



A REVIEW ON CULTIVATION, PROPAGATION AND HARVESTING OF CROSSANDRA INFUNDIBULIFORMIS

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ABSTRACT

Crossandra flowers are very popular for their bright colour, light-weight and long keeping quality. It is believed to be native to South India and Sri Lanka. Crossandra flowers are considered very auspicious and are, thus, grown extensively in South India. The flowers are offered to temple deities, used for making garlands and for adorning women's hair in the form of venis and gajras. Crossandra is a flowering plant in family Acanthaceae, chromosome number of triploid ($2n = 30$) and tetraploid ($2n = 40$). Crossandra is highly susceptible to nematodes. Propagation is done by seeds or using stem cuttings. Seed rate is about 5 kg seeds/ha. Crossandra comes to flowering 2-3 months after planting and continues to bear flowers throughout the year with a drop in production during the rainy season. Average yield of 2000 kg of flowers per hectare per year obtained from tetraploid varieties and 2800 kg of flowers per hectare per year in Delhi Crossandra.

Key words: Firecracker Flower, Crossandra, Acanthaceae, Tetraploids, Delhi Crossandra, Lutea yellow.

1. INTRODUCTION

The Crossandra infundibuliformis pronounced as [kross-AN-druh in-fun-dih-bew-LEE-for- miss] or firecracker flower, known for its bright orange flowers, thrived in India and Sri Lanka nearly 100 years ago. The Greek name means "fringed anthers". Plant growers forgot about "orange marmalade" this evergreen plant with the glossy gardenia-like foliage for many years until their rediscovery and cultivation in the 1950s. The natural habitat of Crossandras is the East Indies, Africa, Madagascar, Sri Lanka and the rest of the Indian subcontinent¹.

Crossandra plants with their bright orange flowers are grown as an annual or perennial, planted in the garden or as wonderful flowering windowsill houseplant depending on where you live. It features narrow, oblong leaves and showy peach or coral flowers. It's grown as a bedding plant in tropical and subtropical areas and as an annual in northern areas². It also can be grown indoors. Crossandra is best planted in the spring and is a moderate to fast grower. If you meet its requirements for moisture and light, your plant should bloom in about seven months.

Crossandra is an erect, evergreen shrub with glossy, wavy-margined leaves and belongs to the family Acanthaceae. The flowers are unusually shaped with 3 to 5 asymmetrical petals. Flower colours range from the common orange to salmon-orange or apricot, coral to red, yellow and even turquoise³. The flowers are of great demand for use in hair adornments and in the form of garlands, venis and gajras. Though not fragrant, crossandra flowers are very popular because of their attractive bright colour, light weight and good keeping quality. Vernacularly it is known as Fire cracker (English), Priyadarsha (Hindi), Aboli (Konkani/ Marathi), Kanakambaram (Malayalam), Kanakambaram (Tamil), Kanakambaramu (Telugu), Abbolige (Kannada), Aboli (Gujarati), Priyadarsha (Sanskrit)⁴.

ORIGIN OF CROSSANDRA PLANT

Native of Crossandra Infundibuliformis plant is South India and Sri Lanka. It is most often found in south Indian region Malenadu.

AREA, PRODUCTION AND DISTRIBUTION STATUS

The estimated area under the cultivation of crossandra in Tamilnadu is around 1317 hectares with the production of 2634 tonnes per annum and the productivity is 2.00 tonnes/ha. The crops cultivated mostly in South India in the districts of Coimbatore, Madurai, Villupuram, Cuddalore, Pondicherry, Trichy and Thiruvannamalai.

2. DESCRIPTION OF PLANTS AND FLOWERS

Crossandra is a flowering plant in family Acanthaceae, chromosome number of triploid ($2n = 30$) and tetraploid ($2n = 40$). It is a small, evergreen ornamental shrub growing 1 m (3 ft) producing beautiful flowers almost round the year. It has a remarkable range of colours varying from orange, pink, red, yellow and double-coloured blue types with a white throat. The leaves are glossy, oval in shape, upright and deep-green in colour. The flowers are unusually shaped with 3 to 5 asymmetrical petals. Inflorescence is hairy and the florets grow from four-sided stalked spikes with prominent bracts. The corolla is cylindrical, more-or-less curved; the stamens are fringed, four in pairs.

