Eco. Env. & Cons. 30 (2) : 2024; pp. (790-795)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i02.061

A Newly Emerging Potential Cut Flower of Lisianthus (*Eustoma grandiflorum*) in Tamil Nadu: A Review

M. Kumaresan*, M. Rajaselvam, K. Nadhiya Devi[3] and S.S. Vasanthkumar[4]

[1]School of Agriculture, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai, Tamil Nadu, India
[2,3]Adhiparasakthi Horticultural College, G.B. Nagar, Kalavai, Ranipet, Tamil Nadu, India
[4]Department of Plantation, Spices, Medicinal and Aromatic crops, Horticultural College and Research Institute, Periyakulam, Tamil Nadu, India

(Received 16 October, 2023; Accepted 6 December, 2023)

ABSTRACT

Lisianthus, botanically known as *Eustoma grandiflorum*, is a member of the Gentianaceae family with a chromosome number of 2n = 36. It is native to the eastern slope of the Rocky Mountains in the United States and is referred to as the prairie gentian. Lisianthus is an herbaceous annual plant that can reach up to a height of 15 to 60 cm and has slightly succulent, bluish-green leaves. It produces funnel-shaped flowers that grow on long, straight stems. The flowers can occasionally grow upright on solitary stems or on branching stems. The flowers come in a range of hues and can go up to two inches in diameter. Lisianthus sepals are significantly smaller than petals and are only united toward the base. It comes in a variety of cultivars with varied patterns of colours. Lisianthus has gained widespread consumer appeal worldwide due to its exceptional keeping quality and a wide range of colours, including purple, rose, pink, white, and bicolour. Owing to its blue flowers, excellent post-harvest life, and rose-like blooms, lisianthus is a relatively new floral crop on the international market and is considered one of the top ten cut flowers. Leading nations that are producing Eustoma are Japan and New Zealand. A single type dominated the marketplaces in America, Europe, and Japan. Double types are preferred more in Australia. In Tamil Nadu, the lisianthus flower has just recently bloomed. It is now possible to produce lisianthus on a modest scale in Tamil Nadu.

Key words: *Lisianthus, Eustoma grandiflorum, Cut flower, Nilgiris and Cultivation Practices*

Introduction

Eustoma grandiflorum (Raf.) Shinners (syn. *Lisianthus russelianus*), also called Texas blue bell, Prairie gentian, Lisianthus, Tulip gentian, blue bells, or Lira de San Pedro, is an annual herbaceous species that is intriguing as a new species for the cut flower market (Pertwee, 2000). The biological definition of Lisianthus, Eustoma, originated in ancient Greece. Prefix Eu means beautiful, and stomameans mouth or a shape like a mouth. However, as lysisin Greek indicates dissolution and Anthos denotes flower, the word lisianthus means a dissolving flower. It's used as a bedding plant, and flowering potted plants are equally widespread. Lisianthus is an annual herbaceous plant that has huge funnel-shaped flowers on long, straight stems and slightly succulent, bluish-green leaves. The base of the stem is monopodial, and it branches apically. The majority of cultivars that are sold commercially have stems that are 50–75

([1]Assistant Prof. (Horticulture), [2,3]Assistant Prof. (Horticulture), [4]M.Sc. Scholar)

cm long. Lisianthus plants have multibranched stems with several flower buds that emerge in succession. Since there are multiple flower buds on a stalk, some flowers continue to open for several more days after they open, and each flower lasts for more than a week beyond that. Luxurious blooms have been produced by lisianthus with two or even three petals. According to Ruffoni and Savona (2006) a single flower can last two weeks, while the entire plant can continue to bloom for up to five weeks. The ideal temperature for young plants is 20 ^{0}C at planting and during the growing season its need temperature of 26 ^{0}C / 18 ^{0}C (day/night) also need high light. The crop needs soil that is free-draining, very light, has a high level of organic matter, and has a pH range of 6-7.

Lisianthus is a relatively new flower species that has been introduced to the global market and, more recently, the Indian market. It was originally made available in Japan in 1933, and in 2001, more than 129 million stems were sold, making it the most popular cut flower. It is one of the top 10 cut flowers in Europe, and its appeal as a bedding plant and pot plant is only increasing in the United States in addition to its cut flower popularity. Its blue blossoms, good post-harvest life, and rose-like flowers are making it more and more popular in the global floral market.

