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Production Technology of Annual Chrysanthemum (*Glebionis coronaria* L. Spach): A Profitable Loose Flower Crop for Floriculture

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Abstract

Annual chrysanthemum (Glebionis coronaria L. Spach), formerly known as Chrysanthemum coronarium L., is an important loose flower crop widely cultivated in India for garland making, religious offerings, landscaping and ornamental purposes. Owing to its short duration, adaptability to diverse agro-climatic conditions, profuse flowering habit and low cultivation cost, the crop has gained considerable commercial importance in recent years. This article presents a comprehensive review of the production technology of annual chrysanthemum based on published scientific research and thesis work. The crop thrives best under mild climatic conditions with temperatures ranging from 15–25°C and performs well in fertile, well-drained sandy loam soils rich in organic matter. Seed propagation remains the most economical and commercially accepted method of cultivation. Research findings indicate that optimum planting during October–November, appropriate spacing, timely pinching, balanced nutrient management and integrated use of biofertilizers significantly enhance growth, flowering and yield. Application of recommended fertilizer doses along with beneficial microorganisms such as Azotobacter, phosphate-solubilizing bacteria and Bacillus subtilis, as well as organic formulations like Jeevamrit, has shown promising results in improving flower production and soil health. Proper irrigation, weed management and integrated pest and disease management practices are essential for sustainable cultivation. Under recommended production practices, annual chrysanthemum can produce 15–20 t ha^{-1} of loose flowers and offers attractive economic returns to growers. With increasing demand for loose flowers and environmentally sustainable production systems, annual chrysanthemum has emerged as a profitable and versatile crop for modern floriculture enterprises.

Keywords: Annual chrysanthemum, Biofertilizers, Disease management, Flower yield, Integrated nutrient management, Jeevamrit

Introduction

Annual chrysanthemum (*Glebionis coronaria* L. Spach), formerly known as *Chrysanthemum coronarium* L., is one of the most attractive annual flowering plants cultivated for loose flowers, landscaping, garland making, religious offerings and ornamental purposes. It belongs to the family Asteraceae and is widely grown throughout India under diverse agro-climatic conditions. The crop is valued for its profuse flowering, adaptability, ease of cultivation and comparatively low production cost. In recent years, the demand for annual chrysanthemum flowers has increased considerably due to expanding floriculture activities, urban landscaping and the religious flower market. In India, it has become naturalized and is known by different local names: 'Bijli' in Nagpur (Meshram *et al*., 2008), 'Baboona' in Haryana (Mishra *et al*., 2002), 'Guldhak' in Punjab, 'Market' in Delhi and 'Gendi' in parts of Uttar Pradesh (Arora, 1990).It is replacing the production of chrysanthemum in many areas of the country and is occupying an area of about five per cent of total area under chrysanthemum mainly in the states of Maharashtra (Ahmednagar and Pune), Karnataka (Bangalore, Dharwad, Belgaum, Hosur and Malur), Bihar (Madhupur and Deoghar districts), Madhya Pradesh (Indore, Ratlam and Ujjain), Punjab,

Haryana, Uttar Pradesh. Research conducted at the University of Horticulture and Forestry, Nauni; University of Agricultural Sciences, Dharwad; Punjab Agricultural University, Ludhiana; and other institutions has helped standardize production technologies for higher flower yield and quality.

Importance and uses

The plant is a good source of essential minerals and vitamins, containing about 610 mg of potassium per 100 g and around 3.4 g of carotene in its edible parts. It is generally utilized as a leafy vegetable in oriental cookery; its leaves are steamed or boiled and used as greens especially in Chinese cuisine. Flowers are edible and fresh or dried petals are used to garnish or to brew tea. Annual chrysanthemum was believed to have protective power against witches and enchantment (provided the plant was taken out of the ground before sunrise and secured round one's body and neck). It is economically important as a natural source of insecticide. The flowers are pulverized and an active component called pyrethrin is extracted and used in insecticidal preparation and it is used as trap crop to trap some lepidopteran pests.

