DORMANCY IN GLADIOLUS: THE CAUSE AND REMEDY– A REVIEW

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Abstract: Gladiolus ranks second in area and production of cut flowers grown in India. Dormancy of corms and cormels is one of the major hindrances in the commercial cultivation of gladiolus. The physiological basis of corm and cormel dormancy has been ascribed to the accumulation of growth inhibiting substances, especially abscisic acid (ABA). Cold storage of corms at 4-5°C for 3-4 months is the widely followed practice for breaking the dormancy, which restricts their use to only one season i.e., winter. Considerable work has been done on breaking dormancy in corms and cormels. Effective chemical treatments need to be standardized irrespective of the variety, location and environment.

Key words: ABA, Corm, Dormancy, Gladiolus, Thiourea.

INTRODUCTION

Gladiolus is one of the commercially important flower crops belonging to the family Iridaceae. It occupies a fourth of world bulbous flower plants area and is referred as the queen of bulbous flowers. In India, among cut flowers, it ranks second in area and production (NHB, 2002). The fascinating spikes bear a large number of florets which exhibit varying sizes and forms, with smooth, ruffled, deeply crinkled or lacinated petals. Its magnificent inflorescence in a variety of colors coupled with its long lasting vase life has made it excellent for vase decoration, preparation of bouquets and other floral arrangements. It is also used widely for planting in the herbaceous borders, beddings, pots and also in garden display. In India gladiolus is grown in an area of about 1270 ha with an annual production of 150 million spikes (Arora *et al.*, 2002).

In the last two decades it has become a very popular flowering plant in India. Its commercial production for spikes is extremely profitable, particularly around metropolitan cities. The major areas being Kalimpong (West Bengal), New Delhi, Srinagar (Jammu and Kashmir), Nainital (Uttaranchal), Pune and Nasik (Maharashtra), Bangalore (Karnataka), Hyderabad (Andhra Pradesh) and its cultivation is rapidly expanding in the states like Andhra Pradesh, Haryana, Karnataka, Kerala, Maharashtra, Punjab, Uttar Pradesh, Uttaranchal, Tamil Nadu, and West Bengal.

Gladiolus is commercially propagated through corms. The plants raised from seeds normally require 2-4 seasons to come to flowering and hence followed only in breeding programs to evolve new cultivars. Poor multiplication rate (each corm producing only 1-2 corms), presence of dormancy for 3-4 months in corms and 4-5 months in cormels, restricting their immediate use in the following season and environmental sensitivity (no corm production at higher growing temperatures) results in lack of planting material and impairs year-round production of gladiolus. This also results in high cost of corms which is often higher than the sale price of the spike produced by that corm. The profitability of gladiolus flower production and export is closely linked to the cost of the corms (APEDA, 1997).

According to North American Gladiolus Council, there are three categories of corms based on their size. These are large, medium and small. Jumbo (>5.1 cm diameter) and No.1 (5.1–3.8 cm) grades come under large; No.2 (3.8–3.2 cm) and No.3 (3.2–2.5 cm) grades are medium and small size corms (2.5 cm) are generally referred as cormels (corm lets). Small sized corms are generally used as planting stock which on subsequent years gives rise to flower grade corms. Large and medium categories with more than 2.5 cm diameter are considered as flowering stock, used for production of cut spikes as well as flower grade corms.

Dormancy of corms and cormels is one of the major hindrances in the commercial cultivation of gladiolus due to which it cannot be grown year round for regular supply of flowers and corms to the markets. Freshly harvested corms and cormels of gladiolus are in a state of deep rest, a condition that disappears with time (Hartsema, 1961 and Ginzburg, 1973). It is more pronounced under warmer climates. Cormels are more dormant than corms and smaller the size greater is the dormancy (Apte, 1962). The length of dormant period depends on both environmental and internal conditions.

CAUSE OF DORMANCY

Dormancy of bulbs and corms has been classified into three different groups. Of which, gladiolus comes under "Lily type", which has 'true physiological dormancy' (Kamerbeek et al., 1972). Chromatographic studies conducted in corm extracts in gladiolus to note the changes in endogenous growth substances revealed that dormant corms contain a marked amount of inhibiting substances but no auxins, while the corms whose

dormancy has been broken show a reduced amount of inhibiting substances together with the appearance of auxins.