Botanical Name

Crossandra infundibuliformis

Common Name	Crossandra, firecracker flower
Plant Type	Evergreen perennial flower
Mature Size	1 to 3 feet tall and 1 to 2 feet wide
Sun Exposure	Part shade
Soil Type	Rich, loamy, well-draining
Soil pH	5.8 to 6.5
Bloom Time	April to October
Flower Color	Orange, apricot, salmon pink, red
Hardiness Zones	10 to 11
Native Area	Southern India, Sri Lanka

SPECIES DESCRIPTION CROSSANDRA INFUNDIBULIFORMIS:

The leaves are glossy and most striking. Flowers throughout the year. The deheaded and pinching back maintain a bushy shape and keep blooming with each new flush of growth.

CROSSANDRA GREENSTOCK II

The bushveld crossandra is a dwarf herb, sometimes regarded as a shrub. It has widely opening orange petals around a yellow centre. The flower stalks emerge erectly from basal rosettes of broad green, unevenly lobed leaves.

CROSSANDRA PUNGENS

It is a dense subshrub up to 60 cm tall. Leaves are oblong, dull green, traced with pearly veins. Spikes are congested, bracts broadly ovate margins bristly to spiny and colour of flowers is orange.

CROSSANDRA FLAVA

It is an unbranched shrub about 15-20 cm tall with erect and green stem. Leaves are glabrous, opposite, obovate to lanceolate in shape and dark green in colour. Lower leaves are stalked, while upper ones are sessile. Spike is 4 sided with spiny yellow green bracts. Flowers are brightly yellow and the corolla tube is much exerted and jointed.

CROSSANDRA GUINEENSIS

It is free flowering and about 30-60 cm in height. The bracts do not bear spines and are pale lilac in colour. It can be grown both in sunny situation as well as in partial shade.

CROSSANDRA NILOTICA

The plants are about 60 cm in height. Stem is semi woody. Leaves are elliptic, dark green and glossy. Brick red flowers are borne in dense spikes. Lower 3 petals form a lip.

CROSSANDRA UNDULAEFOLIA

It is a short branching perennial shrub about 30-90 cm in height. Leaves are about 5-12 cm, long dark green, lustrous and pointed. Spikes are 7.5 to 12.5 cm long and 4 sided. Flowers have prominent spiny bract. It is also known as Fire cracker plant due to the cracking sound of the splitting of the seed pod.

ESSENTIAL REQUIREMENTS FOR THE GROWTH OF PLANT

Soil: A rich, peat-based, fast-draining potting soil is ideal for crossandra. When grown outdoors in the ground, it needs to be in a spot with excellent drainage, and it will enjoy having compost mixed into its soil for the added nutrients.

Water: During the growing season, water frequently and never allow the soil to dry out. Crossandra plants are very susceptible to drought and like a slightly moist—but not soggy—soil at all times. Reduce the amount you water in the winter, even if you're growing your crossandra indoors in a pot.

Light: These plants thrive best in bright, indirect sunlight. During the summertime, do not expose them to direct sunlight. But in the winter, provide as much light as possible. Indoors, your plant can do well with bright artificial light if you don't have a sunny window.

Temperature and Humidity: Crossandra is very heat-tolerant and cold-sensitive, as befitting a plant that comes from the tropics. If the temperature goes below 55 degrees Fahrenheit, the plant can experience damage to its leaves or the top growth. Crossandra also likes high humidity. In arid climates, it

might be necessary to mist your crossandra weekly during the growing season to provide sufficient humidity. You can raise the humidity for indoor plants by placing them on a tray of pebbles that is filled with water, as long as the water doesn't touch the bottom of the pot.

Fertilizer: Feed your crossandra with a weak liquid fertilizer every two weeks throughout the growing season. Cut fertilizer back to once a month in the winter.

POTTING AND REPOTTING

Although they are perennial shrubs in their native habitat, it's not uncommon for gardeners to treat crossandra plants as annuals, only keeping them until their bloom is over and their leaves begin to drop and then discarding the plants. If you do overwinter your plant, repot it in the spring into a slightly bigger container with fresh soil. Provide plenty of indirect, bright light for the transplant to help it adjust.

