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Effect of plant growth regulators on corm and cormels production in gladiolus (*Gladiolus grandiflorus* L.) var. Pusa Shanti

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ABSTRACT

An experimental study was conducted at the Horticulture Farm, Department of Horticulture, CCS Haryana Agricultural University, Hisar, to investigate the Effect of plant growth regulators on corm and cormels production in gladiolus (Gladiolus grandiflorus L.) var. Pusa Shanti. The experiment involved the application of different concentrations of various plant growth regulators, namely gibberellic acid (GA_3), naphthalene acetic acid (NAA), indole-3-butyric acid (IBA), and chlormequat chloride (CCC), to assess their effects on corm and cormels production.The results revealed that corm and cormels attributes were found better in treatment T11(CCC@600ppm) and gave maximum number of corms/plant (3.50), number of cormels/plant (47.33), weight of corms(136.36), weight of cormels/plant(7.33g) and largest Corm diameter(6.42cm) which can be attributed to more and more translocation of photosynthates in the corms and cormels due to the dwarfing nature of CCC. However, the study faced challenges such as maintaining uniform environmental conditions and ensuring consistent application of growth regulators across treatments. Despite these constraints, the study contributes valuable insights into optimizing corm and cormels production in gladiolus and highlights the potential of CCC as an effective growth regulator for improving planting material yield.

Keywords: *Gladiolus, Corm and cormel attributes, Pusa Shanti, Dwarfing regulators, GA3, NAA, IBA and CCC.*

Introduction

Gladiolus, which is also known as Sword Lily or queen of bulbous flowers, is a flowering genus plant is a perennial plant which belongs to Iridaceae family and is known for its tall spikes and a wide range of colors, attractive shapes, varying sizes and numerous forms suited for different tastes and purposes due to which they have gained popularity in floriculture all over the world. This flower has around 260 species and has basically originated from the Sub-Saharan and Mediterranean regions. New flower models and genotypes have been developed in this plant through selection and hybridization techniques, which leads to the development of new and prominent floral traits [15]. It has a basic chromosome number n=15 and the majority of South African species are diploid (2n=30).

It is usually propagated by corms (which is a short, vertical, underground stem that stores food of a plant) of size 3-4 cm in diameter and is perennial in nature i.e. one mother corm produces two to three corms per plant, which can be further used to propagate this beautiful plant while other methods of propagation is through seeds and cormels. Its inflorescence is known as spike, which bears a large number of florets that open from bottom to top, making it an excellent cut flower and popular for its fragrance and can be used in flower exhibitions, bouquet formationand oil extraction etc.

Application of different plant growth regulators GA3, NAA, IBA, and CCC, can have different impacts on the corm and cormels production parameters.

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In the floriculture industry role of PGRs is very important. In gladiolus, they play various roles such as breaking of dormancy of corms and production of quality blooms [2]. The dormancy can be shortened by regulation of various morphogenic processes with the application of physiologically active compounds [5] and [17]. PGRs play an important role by regulating the flower production to fulfil the early and late demands in the cut flower market[3] and also boost the production and quality of flowers by pre-treatment of corms with PGRs [12 and 14]. Among various plant growth regulators used gibberellic acid plays important role in various physiological processes such as seed germination, leaf expansion, stem elongation and flower development [13 and 8], number and size of corm and cormels [20] along with it also increases the post harvest life [17]. CCC is a growth retardant that inhibits gibberellin biosynthesis, which reduces excessive vegetative elongation. This leads to shorter, sturdier plants with improved photosynthetic efficiency. By suppressing shoot elongation, more assimilates (carbohydrates) are diverted towards underground storage organs. This enhances corm and cormels development in terms of both size and number.The Mode of application of any chemical play an important role in efficient utilization for plant growth and development. The Corms soaking method is best over the spray method of application, it can achieve complete absorption of chemicals (growth regulators) by the gladiolus corms under the soaking mode of application, which might have been further utilized for various physiological processes to influence the growth and yield parameters.

Hence the present investigation was carried out to assess the effect of plant growth regulators on corm and cormel production of gladiolus (Gladiolus grandiflorus L.) var. Pusa Shanti.

