

# BUD GROWTH AND POSTHARVEST PHYSIOLOGY OF GLADIOLUS AND CHRYSANTHEMUM-A REVIEW

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**Abstract:** This paper deals with mechanism of flower bud growth and postharvest physiology of gladiolus and chrysanthemum. Both gladiolus and chrysanthemum are leading cut flowers trade in India as well as World. A spike of gladiolus occurs of an acropetal sequence of stage of bud development on a single axis. A critical stage in flower bud growth in the spike of gladiolus is initiated by gibberellic acid and sustained by sucrose. The important role of continued and sequential basipetalis starch hydrolysis in the gladiolus petals could be to maintain by constant osmotic as well as a sink potential in the growing area of the petal. In case of, Chrysanthemum flower fresh and dry weights of the ray florets increase until the capitula is fully open. The soluble protein content declines after opening of capitula. The maximal activity of this enzyme and acid invertase coincide with the period of highest increment in fresh and dry weight. Postharvest senescence of gladiolus and chrysanthemum depends mainly of their methods of harvesting, transporting and increase the longevity of flowers. Two factors play a major role in regulating the vase life of cut flower are carbohydrate supply and water balance. This can be achieved through using of sucrose along with any of the following chemicals CoCl<sub>2</sub>, NiCl<sub>2</sub>, FeCl<sub>2</sub> and AgNO<sub>3</sub>.

**Keywords:** Gladiolus, chrysanthemum, bud growth, postharvest, physiology, vase life

## INTRODUCTION

Man has selected flowers for their beauty, hues, shapes, scents and keeping quality. In India, flowers are generally cut without stalk and used as fresh. Wreaths of jasmine, marigold, crossandra, tuberose, chrysanthemum, rose and champak are offered in temples and also used for personal adornments. The physiology of senescence of flowers grown in India is meagre. It is only recently that floral decorations as practiced in the developed countries have gained popularity in our country. With its varied agro climatic conditions and relatively low cost of production, India has immense opportunities not only to meet the local demands of both traditional and vase flowers but also a high potential for export trade. Lack of enterprise, lack of technical ideas, improper standardized method of growing and harvesting flowers of internationally acceptable quality, problems of packing and transport and also a practically nonexistent production base have been major impediments in realizing this goal. Improvement in the quality of blooms has necessitated research into the basic and applied aspects of flower physiology in some of the major international centres of flower production such as Netherlands, UK, USA and Israel. There is a resurgence of interests in India to broaden the technical base and enthuse entrepreneurs to take up export of flowers. In India, 27122 Million metric tonnes of flowers are exported and its worth of Rs. 423.4 crores (APEDA, 2014). Research in several aspects of flower initiation, flower bud development

and opening, sex expression, pollination biology and physiology of senescence in a large number of plants, especially ornamentals has been carried out for the past three decades in ICAR, New Delhi and several other science universities. In this paper, the main findings on mechanism involved in flower bud growth and on postharvest physiology of gladiolus and chrysanthemum are reviewed.

### Mechanism of flower bud growth in gladiolus and chrysanthemum

A spike of gladiolus presents a nature's own flower arrangement. It is ideal material for bud opening studies. The occurrence of an acropetal sequence of stage of bud development on a single axis makes it possible to carry out several studies. The spike bears buds in two rows (distichous arrangement) with the telescoping of the outer bracts over one another (Fig 1.). The elongation of the flowering axis between the buds loosens and separates the outer bract from the axis. The fresh weight of corolla increases 16 times and the dry weight by seven times and the outer bract separates out until the corolla attains its full expansion (Rao, 1979; Bala *et al.*, 1986). The spike harvest one week before the first floral bud opens and which need exogenous supply of sugars subsequent flower growth and opening (Rao and Mohanram, 1981). The growing corolla continues to import sugars throughout its development. The function of sugar is not directly involved in the metabolism. A part of the accumulated sugar in the petals is secreted as nectar. In gladiolus, this occurs at anthesis. The petal belonging to the buds with unseparated outer bracts were observed to contain

abundant starch in the ground parenchyma only (Rao and Mohanram, 1980). Bala (1982) reported that  $\alpha$ -amylase and acid invertase activities increase with the progression of corolla development and have a positive correlation with the amount of carbohydrates. The decline in starch in late developmental stages can be correlated with the sharp rise in  $\alpha$ -amylase activity and reducing content. The system of overlapping outer bracts which completely enclose the flower buds and their gradual separation represents a system programmed for sequential exposure of successive buds to light and stimulation of  $\alpha$ -amylase, to permit an orderly development of buds (Mohanram *et al.*, 2004). Rao (1982) illustrated that the outer bract acts as a natural qualitative light filter and regulate the production of  $\alpha$ -amylase and petal growth by a red/far-red control.  $\alpha$ -amylase is formed exclusively in the petal epidermis on perception of light. A crucial structural and biochemical role of the epidermis in the perception of light leading to petal growth has been recognized. Rao (1979, 1982) has observed that the epidermal cells of petals of gladiolus possess microlenses. These are formed by the outward growth of the outer radial wall of the epidermal cells causing the formation of curved structure, which thicker in the middle than edges. These microlenses act to focus light specifically on to the nucleus which situated in the central zone of inner radial wall of the epidermal cells. A critical stage in flower bud growth in the spike of gladiolus, which is initiated by gibberellic acid and sustained by sucrose, has also been identified by Rao and Mohanram, (1986). One important role of continued and sequential basipetal starch hydrolysis in the gladiolus petals could be to maintain a constant osmotic as well as a sink potential in the growing area of the petal, in spite of water uptake (Rao and Mohanram, 1980).