PLANTING

The land has to be ploughed 3-4 times. FYM @ 25 t/ha is incorporated and mixed well in the soil. Ridges are formed 60 cm apart. A fertilizer dose of 33.3: 60: 60 kg/ha N: P₂O₅: K₂O is applied as basal. Planting of seedlings or rooted cuttings can be done on one side of the ridge at 30 cm spacing. For seed production the spacing may be 60 x 60 cm. The crop is top dressed twice with 33.3 kg N per ha each time, the first at 3 months after transplanting and the second 8-9 months after transplanting. Application of fertilizers is to be necessarily followed by irrigation.

3. CULTIVATION

SCOPE OF ITS CULTIVATION

Crossandra is an important commercial flower, mainly grown in India, tropical Africa and Madagascar. The flowers are commonly used for hair adornment. Though not fragrant, flowers are very popular because of its attractive bright colour, light weight and good keeping quality. These are used for making garland, either alone or in combination with jasmine flowers. Using crossandra flowers in combination with jasmine is becoming increasingly popular in India, particularly in southern parts, because the jasmine flowers provide colour contrast and the desired fragrance.

Varieties and Hybrids under Cultivation Varieties of crossandra:

- 1) **Orange:** Orange crossandra is tetraploid ($2n=40$) and produces bright orange flowers in profuse number.
- 2) **Delhi crossandra:** Delhi crossandra is triploid ($2n=30$) and bears deep orange attractive flowers. It does not set seeds and is propagated by cutting.
- 3) **Lutea yellow:** It is a tetraploid variety bearing orange yellow colour flowers. It provides an impressive view when planted in pockets.
- 4) **Sebacaulis Red:** It is a tetraploid variety tolerant to nematodes.
- 5) **Mona wall head:** Leaves are lustrous and vivid green while flowers are deep salmon to pink.
- 6) **Lakshmi:** It is a high yielding mutant of Delhi crossandra and is developed through gamma irradiation techniques.
- 7) **Dr. A.P.J. Abdul Kalam:** It is a deep red colour mutant of Delhi crossandra and is developed through gamma irradiation techniques. It bears deep red flowers which are the first time larger than Delhi crossandra. The bold flowers make it suitable for long distance transportation. Flowers of this variety have gentle crater-like patterns and a channel like formation at centre.
- 8) **Maruvur Arasi:** It is a red colour mutant of Delhi crossandra which has been developed by gamma irradiation techniques.

HYBRIDS

TNAU has developed a resistant hybrid by crossing two local types from Palani and Marudhamalai hills. This hybrid is characterized by large attractive yellowish orange flowers showing higher degree of tolerance to nematode-fungal complex. Another hybrid evolved by crossing between the orange flowered cultivar and Sebacaulis Red which produces very attractive dark pink flowers.

CULTURAL PRACTICES

- A. **Soil type:** Crossandra is highly susceptible to nematodes. Hence, a field selected for crossandra cultivation should be analyzed for nematode population and correct Crossandra remedial measures should be taken before transplanting. Crossandra can be cultivated in a wide range of soils. Fertile, red loamy soils with pH range of 6 to 7.5 and rich in organic matter are most ideal for successful production of crossandra. Alkaline or saline soils are not suitable because plants develop chlorosis.
- B. **Climate Requirement:** Crossandra is a tropical plant and cannot tolerate low temperature and frost and mild climate is ideal. It performs well in places where the day temperature is around 30-35°C. Night temperature below 6°C causes frost injury.
- C. **Season:** The ideal time for planting crossandra is June – July and it may be extended up to September-October.

4. PROPAGATION

It can be propagated by seeds or stem cuttings. Seed rate is 5 kg/ha for optimum plant population. Fresh seeds are sown during July-October in raised beds 15 cm apart in lines. Watering should be done daily. Seedlings are ready for transplanting in 60 days when they have 4-5 pairs of leaves. Propagation is done by seeds or using stem cuttings.