Material Methods

The present experiment was conducted at the Horticulture Farm, adjacent to the nursery area, and in the Post-Harvest Laboratory of the Department of Horticulture, College of Agriculture, CCS Haryana Agricultural University (CCS HAU), Hisar, Haryana. Geographically, the experimental site is situated in western Haryana at 29.09°N latitude and 75.43°E longitude, with an elevation of 215 meters above mean sea level. The region experiences a semi-arid subtropical climate, characterized by hot, dry winds during summer and severe cold during the winter season.The study comprised 13 treatment combinations involving pre-sowing dipping of gladiolus corms in different concentrations of plant growth regulators (PGRs) such as Gibberellic acid (GA_3), Naphthalene acetic acid (NAA), Indole-3-Butyric acid (IBA) and Chlormequat chloride (CCC). Each treatment involved soaking the corms for 24 hours prior to planting. The experiment was laid out in a Randomized Block Design (RBD) with three replications, resulting in a total of 39 experimental units. In each plot corms were planted at a spacing of 30 cm × 20 cm. Uniform, healthy, and disease-free corms of gladiolus (Gladiolus grandiflorus) cultivar 'Pusa Shanti', with an average diameter of approximately 3.0 cm, were selected for planting. Prior to PGR treatment, the corms were subjected to surface sterilization to eliminate any surface-borne fungal pathogens. For this, a 0.1% solution of carbendazim (Bavistin 50 WP) was prepared by dissolving 30 g of the fungicide in 30 liters of water. The corms were immersed in this solution for 30 minutes and then removed and air-dried under shade to remove excess moisture and allow uniform surface drying then the corms were immersed in their respective PGR solutions for a period of 24 hours, according to the treatment schedule. Immediately after the completion of this pre-sowing treatment, the corms were planted in the well-prepared experimental field on 28th October 2024 at a depth of 5 cm.

Treatment details		
T1- Control	T5- NAA@ 100 ppm	T9- IBA @150 ppm
T2- GA_3@ 100ppm	T6- NAA @150 ppm	T10- IBA @ 200ppm
T3- GA_3@ 150 ppm	T7- NAA @200 ppm	T11- CCC@ 600ppm
T4- GA_3 @ 200ppm	T8- IBA @ 100ppm	T12- CCC@ 650ppm
		T13- CCC @ 700ppm

Results and Discussions

The data pertaining to the number of corms/plant and number of cormels/plant were shown in the Fig. 1 & 2, where effect of CCC was found to have a profound effect on corm and cormels parameters and greatly influenced the other characters also and was followed by NAA, IBA, and GA3.

Corms are the propagating material of gladiolus plant and their number per plant defines the reproductive efficiency and better resource allocation towards the vegetative material and was represented in Fig. 1, where the maximum number of corms per plant (3.50) was observed in T11 (CCC @ 600 ppm) which was followed by T10 (CCC @ 500 ppm) and T6 (NAA @ 150 ppm) i.e 3.08 and 2.40 respectively whereas the minimum number of corms/plant (1.16) was observed in T1(Control). This might be due to the fact that CCC which is majorly a growth retardant had triggered the multiplication of corms and stops the formation of gibberellins, therefore grows compact and does not increase the shoot-length due to which there is redirection of assimilates from the shoot portion to the storage organ growth. CCC has also been reported to increase the activity of the roots because the activity of the aquaporins protein has been increased by it,which strengthens their stems to be thicker and stronger, which might explain more basal swellings responsible of differentiating to form the corms [11]. These results are in close agreement with the findings of [19], whereas Number of cormels per plant is also another important method used for the multiplication of the plant and was represented in the Fig.2, where the current experiment registered the highest cormels number (47.33) in T11 (CCC @ 600 ppm) and was followed closely by T12 (CCC @ 650 ppm), T13 (CCC @ 700 ppm) and T9 (IBA @150ppm)i.e. 44.00, 43.00 and 40.67 number of cormels respectively. This observation is important as it describes the important role of CCC in stimulating axillary bud growth which acts as a secondary storage organs [6] whereas the physiological basis behind it can be due to the CCC represses stem elongation by blocking gibberellins synthesis, however, it can enhance lateral growth as well as growth of underground organs. This rebalancing of growth can relocate energy and nutrients to the basal nodes where the cormels are normally developed. Also, the role of CCC at elevated levels of chlorophyll retention and compact canopy can be assumed as favouring of the continuance of photosynthesis to provide a sustained supply of assimilates to enable cormels development [16]. These results are in close agreement with the findings of [18].

