Anthurium Breeding

Introduction

- Anthuriums are tropical plants of great beauty and grown either for the showy cut flowers or for their unusually attractive foliage.
- They are very popular cut flowers because of the bold effect and lasting qualities.
- The name anthurium is derived from Greek ***anthos*-flower**, and ***oura*-tail**, referring to the **spadix**.
- These evergreen plants are native to Colombia, Peru, Central and South America, Brazil and Venezuela .
- Anthurium is one of the **Hawaii's principal cut flower** for export.
- commercial cultivation- Philippines, Poland, Mexico, Taiwan, Jamaica, Costa Rica, Trinidad and Dominican Republic.
- Germany is the **highest consumer in European market**.

World production of anthurium cut flower*

Country	Area (ha)	Number of stems (million)
Netherlands	70	30
Hawaii	100	12
Mauritius	50	5
Carribean	40	4

✓World trade in **anthurium is second only to orchids** among tropical flowers.

ORIGIN AND HISTORY

- *A. andreanum* is native **of Columbia**
- *A. scherzerianum* comes from **Costa Rica and Guatemala**
- From Europe, the species spread to Brazil and Hawaii
- *Anthurium* was **introduced in India via England** by coffee and te a planters who wanted showy, exotic plants for their big bungalow s
- Even now some of the old tea and coffee plantations **in Assam, Da rjeeling and Coorg are having beautiful *Anthurium* specimens.**

Morphology and classification

❖*Anthurium* - Araceae

❖Anthuriums - perennial plants with creeping, climbing, assurgent or arborescent stems.

❖Leaves variable, evergreen, net-veined, with a prominent mid-nerve and lateral nerves, and a well-defined nerve at or near the margin.

❖The hermaphrodite flowers which are small and insignificant are densely packed on a cylindrical spadix subtended in large heart-shaped spathe.

❖The spathe may either be flat or slightly undulated ending with a pointed tip.

❖ Spathe and in many cases spadix are brilliantly colored ranging form scarlet, red, salmaon, orange, pink to white.

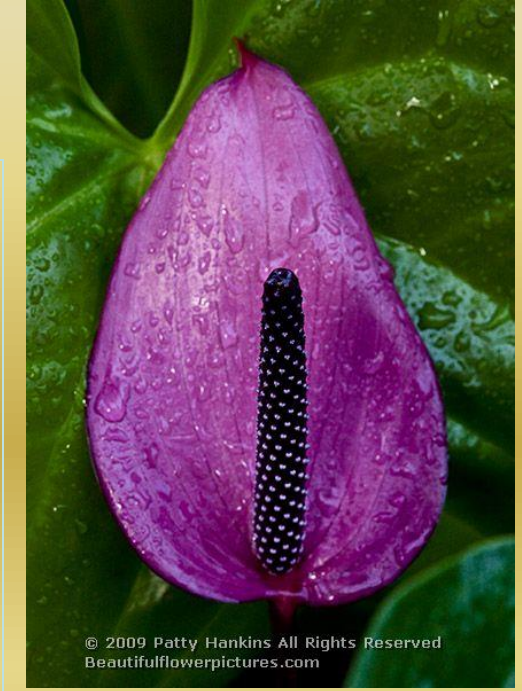
❖Ovary 2 celled with 1-2 ovules.

❖Fruit is berry.

❖Two sections or groups, viz., **foliage and flowering**.

FLOWER BIOLOGY

- The *Anthurium andreanum* flowers throughout the year.
- One flower emerges from **each leaf axil**.
- The sequence of **leaf, flower and new leaf is maint ained** -entire life
- The structure which is commonly called the ***Anthu rium* flower** is combination of colourful modified le af (spathe)
- The spadix or inflorescence spike- cylindrical in sha pe -300 inconspicuous bisexual flowers arranged in a series of spirals .



➢The species is **protogynous**, with the gynosium maturing first, from the **base to the top in an acropetal** succession.

➢Anthesis and anther dehiscence occurred between **08.00 and 10.00 h.**

➢The plant produces a **large number of pollen grains** per anther which are more or less uniform in size, round in shape with a single germ pore.

➢Pollen fertility was low, possibly reflecting the hybrid nature of the species.

➢ *In vitro* pollen germination, was ranged from 9.7 to 17.9% in cultivars Lady Jane Pink and Pink, respectively.

•Flower has 4 parianth segments (Petals) arranged in a 4 sided configuration which envelops 4 stamens with 4 loculed anthers, pistill is cylindrical, 2 carpelled.

•As the pistil develops, a stout style exerts to expose a receptive stigma.