Three zones of inhibitors were recognized in chromatograms. Inhibitor-I seems to be fatty acid compound mainly linolenic acid and III-a phenolic compound mainly ferulic acid, while II was identified as ABA. These substances together cause dormancy in gladiolus corms and cormels (Tsukamoto, 1974). Thus physiological basis of corm or cormel dormancy has been ascribed to the accumulation of growth inhibiting substances, especially abscisic acid (ABA) in the tissue as well as in the scales encapsulating them (Tsukamoto, 1975). The level of dormancy in gladiolus cormels was higher than that of corms of the same plants (Apte, 1962). The ratio of tunic to inside mass is significantly high in cormels. ABA accumulates much in this tunic only. There were 3 to 6 tunic layers in cormels of gladiolus. This number varies from variety to variety which plays a major role in level of dormancy (Jung *et al.*, 2000). The outer scales in the large and small gladiolus cormels contained growth stimulants and inhibitors of phenolic nature. In the scales of large cormels the stimulants were more active, whereas in small cormels the inhibitors were more active (Sarkisyan *et al.*, 1975). Duration of dormancy varies in different cultivars and in the same cultivar when grown under different conditions (Paswan, 1985). Balance between the growth promoters and inhibitors play an important role in the control of dormancy in gladiolus. The inhibitors content in the corms of growing plants will be low, but it increases at harvesting time reaching a maximum. It gradually decreases after passage of storage period and then activities of GA and auxin like substances are resumed, while ethylene production increases and growth inhibitors like ABA activity decreases (Tsukamoto, 1959 and 1960). The dormant corms of gladiolus cv. Charm showed high concentrations of inhibitors but these have decreased along with increase in promoters with the release of dormancy (Hosoki, 1995).

BREAKING OF DORMANCY

Cold storage of corms at 4-5°C for 3-4 months is the widely followed practice for breaking the dormancy, which restricts their use to only one season (i.e. winter). Mathematical models were developed to predict the optimal duration of cold storage, the conventional practice of breaking dormancy. Jean et al (1997) formulated a non-linear programming technique based on least squares optimization to work out the duration of cold storage required for relieving dormancy.

Considerable work has been done on dormancy and chemical treatments for breaking it, in corms and cormels. As early as 1930's Denny and Miller (1934) and Denny (1938) reported that the use of 3-5 ml of 40 per cent ethylene chlorohydrin per litre of air space with in a closed container for 3-5 days hastened sprouting of five gladiolus cultivars. In summer gladiolus corms of several varieties notably of 'Picardy', the treatment with 0.3 percent solution of ethylene chlorohydrin shortened the rest period and stimulated early sprouting and flowering (Evenari *et al.*, 1950). Sprouting was observed in gladiolus corms treated with ethylene chlorohydrin vapour after 75 days of planting, while untreated showed no sprouting (EL-Gamassy, 1957). Halevy *et al*. (1970) found enhanced sprouting of gladiolus corms by 30 min. dipping at various concentrations of ethrel. Ethrel at 1000 ppm enhanced sprouting when corms were stored at high temperature. Mukhamed (1985) observed that corm treatment with ethephon shortened dormancy period and advanced flowering in artificial light. Ethephon application at 0.05 percent was the most effective treatment for breaking dormancy in gladiolus corms.

According to Bylov *et al*. (1988), several substances tested as corm treatments viz., the ethephon based preparations, Hydreol, Flodimex and Composan were the best in shortening the dormancy period of gladiolus corms. The treatments like smoking once a day for 3 days, cracking the outer shell of the cormor treating with 400 ppm Ethrel (Ethephon) for 24 h significantly broke the dormancy and increased the sprouting percentage in the gladiolus cvs. Spic and Span and True Love (Hong and Goo, 1991). Muthoo and Maurya (1995) reported that Etherel at 8000 mg/l positively affected both corms obtained from summer and autumn crops with respect to sprouting percentage and days taken for 50 per cent sprouting. Pal and Choudhury (1998) reported that Etherel at 100 ppm for 24 h significantly reduced the number of days for sprouting over control. Goo *et al.* (1999) reported an increase in sprouting percentage, and reduction in the number of days to sprouting with Ethephon (l000 ppm) treatment in the cvs. Spic and Span, Topaz and White Prosperity. Ram *et al* (2002) compared the effects of GA_3, BA and Ethephon and found that the latter at 400 ppm significantly reduced the dormancy period by 17.5 days as compared to control, while BA and GA_3 to be less effective. Commercially available formulations of hydrogen cyanamide viz., Daybreak, Dormex which are extensively used for breaking bud dormancy and to inducing rapid bud break in fruit crops can also be used for dormancy breaking in gladiolus. Daybreak (hydrogen cyanamide 50% a.i.) @ 1% and thiourea @ 2% as a soaking treatment for 24 h were highly effective in reducing the number of days taken for sprouting and increasing the sprouting percentage (Naveen Kumar, 2005) Salicylic acid, an inexpensive chemical which was found to reverse the physiological effects promoted by ABA in many plant species (Raskin *et al.*, 1990). This also stimulates alternate oxidase (AOX) and in turn promotes alternate respiration. Owing to these

properties, Salicylic acid was also found to be effective in breaking the dormancy of gladiolus (Naveen Kumar, 2005).

CONCLUSION

The literature and reports surveyed attribute the physiological basis of dormancy to the growth inhibiting substances especially abscicic acid. However, it has also been reported that fatty acids like linolenic acid and ferulic acid also act in conjunction with ABA in imposing dormancy. Further studies are required for the quantification of factors causing dormancy at various stages. In order to design efficient strategy to break the dormancy, thorough biotechnological tools, it is necessary to know the exact cause of dormancy. Technology related to use of chemical treatments for breaking dormancy needs to be disseminated and flower growers should be encouraged to take up off-season production of gladiolus.

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