Crossandra readily roots from cuttings. For best results, take cuttings early in the spring at the start of the growing season. Use a rooting hormone, and plant the cuttings into seed-starting soil. Provide bottom heat and plenty of humidity until new growth emerges, and then move

your new plants to their permanent location. Young plants grow quickly and will likely need to be repotted within their first month before they begin to bloom

Seed: Seed rate is about 5 kg seeds which is raised in nursery area of 4 cents. Treat the seeds with mancozeb or carbendazim @ 2 g/kg. The seeds lose viability very soon and hence only freshly extracted seeds should be used. Care should be taken to protect the germinating seedlings from cut worms by dusting Carbaryl 5 % on the beds. The damping off disease can be controlled by applying wettable ceresin (1 g/l) to the seed beds. Vigorous growth of the seedlings can be promoted by applying Ammonium sulphate solution (25 g/10 lit of water) to the seed bed twice a week. The seeds are sown in ridges in depth 1 cm and closed with sand. Mulching is done with dried leaves, paddy straw and irrigated with rose can. Seeds are sown immediately after extraction since the seed viability is very short.

Stem Cuttings: In the case of triploid varieties like Delhi crossandra, Arka Ambara, Arka Shreya is propagated through rooted cuttings since they do not produce seeds. Terminal cuttings are prepared during rainy season and dipped in 1000 ppm IBA for better rooting.

SPACING AND TRANSPLANTING

The land is ploughed thrice, 25 t/ha of farmyard manure is applied in the last ploughing and ridges are formed or beds and channels formed at convenient size (60 cm apart). Seedlings are transplanted on the sides of the ridges (40 cm). When the seedlings develop 3-4 leaves they are ready for transplanting. The seedlings are transplanted at a spacing of 60 x 30 cm/60 x 60 cm (for seed production). Before planting, it is better to dip the roots of the seedlings or rooted cuttings in wet Ceresan solution to prevent the incidence of wilt disease and treated with fungicide and nematicide like Emisan (1 g/lit of water). The seedlings will be ready for transplanting within 50-60 days after sowing. In the case of triploid varieties like Delhi crossandra, Arka Ambara, Arka Shreya, cuttings are used for nursery planting. Cuttings should be transplanted when sufficient roots have developed in polybags at a spacing of 60 x 40 cm.

MANURES AND NUTRIENT REQUIREMENTS²²

High fertility in the soil is essential for good yield. In addition to the basal application of farmyard manure, periodical top dressing with fertilizers and organic manure is essential. The first application of fertilizers should be done in 50-60 days after planting. The application of fertilizers is to be necessarily followed by irrigation.

- A. **Tetraploids:** Apply FYM 25 t/ha as basal and NPK at 75, 50 and 125 kg/ha as top dressing three months after planting. Repeat NPK application at the same dose at half yearly intervals for two more years (Instead of applying N at 75 kg/ha, N at 60 kg/ha + Azospirillum 2 kg/ha can also be applied).
- B. **Delhi Crossandra:** Apply FYM 25 t/ha, Gypsum 100 kg/ha and P & K at 50 and 100 kg/ha respectively as basal dose. Top dressing is done 30 days after planting with neem cake 250 kg and N 40 kg/ha. Apply N P K @ 40:20:60 kg/ha 90 days after planting and repeat this dose at quarterly intervals for a period of two years.

IRRIGATION, WEEDING AND HOEING

Adequate irrigation helps in rapid growth of the plant and also to obtain regular flower yield. At the time of planting, the crop has to be irrigated twice a week and later irrigation is to be provided at 7-10 days interval based on climate and soil conditions for initial growth. During dry period irrigation should be given at shorter intervals and also during the flowering stages which results in more flower and also encourage better plant development.

INTERCULTIVATION

Weeding, application of fertilizer and earthing up are combined together and done simultaneously for easy operation. Weeding once or twice may be done during the first two months. Spray Diuron (pre-emergence) @ 2.5 kg a.i./ha for controlling the weeds.

5. HARVESTING

Flowering: Crossandra comes to flowering 2-3 months after planting and continues to bear flowers throughout the year with a drop in production during the rainy season. The flowers open in sequence from the base of the spike. Two flowers which are diagonally opposite in the spike, open at the same time. It takes about two days for complete opening of the flower plant.

Method of Harvesting: Crossandra flowers within two to three months after planting and continues to bear flowers throughout the year with a lean production during rainy months. Flowers are to be picked early in the morning by pulling the corolla out of the calyx. Flowers will be available for picking for six months in a year. Harvesting of flowers is to be done on alternate days.