The introduction of good cultivars in a wide range of colours, both in single and double forms, has helped to significantly boost the production of lisianthus in recent years (Reid, 2000). In India, lisianthus is a relatively new flower for cut flowers. The quiet center of the Nilgiris district, also referred to as "The Queen of Hill Stations," in Tamil Nadu, region's climate condition is suitable for the successful cultivation of this flower crop. Lisianthus production in Tamil Nadu is cantered in a small area in the hill stations of Kodaikanal and Ooty.

Varieties

Double flowered cultivars viz., Bolero White, Minuet Dark Purple, Art Marine, Art Peach, Shallot Green, Purple Flamingo, Nightingale, Papillon Rose Pink, Gavotte Yellow, Echo Lavender, Echo Pink and Blue Picotee. Anitha *et al*., 2019 reported that the three cultivars, viz., 'Echo Pink', 'Blue Picotee', and 'Bolero White', were found to be best in Nilgiris for commercial cultivation as cut flowers.

Environmental condition

Temperature

Lisianthus can be grown in shade net, climate-controlled greenhouses, open fields, naturally ventilated polyhouses, and inexpensive polytunnels that merely protect the plants from adverse environmental conditions. It grows well in a temperate climate and can be planted between 1,000 and 1,800 meters above mean sea level. The ideal day and night temperatures should be maintained between 20–24 °C and 16–18 °C, respectively, for improved growth and high-quality flower production. Certain Lisianthus cultivars have heightened susceptibility to elevated temperatures, potentially leading to early flowering or rosetting. In vulnerable types, higher temperatures (over 28 °C) during the first four weeks of transplanting can cause rosetting. Avoiding high humidity levels is advised. Maintain nighttime temperatures 4 °C lower than daytime temperatures. While a lower growth temperature might increase stem strength and caliper, it also hinders plant development and significantly lengthens the harvest period.

Light

A light source of 4,000 to 6,000 footcandles is ideal for lisianthus blooms. High light intensities may cause plants to generate more florets, but they may also cause the colours of the flowers to become less vibrant. Shade is preferred in the field during periods of high light intensity. If a stem is shaded, its diameter and floret count decrease. According to Harbaugh *et al.* (1995), Eustoma's photoperiodic response varies according to the cultivar; the majority of cultivars are facultative long-day plants, but a small number are nearly day-neutral or obligate long-day plants. It has also been demonstrated that high light intensity shortens the flowering time (Islam *et al*., 2005). According to Harbaugh and Scott (1999), higher temperatures at the seedling stage (up to 4-5 true leaf pairs) cause rosette development and delay bolting (Ohkawa *et al*., 1994). Harbaugh (1995) mentions that longer days can expedite the end stages of stem elongation and flower bud initiation and development.

Propagation

Seed

The primary method of Lisianthus propagation is by

seed. Under appropriate environmental circumstances, seeds can be sown in hilly places between mid-December and February. Lisianthus seeds are extremely tiny, at 19,000 seeds per gram, and the growth of the seedlings is incredibly sluggish. Plug seedlings should be bought from commercial nurseries due to these reasons. The majority of seed firms selling this flower crop in markets are selling pelleted seeds. Before planting, seeds can be put in pots, 392 or 406 cell plug trays, or seedlings can be moved into 48-cell trays to continue growing. After sowing, don't cover the seeds. Covering seeds with soil or germination media can inhibit their ability to germinate. Maintain the air temperature between 18 and 21 °C (night) and 21 and 24 °C (day) during the seedling period. Fertilization is crucial because the first stages of seedling development are quite slow. After thirty days of sowing, the seedlings should be treated once a week with liquid water-soluble fertilizers such as calcium nitrate (1.5 g/l) and NPK (19:19:19) at a rate of 1 g/l. Just enough water should be added to keep the young seedlings moist.

The lisianthus minuscule seeds exhibit a poor germination rate (between 34 and 39%) Arpana *et al*. (2012) and in certain instances, the heterozygous characteristics of seed-derived plants result in a broad range of plants with an extended flowering period exceeding 4.5 months.

Vegetative methods

The other techniques for propagating this crop are micro-propagation and vegetative propagation using rooted cuttings (Rezaee *et al*., 2012)

Micropropagation

For lisianthus shoot regeneration and proliferation rate, the best media combination of plant growth regulators is 0.10 mg l^{-1} 2,4-D plus 5.00 mg l^{-1} BAP. The callus that was dedifferentiated from the explant produced these enormous quantities of shoots. 0.10 mg l^{-1} 2,4-D was the most effective medium for shoot length (Kaviani *et al*., 2018). According to Shintiavira *et al*. (2015), the more shoot growth is produced by Murashige and Skoog (MS) medium supplemented with 10 mg l^{-1} Gibberellic acid, the more roots are produced by MS medium supplemented with 2.0 mg l^{-1} indole-3-acetic acid (IAA) and 1 mg l^{-1} activated charcoal (AC).