When *Chrysanthemum coronarium* is applied as a green manure to the other crops noticed that it is very effective in controlling the root-knot nematodes (*Meloidogyne incognita* and *Meloidogyne javanica)*. Its nematicidal activity also found effective on *Heterodera avenae* and *Pratylenchus mediterraneus,* but it was not fatal to the beneficial entomopathogenic nematode, *Steinernema feltiae* (Bar *et al*., 2006). Plant parts were more effective than flowers. The crop retains the nematicidal activity even when applied as dried material. In addition, the plant has various antioxidants in stem, leaf and root tissues which have potential long-term benefits on human health.

Annual chrysanthemum is primarily cultivated for loose flowers used in garlands, floral decorations, bouquets, religious ceremonies and social functions. The flowers are attractive, long-lasting and available in white and yellow colors. The crop is also widely utilized in landscape gardening for bedding, borders, edging and mass planting. Young leaves and tender shoots are edible and are consumed as leafy vegetables in several Asian countries. The species possesses medicinal properties and has been reported to contain bioactive compounds with antioxidant and antimicrobial activity. Due to its extended flowering period and suitability for both commercial and home gardens, annual chrysanthemum has become an important component of the floriculture industry.

Botanical description

Annual chrysanthemum (*Glebionis coronaria* (L.) Cass. ex Spach) belongs to the family Asteraceae. The genus comprises two major species i.e. *G. coronaria* and *G. segetum*, both are diploid species with a chromosome number of 2n = 18. Among them, *G. coronaria* is the commercially important species cultivated for loose flower production in India. *G. segetum* is a herbaceous annual plant growing to 80 cm tall,


Glebionis coronaria


Glebionis segetum

with spirally arranged, deeply lobed leaves 5–20 cm long. The flowers are bright yellow, produced in capitula (flowerheads) 3.5-5.5 cm in diameter, with a ring of ray florets and a center of disc florets. *G. coronaria* grows up to the height of a meter with five to twenty-three branches bearing the finely cut, bipinnately lobed aromatic leaves and it is propagated through seeds. The inflorescence is capitulum or flower head which consists of yellow or white ray florets which are usually female and the central 2-3cm disc florets are bisexual flower. It bears flowers of yellow and white shaded single, semi-double or double forms with cream zones at the center which varies in size from 2.5-6 cm diameter. It is different from the chrysanthemum (*Dendranthema grandiflora*) in several aspects *viz*., it is short duration crop generally of 3-4 months, grows much taller, photo-insensitive, vigorous, hardier and can grow in all seasons.

Origin and distribution

Glebionis coronaria is native to the Mediterranean Basin, particularly the coastal regions of southern Europe, North Africa and western Asia. It is believed to have originated in the eastern Mediterranean region, where it has been cultivated and utilized since ancient times as both an ornamental plant and a leafy vegetable. The species is now widely distributed throughout temperate and subtropical regions of the world. It has been introduced and naturalized in many countries due to its ornamental and culinary value. It is cultivated in Southern Europe (Spain, Portugal, Italy, Greece, Cyprus), North Africa (Morocco, Algeria, Tunisia, Libya, Egypt), Western and Central Asia (Turkey, Syria, Lebanon, Israel), East Asia (China, Japan, Korea), South Asia (India, Pakistan, Bangladesh, Nepal), Australia and New

Zealand and North and South America as an introduced ornamental species. In India, *G. coronaria* is cultivated extensively in states such as Karnataka, Tamil Nadu, Telangana andhra Pradesh, Maharashtra, Punjab, Himachal Pradesh, Haryana, Uttar Pradesh and West Bengal for loose flower production and landscaping purposes.

G. segetum originated in the western and central Mediterranean region and is distributed throughout Europe, North Africa and other temperate parts of the world, where it occurs primarily as an ornamental plant and naturalized wildflower. Both species have adapted successfully to a wide range of climatic conditions outside their native Mediterranean habitat.

Varieties

There are limited varieties developed in annual chrysanthemum, but the Indus company developed two open pollinated varieties such as 'Shubra' (White double type flowers) and 'Yellow Moon' (Yellow double type flowers). Some of the listed cultivars in the research conducted at different institutes were listed here, 'White Majestine', Sarpan White', 'Sarpan Yellow', 'Dharwad White', 'Dharwad Yellow' and Garden Aid (Shwetha, 2022).

1. Shubra: Produces double type flowers of White/Cream White color. Size of the flower will vary from 6-10 cm and flowers 35-40 days after transplanting.

2. Yellow Moon: Produces compact ball-shaped flowers of Lemon-Yellow color. The size of the flower ranges from 7-8 cm and it is a high yielding variety.