Chrysanthemum is only flower next to rose in importance as cut flower in world trade. It comes in various sizes and shapes and has an unmatched wholesomeness and elegance. Pardhasaradhi (1985) had made a detailed study of the growth of chrysanthemum capitulum using different stages. His finding revealed that the fresh and dry weights of the ray florets increase until the capitulum is fully open. The soluble protein content declines after opening of capitulum. The maximal activity of this enzyme and acid invertase coincide with the period of highest increment in fresh and dry weight. Amylase activity has increase in the florets till the half open flower stage. Ethylene production is low during initial stages of development of the capitulum and increase with age (Fig 2.). Anelegant method has been developed in this laboratory to study the expansion of ray florets. This consist of floating ray florets (9 to 9.5mm) of *Chrysanthemum morifolium var jyotsna* removed from the outer most whorl of young capitulum and it can be taken into petri-plates containing 30 ml of the test solution (Pardhasaradhi

and Mohanram, 1987). Using this technique it has been shown that KCL causes upto 33% increase in elongation. The value for GA<sub>3</sub> and sucrose when used individually are 39.8 and 28.9% increase in elongation respectively. Maximum growth response (82.8%) is recorded in combination of KCL+GA<sub>3</sub>+sucrose. It is inferred that the increased turgor resulting from sucrose promoted potassium uptake along with GA<sub>3</sub> caused tissue extensibility accounts for the enhanced floret growth. Ray floret expansion is also retarded by Trimethyl Ammonium Chloride (CCC), an inhibitor of gibberellin biosynthesis. Pardhasarathi (1985) implied that endogenous gibberellins are involved in ray floret growth. The CCC effect can be overcome by simultaneous application of GA<sub>3</sub>.

#### Postharvest physiology of flower

Flowers naturally lose moisture and colour fade with limited time. While flowers like jasmine and tuberoses turn brown and dry, in some plants mass shedding of petal occurs. Although majority of flowers are short lived, there are orchids such as *Phalaenopsis shilleriana* in which a flower may stay fresh on the plant for as long as four months as it waits for the specific insect pollinator (Molisch, 1938). In most of plants petal wither, the sepals drop and the stamens dry up following pollination. A clear understanding of the causes of senescence should help in developing methods of harvesting, transporting and increase the longevity of gladiolus and chrysanthemum. Two factors play a major role in regulating the vase life of cut flowers are carbohydrate supply and water balance. Injury at the cut end or growth of microorganism in the lumen of xylem vessels (physical blockage) or accumulation of microbial secretions and metabolic by products (physiological blockage) could prevent absorption which resulted in severe water deficit. Cut flower longevity is also curtailed by ethylene (Chandra and Mohanram, 1980). Investigation of postharvest physiology of chrysanthemum and gladiolus has shown that addition of a respirable substrate like sucrose and antimicrobial agent (streptomycin and 8-hydroxyl quinoline citrate) will prolong the vase life (Mohanram and Rao, 1977).

#### Flower senescence

Senescence of flowers is strongly promoted by ethylene. Ethylene induced senescence of carnation flowers was reported by Crocker and Knight (1908). It prevents opening of young blossoms, causes closure of opened flowers and fading of petals. Pollination also causes fading of flowers and it has been inferred that the senescence of the flower is triggered by pollen-auxin stimulated ethylene production (Burg and Dijkman, 1967). Similar finding was also identified by Lang (1961) in rose and gladiolus. Antiethylene compounds such as CoCl<sub>2</sub>, NiCl<sub>2</sub>, FeCl<sub>2</sub> and AgNO<sub>3</sub> promote the vase-life and increase the size of the cut capitula in chrysanthemum and marigold (Chandra *et al.*, 1981).

Use of sucrose along with  $\text{CoCl}_2$ ,  $\text{NiCl}_2$ ,  $\text{FeCl}_2$  and  $\text{AgNO}_3$  causes a further increment in vase life of

gladiolus by 20-24 days as compare to 7-8 days in water (Fig 3.).



**Fig 1.** Flower bud growth in Gladiolus development



**Fig 2.** Initial stages of development of capitulum in chrysanthemum



**Fig 3.** Gladiolus kept under sucrose solution

## CONCLUSION

This is brief account of the work carried out by ICAR and other science research departments, has shown the various ongoing and completed experiments. We also recognized the need to understand the science behind empirical indigenous practices of growing, harvesting and storage of gladiolus and chrysanthemum to put it on a sound basis for exporting oriental flowers to the rest of the world. And also reviewed brief subject related to the basis of flower growth and wish to develop techniques to prolong the shelf life of harvested flower and we find a little information available in India mostly based on ongoing experimentation and systematic analysis.

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