Field preparation

The most crucial step in the production of Lisianthus is preparing the soil before planting. It should be planted in soil that is free of diseases. Diseases carried by the soil can easily affect Lisianthus. It is advised to sterilize soil using formaldehyde. Apply formaldehyde as a spray or soil drench, then cover the bed right away with polythene sheeting for a period of seven days. Give the soil another six to eight days to aerate after removing the plastic cover. One week before planting, the planting beds should be thoroughly irrigated to get rid of any pesticide residue. For soil disinfection, further options include soil solarization, methyl bromide (25–30 g/m^2), or basamid/dazomet (30g/m^2).

pH

The pH of the soil needs to be kept between 6.5 and 7.2 for effective cultivation. A pH of 6.5 or more might weaken the colour intensity of flowers, while a pH of less than 6.0 can be harmful. In addition to weak stems and poor development, low pH can cause zinc poisoning. Maintaining the soil EC at 1.5 mm/cm is recommended. For growth, it also needs a lot of calcium and enough phosphorus. Before planting, add calcium and phosphorus and adjust the pH. In vulnerable types, high salt levels might cause a delay in flowering and encourage rosetting.

Planting

The seedlings are transplanted in the main field 8–12 weeks (65–80 days) after seed sowing. It is appropriate to cultivate seedlings that have four to five pairs of true leaves. Before they become root-bound, seedlings need to be moved. The stem quality of the mature plant will decline as a result of any growth restrictions during the seedling stage.

Planting density

The lighting conditions determine the planting density. It is advised to grow at densities of 64 to 96 plants per m^2. In regions with abundant light, the average planting density is 84 plants per m^2 or more. Nonetheless, 64 plants per m^2 should be planted in low-light situations. Growers can use summer plants at a higher density and winter plantings at a lower density in places with varied light levels. The plant spacing of 30 cm × 25 cm is the most optimum spacing for the better growth, quality, and yield attributes of Lisianthus production (Husna *et al*., 2022).

Fertilizers

Lisianthus is a strong feeder that thrives in soil that has high levels of fertility. Good growth necessitates high fertilization rates of both potassium and nitrogen. It is advised to fertilize with a 15:0:15 N: P: K fertilizer for better growth of lisianthus. Potassium should be the same as nitrogen, with nitrogen being applied primarily in the nitrate form. It is advised to fertilize with liquid fertilizer at 200 ppm N and K at each irrigation. A lack of calcium can lead to weak stems, bud abortion, and tip burn in early leaves. If the soil doesn't contain a lot of calcium, apply extra calcium throughout production. The Ca concentrations of 150 mg/l stimulated the greatest number of branches within 3 cm of the plant base and chlorophyll content, while increasing Ca concentrations increased the number of buds and shoot dry weight. The plants grown in a medium including peat, vermiculite, sand, and perlite with fertilizer amendments (20-8.8-16.6, NPK) are best suited for cultivation. A weekly application of 1000–1500 mg N/l from a soluble complete fertilizer was shown to optimize growth and flowering (Frett *et al*., 1988).

Irrigation

The irrigation needs to be done carefully. Plants that receive excessive watering are more vulnerable to fungi that are spread through the soil. Conversely, early bloom initiation brought on by drought stress can produce short, feeble stems. In general, plants need less water in environments with reduced light and temperature. The majority of growers use overhead irrigation to establish the crop, then transition to drip irrigation once the roots have taken hold in the beds. Moreover, this crop benefits from overhead irrigation in times of intense light and heat. In areas with excessive heat and light, stem length can be increased in the greenhouse by increasing humidity with early afternoon irrigation. However, after buds have grown, stay away from high humidity and overhead irrigation since botrytis can develop.

Light and shade intensity

The essential element for the proper growth of Lisianthus is light. The growth, time, and quality of the flowers in this crop are greatly influenced by the amount of light and the duration of the day. For Lisianthus flowers, light levels between 4,000- and 6,000-foot candles are ideal. To grow a high-quality crop in areas with low light intensity, additional high-intensity lighting may be required. A larger bud count and healthy flower growth are encouraged by the increased light. However, intense light (more than 7,000 feet of candles) shortens Lisianthus stems. Adding shading can be necessary to lengthen the stem. Additional light, such as incandescent or HID, can be used in the winter months when days are shorter than twelve.