Climate

The crop performs best under mild climatic conditions with ample sunshine. It can be grown throughout the year in many parts of India; however, winter cultivation produces superior flower quality and yield. Temperatures ranging from 15–25°C are considered ideal for vegetative growth and flowering. Studies have shown that planting during November resulted in better vegetative growth, flower production and flower quality compared with later plantings (Kumar *et al*., 2025; Sharma *et al*., 2015).

Soil

Annual chrysanthemum grows well in fertile, well-drained sandy loam to loam soils rich in organic matter. The ideal soil pH ranges from 6.0 to 7.5. Waterlogged conditions should be avoided as they adversely affect root growth and flowering.

Propagation

Annual chrysanthemum (*Glebionis coronaria* L. Spach, synonym *Chrysanthemum coronarium* L.) is propagated exclusively through seeds. Unlike perennial florist's chrysanthemum (*Chrysanthemum × morifolium*), which is commonly propagated through stem cuttings and suckers, annual chrysanthemum is a true annual crop that completes its life cycle within a single growing season and produces abundant viable seeds suitable for commercial cultivation. The seeds of annual chrysanthemum (*Glebionis coronaria* L. Spach, syn. *Chrysanthemum coronarium* L.) are actually dry, indehiscent fruits known as cypselae, a characteristic feature of the family Asteraceae. The seeds are elongated to oblong in shape, slightly compressed and greyish-brown to dark brown in color when fully mature. They possess longitudinal ridges on the surface and are relatively larger than those of many other ornamental annuals. The average seed size ranges from 5 to 8 mm in length, although slight variations occur among cultivars and flower types.

Seeds are sown either directly in the field or, more commonly, in raised nursery beds for transplanting. For large-scale cultivation, nursery raising is preferred because it ensures better germination, uniform seedling growth and efficient utilization of seeds. A seed rate of about 1.0–1.5 kg per hectare is generally sufficient for loose flower production (Rao, 2010). The nursery beds should be prepared with fine, well-drained soil enriched with well-decomposed farmyard manure. Seeds are sown shallowly in rows, lightly covered with fine soil or sand and irrigated gently. Under favorable conditions of temperature (20–25°C) and adequate moisture, germination begins within 5–7 days and is usually completed within 10–15

days.

The seedlings become ready for transplanting approximately 25–35 days after sowing when they attain a height of 8–10 cm and develop 4–6 true leaves. Transplanting is generally carried out during the cooler hours of the day, followed by immediate irrigation to ensure proper establishment. Healthy, disease-free seedlings should be selected for planting in the main field. Although direct seeding is possible, transplanted crops generally exhibit better plant stand, uniform growth and higher flower yield.

For seed production, selected healthy plants with desirable flower characteristics are maintained until seed maturity. The flower heads are harvested when they turn brown and dry. After drying, the seeds are extracted, cleaned and stored under cool and dry conditions. Properly stored seeds retain good viability for about 1–2 years and can be used for subsequent planting seasons.

Thus, seed propagation remains the simplest, most economical and commercially accepted method for the cultivation of annual chrysanthemum, making it a suitable crop for both small-scale and large-scale flower growers.

Land preparation

The field should be ploughed 2–3 times to obtain a fine tilth. Well-decomposed farmyard manure (FYM) at 20–25 tonnes per hectare should be incorporated during the final land preparation. Raised beds facilitate proper drainage and ease of intercultural operations.

