protocol for Gerbera which can be used to introduce horticulturally important genes that govern pigment biosynthesis in flowers.
- Jerzy and Zalewska (1998) the colour recurrence in gerbera is possible only through meristem explants.
- Orlikowska (1999) has developed an effective system for *in vitro* regeneration of adventitious shoots from callus for the transformation or mutation of *Gerbera hybrida*

IIHR varieties

- IIHR99-1: Gerbera half-sib selection, has a potential to grow outside the polyhouse
- IIHR99-2: Gerbera half-sib selection, has a potential to grow outside the polyhouse
- **Arka Krishika: open cultivated variety.**
- **Arka Nesara**
- **Arka Ashwa**

IHBT Palampur :

- Him Glow
- Him Peace
- Him Saumya
- Him Gaurav

Other Varieties

Varieties	Colour
Danaellen, Alberino, Uranus, Fredeking & Nadja.	Yellow
Pink Elegance, Fredonzella, Terraqueen, Valentine & Fredaisy.	Pink
Dalma, Cassiana, Vesta, Dusty & Fredorella.	Red
Flamingo	Pale rose
Labalga	Lilac
Carolli	Light
Flavia	Light yellow
Lexus	Brownish orange
Delpi	White


THANK YOU