Stages of Harvesting: The flowers open in sequence from the base of the spike. Two flowers which are diagonally opposite in the spike open at the same time. It takes two days for complete opening of flower. It takes nearly 15-25 days to complete flowering on a spike.

Yield of Flowers: Crossandra flowers within 2-3 months after planting and continues to bear flowers throughout the year with a lean production season during rainy months. Fully opened flowers are to be picked early in the morning by pulling the corolla out of the calyx. At each picking, a yield of 5-7 kg of flowers will be obtained. After 6 months, about 200-280 kg of flowers per hectare/year will be obtained. 1500 flowers make one kilogram. Average yield of 2000 kg of flowers per hectare per year obtained from tetraploid varieties and 2800 kg of flowers per hectare per year in Delhi Crossandra. The crop can be retained in the field for about three years. After that it has to be removed as it would not be economical to keep it. An average yield of 2000 kg.

POST-HARVEST HANDLING

- 1) Handling for Domestic Local Market and Distant Markets
- 2) Local markets – flowers packed in gunny bags
- 3) Distance markets – Bamboo baskets

SHELF LIFE

The fully opened flowers remain fresh on the plant for about three days but when picked they fade away in 36-48 hours.

6. PLANT PROTECTION

MAJOR PESTS OF CROSSANDRA AND ITS MANAGEMENT

- A. **Brown Scale (*Saissetia nigra*), White scale (*Orthezia insignis*)** : Yellowish nymphs and dark brown adult scales are seen in large numbers under leaves and on petioles and stem. Severe infestation results in stunted growth and leaves turn yellow and drop. Honey dew secreted by *Orthezia* sp. Favours development of sooty mould which harms the plant growth.

Management: Removal and burning of infested portion of plants prevents further spread. Application of Carbofuran granules at 1 kg a.i./ha and spraying of dimethoate @ 2 ml/lit or acephate @ 1 gm/lit or Chlorpyrifos 0.05 % at fortnightly intervals.

- B. **Mealy bugs:** Nymphs and adults suck the sap and weaken the plants.

Management: Spray dimethoate @ 2 ml/lit or acephate @ 1 gm/lit.

- C. **White flies (*Lipaleyrodus* sp.)** : It occurs in large numbers on the under surface of leaves. It is prevalent during August-November and heavy infestation leads to chlorosis and development of sooty mould.

Management : Spray Dimethoate @ 2 ml/lit or Acephate @ 1 gm/lit or Phosalone 0.05% or Fenthion 0.05 % at fortnightly interval repeated twice.

- D. **Nematodes** : They are serious pests in crossandra. The affected plants shows brown to black coloured spots and lesions on the roots. In severe conditions, plants are stunted in growth and finally death occurs.

Management : They can be controlled by application of 4-5 quintals of neem cake per acre during last ploughing. At the time of planting apply Furadan granules 2 8-10 Quintals per acre.

- E. **Lesion nematode (*Pratylenchus delatrei*), Root-knot nematode (*Meloidogyne incognita*), Needle nematode (*Longidorus africanus*)** : Stunting of plants with pinkish to purple and yellow coloured leaves, reduction in inflorescence and flower size, retardation of root growth with brown to black spindle shaped lesions/galls, reduction in yield (22 %).

Management : Apply neem cake 2 kg/m² in nursery beds. Application of FYM and interplanting with marigold or pangola grass are helpful. Soil application of Carbofuran 2.5 kg/ha or neem cake 1t/ha.

7. MAJOR DISEASES OF CROSSANDRA AND ITS MANagements^{29,30}

- A. **Wilt (*Fusarium solani*)** : Wilt caused by *Fusarium solani* will result in yellowing of leaves and death of the plants. The incidence of the disease is found to be more in the presence of root lesion nematode.

Management: It can be controlled by application of phorate @ 1 g per plant. Water logged conditions are to be avoided.

- B. **Foot and Root rot (*Phytophthora nicotianae*)** : In young seedlings, symptoms appear as brown lesions on rootlets followed by rotting of the entire rootlet. On the collar region peculiar brown rot can be seen. The leaves show pink discolorations and drooping. In advanced stages of infection wilting of whole plant can be noticed.