Manure and fertilizers

Proper nutrient management is very important in annual chrysanthemum cultivation. Deficiency of nutrients results in poor growth and flowering. Annual chrysanthemum (*Glebionis coronaria* L. Spach) responds remarkably well to adequate and balanced nutrition, which is essential for vigorous vegetative growth, profuse flowering and higher flower yield. The crop grows best in fertile, well-drained soils rich in organic matter. During land preparation, 20–25 tonnes of well-decomposed farmyard manure (FYM) or compost per hectare should be incorporated into the soil to improve its physical condition, water-holding capacity and nutrient availability. Research conducted on annual chrysanthemum has demonstrated that the application of 150 kg nitrogen, 100 kg phosphorus (P_2O_5) and 100 kg potassium (K_2O) per hectare significantly enhances plant growth, flower production and seed yield. The entire dose of phosphorus and potassium along with half of the nitrogen is applied as a basal dose at the time of transplanting, while the remaining nitrogen is top-dressed about 30–40 days after transplanting to support active vegetative growth and flower bud development (Rao, 2010). Recent studies showed that drenching the *Bacillus subtilis* resulted in better performance of plants for growth and yield attributes similar to the RDF (Lohia *et al*., 2025). Therefore, *Bacillus subtilis* was identified as an effective eco-friendly biofertilizer capable of reducing dependence on chemical fertilizers and supporting sustainable commercial flower and seed production in annual chrysanthemum. Drenching annual chrysanthemum with Jeevamrit at the rate of 35% at 15-day intervals is an effective eco-friendly alternative to chemical fertilizers. It produced high-quality seeds and vigorous seedlings, maintained soil nutrient status comparable to RDF and substantially enhanced beneficial soil microorganisms. Therefore, Jeevamrit at the rate of 35% can be recommended as a sustainable and cost-effective biofertilization strategy for annual chrysanthemum cultivation, improving both crop performance and long-term soil health (Lohia *et al*., 2024).

Recent studies have also highlighted the benefits of integrated nutrient management (INM), wherein biofertilizers such as *Azotobacter* and phosphate-solubilizing bacteria (PSB) are used in combination with chemical fertilizers. The application of *Azotobacter* and PSB along with 75% of the recommended fertilizer dose has been reported to improve nutrient uptake, increase flower yield, prolong flowering duration and enhance soil fertility (Lohia, 2021). Therefore, the combined use of organic manures, chemical fertilizers and biofertilizers is recommended for achieving sustainable and profitable production of annual chrysanthemum. A study showed that spraying a 0.5% micronutrient mixture (Fe 2.5%, Zn 3%, Mn 1% and B 0.5%) at 20 and 40 days after transplanting proved most effective for enhancing growth, promoting early flowering and maximizing flower yield (Vasudev and Naik, 2025).

Planting

Planting is a critical operation in the successful cultivation of annual chrysanthemum (*Glebionis coronaria* L. Spach). The crop is generally established through transplanting healthy seedlings raised in nursery beds. Seedlings become ready for transplanting about 25–35 days after sowing, when they attain a height of 8–10 cm and develop 4–6 true leaves. Transplanting is usually carried out during the cooler hours of the day, preferably in the evening, to minimize transplanting shock and

ensure better establishment. Before transplanting, the field should be thoroughly prepared and enriched with well-decomposed farmyard manure. The seedlings are carefully uprooted from the nursery, retaining a small ball of soil around the roots and planted at the same depth at which they were growing in the nursery. Immediate irrigation after transplanting helps in rapid root establishment and reduces seedling mortality.

The optimum planting time varies with the agro-climatic region; however, planting during October to November is generally considered ideal for winter flowering in most parts of India. Research studies have shown that November planting results in better vegetative growth, increased branching, earlier flowering and higher flower yield compared with delayed planting. Appropriate spacing is also important for proper plant growth and flower production. A spacing of 45 × 45 cm is commonly recommended for loose flower production, while wider spacing of 50 × 50 cm promotes greater plant spread, more branches and higher flower yield per plant. Proper planting time and spacing ensure efficient utilization of sunlight, nutrients, moisture and air circulation, thereby contributing to improved flower quality and overall crop productivity.

A study revealed that planting annual chrysanthemum during the second week of November is most suitable under Punjab conditions. For superior vegetative growth, flower quality and yield per plant, a spacing of 60 × 60 cm (4 plants m^{-2}) is recommended. However, for commercial cultivation aimed at maximizing flower and seed yield per unit area, 60 × 30 cm spacing (9 plants m^{-2}) is more advantageous (Kumar *et al*., 2025). A study demonstrated that wider spacing enhanced vegetative growth, whereas a moderate spacing of 45 × 30 cm optimized flower production (Nagdeve *et al*., 2021).

Irrigation

Immediately after transplanting, light irrigation should be provided. Subsequent irrigations should be scheduled at 7–10 days intervals depending upon soil type and weather conditions.

Critical stages for moisture availability include:

- Establishment stage
- Bud initiation stage
- Peak flowering stage

Excess irrigation should be avoided to prevent root diseases.