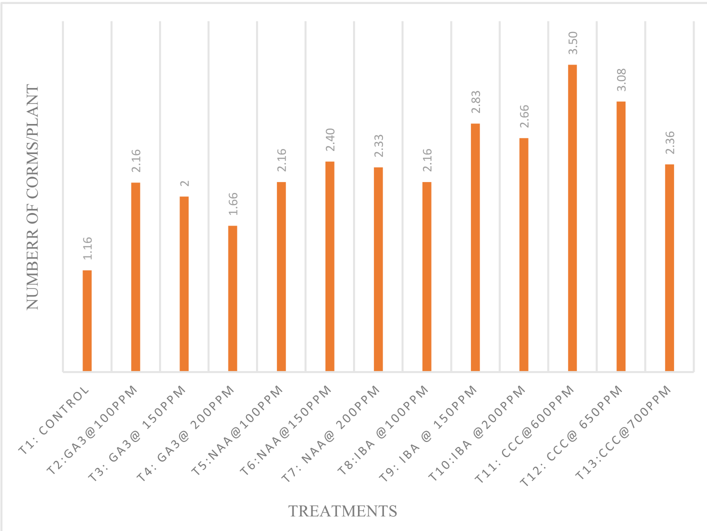

Fig 1: Effect of plant growth regulators on number of corms/plant in gladiolus var. Pusa Shanti

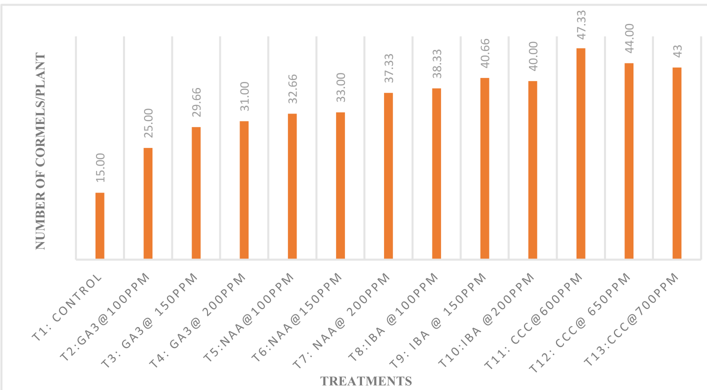

Fig. 2: Effect of plant growth regulators on number of cormels/plant of gladiolus var. Pusa Shanti

Weight of Corms serves as a direct indicator of underground biomass accumulation and storage potential and was presented in the Fig.3 where it was found that the highest corm weight/plant (136.36 g) was recorded under T11 (CCC @ 600 ppm), followed by T12 (CCC @ 650 ppm) and T10 (IBA @ 200 ppm) i.e. 134.61g and 120.63g respectively, meanwhile the minimum weight of corms/plant (68.61g) was recorded in

T3(GA3@150ppm). This finding stands in contrast to the general assumption that gibberellins are most effective in promoting storage structures, which highlights the distinct physiological action of CCC under controlled conditions [16] whereas the physiological basis behind it can be due to the fact that CCC inhibits endogenous gibberellin synthesis, which leads to compact aerial growth. This restriction on vertical shoot elongation likely redirected assimilates toward underground organs. By shortening internodes and reducing apical dominance, CCC may have encouraged increased retention of photosynthates in the lower plant axis, contributing to corm enlargement. CCC is also known to promote root vigour and chlorophyll stability, indirectly supporting higher photosynthetic efficiency and biomass partitioning [7&10]. These results are in agreement with the findings of [18] whereas weight of cormels/plantreflects the overall bulk and storage potential of propagation units and was represented in the Fig. 4 where the highest cormel weight(7.33g) was recorded under T11 (CCC @ 600 ppm), followed by T12(CCC@650ppm) and T5(NAA@100ppm) i.e. 7.00g and 6.58g respectively. This trend mirrors the results observed for cormel size and number, reinforcing the consistent effect of CCC in enhancing underground growth attributes [18] and [4]. The physiological basis behind it may be attributed to the fact that CCC prolonged the leaf functionality and assimilate retention. By suppressing shoot elongation and delaying leaf senescence, it increases the effective source strength (leaves) and sink activity (cormels), allowing for more sustained carbohydrate flow and starch accumulation in the developing cormels[1]. These results are in close findings of [18] and Swain [19].