Pinching

After transplanting for 20–25 days, some growers carry out a single pinching. Pinching often results in shorter stems and postpones blossoming. Plants should be trimmed back f ollowing the initial picking to promote a healthy second flush. Support netting with one to two thicknesses (4 × 6 in./15 × 20 cm) is advised. The number of blooms on each plant was reduced, and the flower stalks were shortened when paclobutrazol was applied. The pinching technique results in an increase in the number of internodes, branches, nodes, and flowers per plant. Plants of lisianthus with thick branching and lots of flowers could have their height reduced by using double pinching techniques and using paclobutrazol eighteen days after planting.

The lisianthus cultivar Mariachi Blue suggested that single pinching combined with 150 ppm of GA_3

Table 1. Effect of pinching and growth regulators on flowering characters

Single pinching + GA_3 @ 150 ppm	Flower stem length (cm)	Number of flowers per plant	Kathari *et al*., 2019
	63.33	16.68	

Table 2. Effect of chemicals treatment on flower quality characters

Sucrose at 2.5%+ Salicylic acid at 200 mg l^{-1}+NaOCl 50 ppm	Physiological loss in weight	Membrane integrity	Vase life	Kathari *et al*., 2019
	21.70	21.68	21.92 days	

would produce favorable results in terms of stem length and flower productivity. Even though double pinching caused the plant to experience stress and produce more flowers, the quality of the blossoms was found to be worse.

Harvesting and Post-harvest

One or more open flowers indicate that the Lisianthus-cut flowers are ready to be picked. In the morning, when the plant and flower tissues are still cool, flowers should be picked. After harvesting the bunches, move them to buckets filled with water to eliminate the field heat. The ethylene sensitivity of Lisianthus is unknown. To extend the vase life of this flower, pulsing it with 10% sucrose for a full day following harvest has been documented. Depending on the cultivar, the vase life of cut Lisianthus might vary from 12 to 15 days.One of the key quality factors that determines a consumer's preference for a cut flower crop is vase life. Since the Eustoma inflorescence has a large number of flowers and buds, it is crucial to enhance its post-harvest performance, promote bud opening, and delay the open flower senescence. Cut Eustoma flowers have a short vase life (Cho *et al*., 2001).

Lisianthus flowers, when treated with a combination of sucrose (2.5%), salicylic acid (200 mg/l), and NaOCl (50 ppm), improve the floral quality and vase life (Kathari *et al*., 2019). Raquel *et al.*, 2018, reported that thecombination of SA and 1-MCP did not showed sufficient results to sustain carbohydrate levels. However, when applied alone, 1-MCP had a favorable effect to sustain carbohydrate levels, which will manifest in vase life. The best way to preserve the amount of carbohydrates in lisianthus vases is to keep them at an appropriate temperature.

Rosettes

Rosettes are plants with a cluster of leaves on the stem that have very short internodes. When young plants are being produced, high temperatures are the most prevalent cause of rosetting. The conditions during seed production can have an impact on a variety's susceptibility to rosetting. Rosetted plants will ultimately start to grow, although the quality of the stems is frequently diminished. Additionally, rosette plants require an excessive amount of time to flower, and the products are unsuitable for commercial production. Gibberellic acid (10–100 ppm) can be sprayed once or twice to encourage growth in plants that show signs of rosetting. Novelty series including Balboa, Catalina, and Avila have shown good resistance to rosetting.

Pest and diseases

Lisianthus crop is extremely damaged by aphids, thrips, whiteflies, red spider mites, and leaf miners. They serve as the viruses' vectors as well. The typical symptoms of viruses include mottling, chlorosis, yellowing of the leaves, and poor flowering. Thrips transfer the viruses that cause tomato spotted wilt and Impatiens necrotic spot; aphids spread the virus that causes bean yellow mosaic; whiteflies spread the virus that causes tomato yellow leaf curl; and people spread the tobacco mosaic virus. Starting a spray program as soon as the issue arises may swiftly eradicate the insect; however, managing a significant outbreak may be highly challenging.

Among the most often transmitted diseases in lisianthus are Botrytis blight, Downy mildew, Rhizoctonia stem rot, Pythium root rot, Fusarium crown and stem rot, and Fusarium wilt. The majority of these fungi cannot harm the plant if the soil is properly drained. A two-week application of captan (0.2%) and alternating dousing with dithane M-45 (2 g/l) and carbendazim (2 g/l) can avert fungal disease outbreaks.