Management: Growing seedlings in raised beds drenched with Captan, application of neem- cake to control nematode infestation, prophylactic application of Captaf as soil drench at the time of planting in the main field and application of Fosetyl Al as soil drench 2-3 times at monthly interval during monsoon season are effective.

- C. **Flower blight (*Alternaria* sp.)** : Drying up of flowers during winter months are symptoms. Young flowers fail to open on infection.

Management: Spray Mancozeb at fortnightly interval.

COMMON PESTS AND DISEASES

Crossandra plants typically don't have pest or disease problems. But they can be vulnerable to mealybugs, mites, and aphids. Signs of infestation include tiny webs on plants, clumps of white powdery residue, or visible insects on the plant. Treat infestations as soon as possible to prevent them from spreading to the rest of your collection. As always, start with the least toxic treatment option first, only progressing to harsher chemicals if your initial efforts fail.

PESTS AND DISEASES

Here are some issues that will prevent you from achieving good results when growing and caring for Crossandra. We also include solutions to each problem for your benefit.

DRY, CURLED LEAVES

This only means that the air is too dry or the sunlight is too strong. Move the plant to a spot with better protection and mist frequently.

BROWN SPOTS

These brown spots indicate that your Crossandra received cold watering. If this happens frequently, the plant will surely die.

POOR APPEARANCE OF LEAVES AND STEMS

Crossandra is a bushy plant and shows glossy leaves with the best care. If the plant shows otherwise, it may be due to overwatering. If the growth is stagnant and the leaves drop, the plant is too cold. Follow our advice and read more about providing the right temperature and humidity for your Crossandra plants.

ONLY TINY LEAVES DURING SPRING

You over-watered the Crossandra. Repot your plant and provide fresh soil.

MEALY BUGS

Mealy bugs can cause serious damage and must be eliminated immediately. Read our article on how to get rid of and control mealybugs.

APHIDS

This nuisance often appears on older orange marmalade plants. More in controlling and getting rid of aphids in our article. Crossandra plants may be sensitive to cold, but for as long as its growing requirements are met, you can ensure a great reward of brightly-colored blooms and foliage.

8. PLANT PROTECTION

- A. **Brown Scale (*Saissetia nigra*), White scale (*Orthezia insignis*)** : Yellowish nymphs and dark brown adult scales are seen in large numbers under leaves and on petioles and stem. Severe infestation results in stunted growth and leaves turn yellow and drop. Honey dew secreted by *Orthezia* sp. Favours development of sooty mould which harms the plant growth.

Management: Removal and burning of infested portion of plants prevents further spread. Application of Carbofuran granules at 1 kg a.i./ha and spraying of dimethoate @ 2 ml/lit or acephate @ 1 gm/lit or Chlorpyrifos 0.05 % at fortnightly intervals.

- B. **Mealy bugs:** Nymphs and adults suck the sap and weaken the plants.

Management: Spray dimethoate @ 2 ml/lit or acephate @ 1 gm/lit.

- C. **White flies (*Lipaleyrodos* sp.):** It occurs in large numbers on the under surface of leaves. It is prevalent during August- November and heavy infestation leads to chlorosis and development of sooty mould.

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- D. **Nematodes:** They are serious pests in crossandra. The affected plants shows brown to black coloured spots and lesions on the roots. In severe conditions, plants are stunted in growth and finally death occurs.

Management: They can be controlled by application of 4-5 quintals of neemcake per acre during last ploughing. At the time of planting apply Furadan granules 2.8-10 Quintals per acre.

9. LESION NEMATODE (*PRATYLENCHUS DELATREI*), ROOT-KNOT NEMATODE (*MELOIDOGYNE INCOGNITA*), NEEDLE NEMATODE (*LONGIDORUS AFRICANUS*) :

Stunting of plants with pinkish to purple and yellow colored leaves, reduction in inflorescence and flower size, retardation of root growth with brown to black spindle shaped lesions/galls, reduction in yield (22 %).

Management: Apply neem cake 2 kg/m² in nursery beds. Application of FYM and interplanting with marigold or pangola grass are helpful. Soil application of Carbofuran 2.5 kg/ha or neem cake 1t/ha.

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