✓*A. andreanum* -out breeding species with protogynous

✓This mechanism of **protogyny prevents self fertilization**, as the stigmatic surface becomes **receptive about 7-10 days before the pollen is shed.**

✓ The time required from pollination to the maturity of seeds is about 180-200 days

✓Seeds **lose their viability very fast** and cannot be stored.

✓They should be hand **pulped and sown immediately**

Species

- The genus *Anthurium* consists of some 500-600 known species,
- though there are probably not more than fifty in cultivation and
- perhaps not more than ten or fifteen known to the trade .

Flowering group

- A. andreanum, A. bakeri, A. brownie, A, ferrierense,
- A. ornatum, A. regale, A. Regnellianum,A. robustum, scherzerianum

Foliage group

- *A. clarinervium*, *A. corrugatum*, *A. crystallinum*, *A. holtonianum*,
- *A. leuconerum*, *A. magnificum*. *A. panduratum*, *A. papilionensis*,
- *A. splendidum*, *A. veitchii* *A. warocqueaman*.

- Among the various species, *A. andreanum* and *A. scherzerianum* are cultivated

Anthurium andreanum

- ***CN:*** Oil cloth flower, Tail flower, Painter's palette
- An erect plant.
- Leaves oblong, heart-shaped, 20-35 cm long, 15-20 cm wide;
- **spathe heart-shaped**, **lacquered reddish orange or scarlet**, 10-15 cm long;
- spadix **yellow and white**.
- It is suitable for greenhouse and is widely grown for its **handsome foliage and colored spathe.**

*A. **scherzerianum***

- ***CN:*** Flamingo flower, Flame plant
- The plant is better known for compactness
- Leaves narrow, 15-20 cm long, 4.6- 6.6 cm wide:
- **spathe ovate**, **brilliant scarlet spadix spirally twisted, golden-yellow**
- Flowers from February to July and needs keeping moist.
- This is a popular house plant .

Some other species

- *A. acutangulum* – **spathe green tinged with red-violet** in colour and spadix yellow green in colour.
- *A. bakeri* – **spathe is pale yellow- green** and spadix cream white in colour
- *A. brownie* – **spathe is greenish rose** tinted and spadix purple.
- *A. crystallinum* – spathe green **heavily tinged red violet and spadix** green turning t o yellow

- *A. digitatum* – **spathe is green to red purple** and spadix purple.
- *A. spectabile* – **spathe is green** and spadix yellow green in colour.

Cultivars

- **A good anthurium variety**
  - Compact plants,
  - producing suckers profusely
  - bright clear colored
  - showy, heart- shaped spathe, with plenty of blisters **and symmetrical overlapping of basal lobes.**
  - Spadix reclining to the spathe
  - shorter in length than the spathe
  - oriented at an angle of 30^0 - 45
  - an erect, long flower stem, above five times the length of the spathe, resistance to common diseases.

- **The cultivars based on spathe color are**
- Red: Altiplano, Avo-Claudia, Cancan, Kaumana, Ozaki, Quito, Tropical
- Orange: Casino, Nitta, Sun Burst
- White: Acropolis, Angel, Chameleon, Cotopaxi, Lambada, Manova Mist, Trinidad
- Pink: Abe, Avo-Anneke, Fair Lady, Marian Seefurth, Rosa, Sonata
- Green; Midori
- **Obake Cultivars** with bi-coloured spathe. They are extremely variable in size and shape and contain some development of chlorophyll in the spathe
- The important ones are : Avenue, Chameleon, Cardinal, Paradiso

Novelties: Tulip-type, miniatures. Spathe cupped, tulip-type; spadix straight, erect and not reclining as in other varieties.

- The important varieties are Calypso and Trinidad
- Exclusive; Cascade - White, green spadix
- Cheers - Light pink, green spadix
- Choco - Dark brown-green spadix
- Jumbo - Obake-cream
- Safari - Brown-red white veins
- Taquila - Cream-green red veins
- Double; The double, flowering anthurium plants produce one small and one
  large spathe on the same stem with a single spadix. Red, pink, and orange doubles are reported.

Commercial Varieties:

1.**Temptation:** This variety has a peculiar blood red coloured spathe with yellow spadix. The spadix is inclined at an angle of 50^{O} to the spathe. Flower stalk is straight.

2. **Leema white**

3. **Honduras:** This variety has maroon red spathe with greenish yellow spadix, inclined at 40^{O}C to the spathe. Flower stalk is straight and spadix inclined at 45^{0}.

- 5. **Agnihotri:** It has a spathe with attractive pink colour and a yellow spadix. The angle of inclination is 60^{O}.

- 6. **Candy queen:** The spathe colour is peach with yellow spadix. The spadix inclines at an angle of 40^{O} to the spathe. The stalk of the flower is weak and drooping.