Weed management

Two to three hand weedings are generally sufficient to keep the field weed-free. Earthing up after weeding improves root development and plant anchorage.

Pinching

Pinching is an important cultural operation in annual chrysanthemum. Removal of the terminal growing point about 25–30 days after transplanting encourages lateral branching, resulting in increased flower production and improved plant architecture. Research on production technology standardization confirmed the positive role of pinching in enhancing yield and flower quality. Recent studies showed that double pinching (30 and 45 days after transplanting) significantly improved vegetative growth and flower yield. It produced the highest number of primary branches, maximum plant spread, highest flower weight per plant, flower yield per plot and flower yield per hectare but delayed the flowering compared to single pinched plants and plants which were not pinched (Jena *et al*., 2025). A study demonstrated that pinching improved branching and yield, with pinching at 30 days after transplanting proving most beneficial for flower production. Overall, the combination of 45 × 30 cm spacing and pinching at 30 DAT was identified as the best treatment for maximizing loose flower yield in annual chrysanthemum (Nagdeve *et al*., 2021).

Plant protection

Diseases

1. Witches' Broom and Stunting

Recent reports have identified phytoplasma-associated witches' broom disease causing stunting, excessive branching and reduced flower production. Infected plants should be removed and vector control measures adopted.

2. Alternaria leaf spot

The disease is primarily caused by species of the fungus *Alternaria*, most commonly *Alternaria alternata* or related species. It occurs under conditions of high humidity, prolonged leaf wetness, poor air circulation and moderate temperatures. The disease can affect leaves, stems and occasionally flower stalks, leading to reduced plant vigor and flower yield. The initial symptoms appear as small, circular to irregular brown or dark-brown spots on older leaves. As the disease progresses, the spots enlarge and develop characteristic concentric rings, giving them a target-board appearance. Severely infected leaves turn yellow, dry up and may fall prematurely. In advanced stages, extensive

defoliation occurs, reducing photosynthetic activity and adversely affecting flower production and quality. The pathogen survives on infected plant debris and spreads through wind-borne spores, rain splash, irrigation water and contaminated plant material.

Effective management of Alternaria leaf spot involves an integrated approach. The crop should be planted at the recommended spacing to ensure good air circulation and rapid drying of foliage. Diseased leaves and crop residues should be removed and destroyed to reduce sources of infection. Overhead irrigation should be avoided, especially during evening hours, as prolonged leaf wetness favors disease development. Balanced fertilization should be practiced because excessive nitrogen encourages lush growth that is more susceptible to infection. Seed treatment with fungicides such as carbendazim (2 g kg^{-1} seed) can help reduce seed-borne inoculum. Upon appearance of symptoms, foliar sprays of fungicides such as Hexaconazole (5%) at 1 ml per liter, Propiconazole (25% EC) at 1 ml/l, mancozeb (0.25%), chlorothalonil (0.2%), copper oxychloride (0.3%), or a combination fungicide like carbendazim + mancozeb (0.2%) at 10–15 days intervals effectively suppress disease development. Adoption of good sanitation practices, proper irrigation management and timely fungicidal sprays can successfully minimize losses caused by Alternaria leaf spot and maintain healthy chrysanthemum crops.

3. Powdery mildew

Powdery mildew is a common fungal disease of annual chrysanthemum (*Glebionis coronaria* L. Spach) caused by fungi belonging to the genera *Golovinomyces* (formerly *Erysiphe*) and related powdery mildew pathogens. The disease is favored by moderate temperatures (20–30°C), high relative humidity, poor air circulation and crowded plant growth. Unlike many other fungal diseases, powdery mildew can develop even under relatively dry conditions when humidity is high.

The disease first appears as small white, powdery patches on the upper surface of leaves, young shoots and flower stalks. As the infection progresses, these patches enlarge and coalesce, covering large portions of the plant with a white flour-like growth. Severely infected leaves become yellow, curl, dry prematurely and may eventually fall off. Flower quality and yield are reduced due to impaired photosynthesis and weakened plant growth.