Conclusion

Because of its flexibility and growing conditions, lisianthus may be suitable for extensive cultivation in the Nilgiris' regions. The review paper gives all the information related to cultivation practices and plant protection practices. The above information on lisianthus highly useful for the farming community as well as cut flower grower industries.

Conflict of Interest: None

References

Anithaa K., Selvaraj, N., Jegadeeswari, V. and Sharathkumar, M. 2019. Performance evaluation of lisianthus (*Eustoma grandiflorum* (Raf.) Shinn.) cultivars as an emerging cut flower under Nilgiri conditions. *Acta Hortic.* 1241: 41.

Arpana, M., Singh, M.K., Raja, R., Kumar, S., Prasad, R. and Ahuja, P.S. 2012. Effect of *in vivo* and *in vitro* seed germination and performance of *Lisianthus* seedlings. *Indian J. Hort*. 69: 136-139.

Cho, M.S., Gelikel, M.G., Dodgen and Reid, M.S. 2001. Socrose enhances the postharvest quality of cut flower of *Eustoma grandiflorum. Proc. 7th Int. Symp.*

Postharvest Physiology of Ornamentals Acta Hortic. 543:179-183.

Frett, J.J., Kelly, J.W., Harbaugh, B.K. and Roh, M. 1988. Optimizing nitrogen and calcium nutrition of lisianthus. *Communications in Soil Science and Plant Analysis*. 19(1).

Harbaugh, B.K. 1995. Flowering of *Eustoma grandiflorum* (Raf.) Shinn. cultivars influenced by photoperiod and temperature. *Hort. Science.* 30:1375-1377.

Harbaugh, B.K. and Scott, J.W. 1999. 'Florida Pink' and 'Florida Light Blue' - semi-dwarf heat tolerant cultivars of lisianthus. *Hort Science.* 34: 364-365.

Husna, M. A., Sultana, M. N., Maliha, M., Dina, A. and Uddin, A.F.M.J. 2022. Growth and flowering responses of Lisianthus to different plant spacing. *Journal of Bioscience and Agriculture Research.* 29(02): 2442-2449.

Islam, N., Patil, G.G. and Gislerød, H.R. 2005. Effect of photoperiod and light integral of flowering and growth of *Eustoma grandiflorum* (Raf.) Shinn. *Sci. Hortic.* 103:441-451.

Kathari Lakshmaiah, S. Subramanian, M. Ganga and P. Jeyakumar. 2019. Optimization of pinching and GA3 application to improve growth and flowering of lisianthus (*Eustoma grandiflorum*). *Journal of Pharmacognosy and Phytochemistry.* 8(6): 614-616.

Kaviani, Behzad Bahari, Behnaz Tarang, Alireza Ansari and Mohammad Hossein. 2018. Rapid micropropagation of lisianthus (*Eustoma grandiflorum*), a rose-like ornamental plant, through axillary buds using 2,4-D and BAP. *International Journal of Biotechnology*. 17(2).

Ohkawa, K., Yoshizumi, T., Korenaga, M. and Kanematsu, K. 1994. Reversal of heat-induced rosetting in *Eustoma grandiflorum* with low temperatures. *Hort Science.* 29:165-166.

Pertwee, J. 2000. International cut flower manual. Elsevier International Business Information, Netherlands.

Raquel Cavasini, Denise Laschi, Armando Reis Tavares and Giuseppina Pace Pereira Lima. 2018. Carbohydrate reserves on postharvest of lisianthus cut flowers. *Ornam. Hortic*. 24 (1).

Reid, S.M. 2000. Lisianthus - Recommendations for Maintaining Postharvest Quality. Perishables Handling (Department of Environmental Horticulture, University of California).

Rezaee, F., Ghanati, F. and Boroujeni, L.Y. 2012. Micropropagation of lisianthus (*Eustoma grandiflora* L.) from different explants to flowering onset. *Iranian J. Plant Physiol*. 3: 583-587.

Ruffoni, B. and Savona, M. 2006. Somatic embryogenesis in floricultural crops: experiences of massive propagation of Lisianthus, Genista and Cyclamen. *Floriculture, Ornamental and Plant Biotechnology*. 305-313.

Shintiavira, H., Pramanik, D. and Winarto, B. 2015. In Vitro Organogenesis of Lisianthus (*Eustoma grandiflorum* (Raf.) Shinn) Derived from Leaf Explant. *Thai Journal of Agricultural Science*. 48(4): 199-206.