- 7. **Nitta:** This exhibits bright yellow cup shaped spathe with yellow spadix. The spadix is inclined at an angle of 45^{O}

Common Varieties based on colour of spathe

- **Red :** Osaki, Kaumana, Kosohara, Hawaiian Red, Mickey mouse.
- **Orange :** Nitta, Sunburst, Sunset orange, Diamond Jubilee, Mauritius **orange.**
- **White :** Manoa mist, Uniwai, Hidden Treasure, Morocco, Trinadad, Uranus, Lima white.
- **Pink :** Marian, Candy Queen, Abe pink, Surprise, Spirit, Cheers, Sonata, Magic pink, Agnihotri, Lady Jane, Paradise pink.

- The **present-day flowering anthuriums are mostly hybrids** of different species, involving mainly *A. andraeanum* and *A. scherzerianum*.
- The **popular cultivars grown throughout the world** both for cut flower and in pots are
- Abe (bright pink), Aneunue (green and coral-pink), Avo-Anneke (pink), Avo-Jose (white), AvoClaudia (red), Chameleon (white), Favoriet (orange), Haga White, Horning Orange, Horning Rubin, Jamaica (white), Katimana (red), Kozohara (red), Kansako No. 1 (red), Mauna Kea (white with green border), Marian Seefurth (rose pink), Mirjam (red), Manova Mist (white), Nitta (orange), Nova Aurora (red), Ozaki (red), Red Elf Rico (rose), Sun Burst (bright orange), Sarina (white and rose) and Uniwai (white).
- **Cultivars like Calypso (dark pink on inner surface and light pink on outer side), Trinidad (off white), Blush (red veins on spathe) and Double (different colours) are the novelties**

- **Ruth Morat syn. Lady Ruth-** Cross of *Anthurium antioquiense* x Rotolante
  - Spathes are red larger than those of Lady Jane, with a mean width and length of 50.1 and 76.8 mm, respectively.
- ***Anthurium Var.* Red Hot-** cross between cv. Southern Blush (an F_1 hybrid of *A. andreanum* and *A. amnicola)* and cv. Lady Jane.
  - leaves dark green, lanceolate, 18- 20 cm long, base 11-12 cm wide;
  - peduncle grey-orange, 20-28 cm above soil surface when the spathe is fully open;
  - spathes 6-7 cm long, 4-5 cm wide and medium **red at** anthesis,
  - gradually changing to a lighter **red prior to senescence**;
  - spadix orange-red apically, blending to red at base, 3-4 cm long and 5-6 mm wide

Genetics and breeding

Genetics

- The basic chromosome numbers of anthurium are n = 15, 16 and 22.
  - The species like *A. andraeanum* (2n = 45),
  - *A. hookeri* (2n = 30) and
  - *A. magnificum* (2n = 32) **are diploid,**
  - *A. scandens* (2n = 30) **is triploid**
  - *A. digitatum* and *A. wallisii* (4n = 60) **are tetraploid**
- The chromosome number of *A. warocqueanum* was found to be 2n = 30+3 B chromosomes.
- Paleoneuploidy, polyploidv and B chromosomes have been the basic features of the genus
- but aneuploidy has **not been found**.

- Cytological analysis of *Anthurium andraeanum* revealed 2n = 30 as the number of chromosomes with 4 fairly large, 22 medium and 4 small chromsomes
- Somatic chromosome number for ***Anthurium andraeanum*** **was 2n = 30 + 2B**, irrespective of the varietal type.
- A high percentage of **meiotic abnormalities and karyotype differences** within the species indicated a hybrid origin for the species.
- *A. andraeanum* is a **secondary polyploid** with a probable basic chromosome number of x = 6.

Breeding methods and objectives

- ✓ *Anthurium* breeding programme is generally limited to crossing between different sel ected cultivars.
- ✓ **Hybridization and selection** are the most common methods

Objectives:

- ✓ Flower colour, shape and texture
- ✓ A desirable *Anthurium* plant should have **short internodes and grow vigorously** and **produce more number of flowers, spathe should be heart shaped with symmetric al lobes, spadix should be reclining to facilitate packing**. Dark colour **with pucker ed surface** is preferred in International market.
- ✓ **Introductions:**
- ✓ While the first *Anthurium andreanum* introductions were colored flower (pink, salmo n etc.) And selections for different colours.

Clonal selection

Two cultivars, Uniwai (an exceptionally hig h yielding white) and Marian Seefurth (wit h a rose opal spathe) were evolved by clon al selection (Kamemoto and Nakasone, 19 63).