Management of powdery mildew involves the adoption of integrated disease management practices. Plants should be maintained at the recommended spacing to improve air circulation and reduce humidity around the canopy. Excessive nitrogen fertilization should be avoided, as it promotes succulent growth that is more susceptible to infection. Infected plant parts should be removed and destroyed to reduce the spread of the pathogen. At the onset of disease, fungicidal sprays such as wettable sulphur (0.2–0.3%), hexaconazole (0.1%), propiconazole (0.1%), difenoconazole (0.05%), or tebuconazole (0.1%) may be applied at 10–15 days intervals depending on disease severity. Regular monitoring of the crop, proper field sanitation and timely fungicide application are effective in controlling powdery mildew and maintaining healthy annual chrysanthemum plants.

Insect Pests

Common insect pests include Aphids, Thrips, Mealy bugs and Leaf miners. Annual chrysanthemum (*Glebionis coronaria* L. Spach) is attacked by several insect pests that reduce plant vigor, flower quality and marketable yield. The most important pests include aphids, thrips, leaf miners, caterpillars and mites. Effective pest management is achieved through an integrated pest management (IPM) approach that combines cultural, biological and chemical methods.

1. **Aphids** (*Aphis gossypii*, *Macrosiphoniella sanborni*) are among the most common pests. They suck sap from tender shoots, leaves and flower buds, causing curling, yellowing and stunted growth. They also excrete honeydew, which encourages the development of sooty mold.
2. **Thrips** (*Thrips tabaci* and other species) feed on leaves and flowers, producing silvery streaks, distorted petals and reduced flower quality.
3. **Leaf miners** create serpentine tunnels within leaves, reducing photosynthetic area, while caterpillars feed on foliage and flower buds.
4. **Spider mites** become problematic during hot and dry weather, causing yellow speckling, bronzing and premature leaf drop.

For effective management, fields should be kept free from weeds and crop residues that serve as alternate hosts for pests. Healthy seedlings should be used for planting and regular field monitoring should be carried out to detect infestations at an early stage. Yellow sticky traps can be installed for monitoring and partial

control of aphids and thrips. Conservation of natural enemies such as ladybird beetles, lacewings and parasitic wasps helps suppress pest populations naturally.

When pest populations exceed economic thresholds, need-based insecticide applications may be adopted. Aphids and thrips can be effectively managed by spraying imidacloprid 17.8 SL at 0.3 ml L^{-1}, thiamethoxam 25 WG at 0.25 g L^{-1}, or acetamiprid 20 SP at 0.2 g L^{-1} of water. Leaf miners may be controlled with neem-based formulations or suitable systemic insecticides, while caterpillars can be managed using biological insecticides containing *Bacillus thuringiensis* (Bt) or other recommended insecticides. For mite infestations, acaricides such as propargite or spiromesifen may be applied as per label recommendations. Sprays should be rotated among different modes of action to minimize the development of resistance.

Thus, timely monitoring, field sanitation, conservation of beneficial insects and judicious use of pesticides form the basis of sustainable pest management in annual chrysanthemum, ensuring healthy crop growth and high-quality flower production.

Flowering and harvesting

Flowering generally commences 70–90 days after transplanting depending upon cultivar and season. Flowers are harvested when fully open but fresh. Loose flowers should preferably be harvested during early morning hours and immediately transferred to shaded conditions to maintain freshness.

Yield

Under good management practices, annual chrysanthemum produces:

- 15–20 tonnes of loose flowers per hectare
- 10–15 quintals of seed per hectare under seed production programs

Research trials have reported more than 170 flowers per plant and flower yields approaching 490 g per plant under integrated nutrient management practices (Chandel, 2018; Chandel *et al*., 2020).

Economic importance

Annual chrysanthemum is a highly remunerative crop due to:

- Low production cost
- Short crop duration
- Continuous flowering
- Strong demand for garlands and religious offerings
- Suitability for landscaping and bedding purposes

The crop offers attractive returns to small and medium-scale flower growers and can be effectively integrated into diversified floriculture enterprises.

Conclusion

Annual chrysanthemum is an economically important loose flower crop with immense commercial potential in India. Adoption of scientific production technologies, including optimum planting time, appropriate spacing, integrated nutrient management, biofertilizer application, pinching and efficient irrigation management, can substantially enhance flower yield and quality. Recent research indicates that integration of Azotobacter, PSB, PGPR and reduced fertilizer doses not only improves productivity but also promotes sustainable floriculture by improving soil health. With increasing demand for loose flowers and eco-friendly production systems, annual chrysanthemum is poised to become a profitable component of modern floriculture enterprises.

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