Hybridisation

- *A. andreanurn* is an **out breeding species** with protogynous flowers.
- Protogyny **prevents self-fertilisation**, as the stigmatic surface becomes receptive 7 -10 days before the pollen is shed (Singh 1992).
- **Cross- pollination** among selected plants is preferred
- The time required from pollination to the **maturity of the seeds is 180- 200 days**
- Seeds **lose their viability very fast** and cannot be stored.
- Seeds **should be hand pulped and sown immediately** either *in vivo* or *in vitro*
- Kamemoto and Sheffer (1978) made **successful crosses** between *A. scherzerianu m* and *A. wendlingerii* to produce a **hybrid with greyish orange spathe.**

- Hybridization indicated that **neither white nor red flower colour was dominant** and pink was an intermediate heterozygous condition
- Anthocyanins in the spathes of various *A. andreanum* cultivars were identified as cyanidin 3-rhamnosylglucoside and pelargonidin 3-rhamnosylglucoside.
- Both pigments were presents in the red cvs. Ozaki, Kaumana, Kozohara, Kansako No. I and Nakazawa and in pink cultivar Marian Seefurth.

- The orange cv. Nitta and the coral coloured cv. Teteishi Coral contained **only pelargonidin 3-rhamnosylglucoside**.
- spathe colour in these species was determined by the relative concentrations of the anthocyanins : a predominance of cyanidin 3-rhamnosylglucoside which results in pink to dark red colours
- whereas a predominance of pelargonidin 3-rhamnosylglucoside resulted in coral to orange.
- Maurer (1979) -techniques of cross pollinating *A. scherzerianum* and discussed the presence of recessive characters *(A* = with anthocyanin, *a* = without anthocyanin, *B* = whole spathe coloured and *b* = spotted spathe).

•Preliminary breeding results at IIHR, Bangalore have shown that basically there **are only two genes involved, M and 0.**

•The gene **M controls** production of cyanidin 3 rutinoside and the gene **0 controls** the production of pelargonian 3 rutinoside.

• It was also observed that **red and pink spathe result** when **both M and 0 are present**

• and **orange and coral result** when **only 0 is present**, both orange and white (homozygous recessive) breed true.

✓**The inheritance pattern of different colours is as follows**.

✓**Red x Red** : The progenies **are all red or segregate into red and orange** with red dominant over orange.

✓**Red x Pink** : The progenies are all red or segregate into red, orange and pink.

✓**Red x Orange** : The progenies are all red or segregate into 1:1 ratio of red and orange.

✓**Pink x Pink** : The progenies produce 3 type segregations, red, orange and white (di-hybrid ratio) indicating that multiple allele system does not work here.

✓**Pink x Orange** : The progenies show 1:1 ratio of red and orange groups, the red groups includes red and pink and orange includes orange and coral.

Few hybrids have been evolved.

IIHR 26 (1990):

•The hybrid is attractive with orange coloured spathe and reclining spadix

•The yield is 8.3 flowers per year. The plant is erect with short stem and internodes.

IIHR 139 (1991) :

•This is a very **floriferous hybrid**

•spathe is **white** heart shaped with reclining **yellow orange spadix**

•the yield is 7.2 flowers per year, sucker production is poor.

IIHR 243 (1992) :

•A very floriferous hybrid, flowers are bright red with puckered, h eart shaped spathe and slightly overlapping basal lobes

•the spadix is yellow reclining and very ideal for packing

IIHR 51 (1992) :

•The hybrid is with white spathe and pink spadix .

•The flowers are highly fragrant in the morning and spread a plea sant chocolate fragrance in the glass house.

•The plant is very vigorous and short noded, 11-12 flowers are pr oduced every year.

•The hybrid is ti¸ighly resistant to Anthracnose disease.

Interspecific hybrids

Anthurium var. Red Hot is a new interspecific hybrid pot plant,originating from a cross between cv. Southern blush (an F1 hybrid of A.andraeanum and A.amnicola) and cv. Lady Jane.

Biotechnology

- Kuehnle and Nan (1991) isolated protoplasts capable of first divisio n from *A. andreanum.*
- Two cultivars Rudolph and UH1060 were transformed with vectors containing antibacterial genes and synthetic derivatives from *Hyalo phora cecropia* and bacteriophages (Kuehnle et al. 1995).
- Regenerated plants showed delay in disease symptom development compared with non-transformed controls

Mutation breeding

A programme on breeding novel characters in Anthurium ornatum had led to a natural mutant 'IIHR A1' or 'IIHR-selection A1' at Indian Institute of Horticultural Research, Bangalore, India.

Anthurium andreanum 'Orange Hot' is a mutation found in a large population of tissue cultured progenies of Anthurium 'Red Hot. The mutation was collected and tested as part of the Foliage Plant Breeding and Genetics Research Program at that Mid-Florida Research and Education Center - Apopka (Henny et al., 2003).