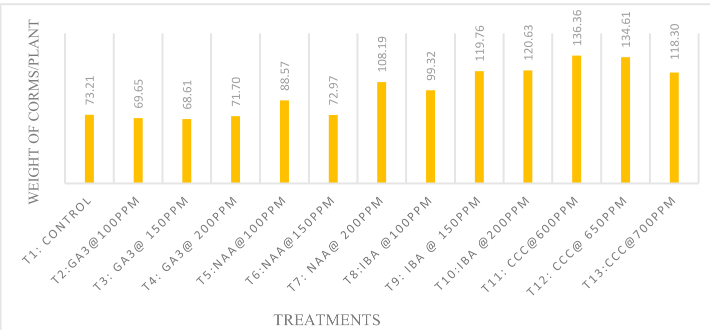

Fig. 3: Effect of plant growth regulators on weight of corms (g) of gladiolus var. Pusa Shanti

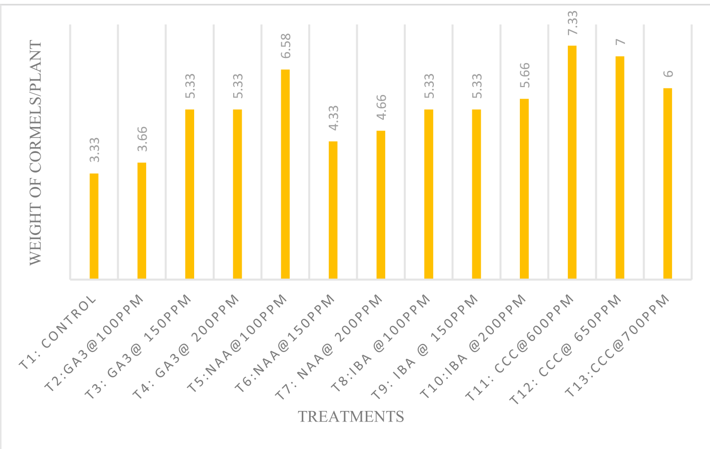

Fig. 4: Effect of plant growth regulators on weight of cormels/plant (g) of gladiolus var. Pusa Shanti

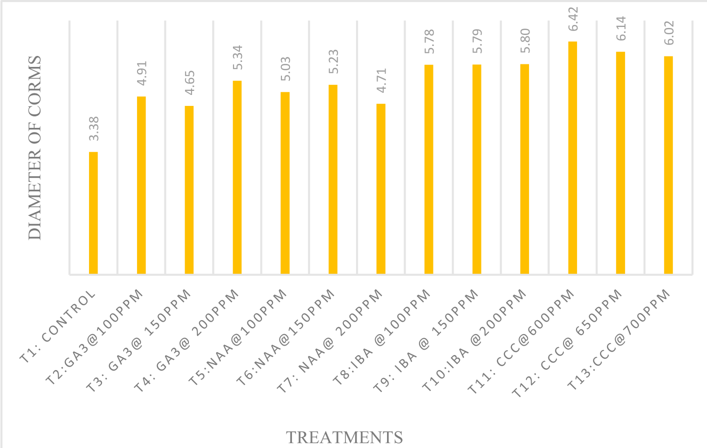

Fig. 5: Effect of plant growth regulators on diameter of corms(cm) of gladiolus var. Pusa Shanti

Whereas in context to corm diameter which is an important trait and reflects the radial expansion and sink strength of the developing storage organ and was represented in the Fig. 5where the maximum corm diameter(6.42cm) was recorded in T11 (CCC@600 ppm) which was followed by T12(CCC@650 ppm), T13(CCC@700ppm) and T10(IBA @200ppm) i.e. 6.14cm, 6.02cm and 5.80cm respectively. This aligns with CCC's growth-retardant effect, which concentrates biomass near the basal portion of the plant rather than promoting shoot elongation [9]. Physiologically, CCC restricts internodal elongation and stimulates lateral and radial cell expansion in the lower stem and corm tissues. This shift in hormonal balance may enhance cambial activity and xylem loading efficiency, leading to increased girth. CCC also improves water retention in tissues and stabilizes cell membrane integrity, supporting uniform and sustained growth of the corm body [9]. These results are in close agreement with the findings of[18 &19].

Conclusions

The present investigation clearly demonstrated that the application of plant growth regulators had a significant influence on corm and cormel production of Gladiolus grandiflorus L. var. Pusa Shanti. Among the treatments, CCC at 600 ppm (T_{11}) proved to be most effective, recording the highest number of corms per plant, cormels per plant, corm weight, cormels weight, and corm diameter. The superiority of CCC @ 600 ppm may be attributed to its growth-retarding effect, which restricted excessive vegetative elongation and facilitated greater translocation of assimilates towards underground storage organs, thereby enhancing both the quantity and quality of corms and cormels. Thus, CCC at 600 ppm can be recommended as an effective treatment for maximizing corm and cormels production in gladiolus cultivation under Hisar conditions.

Future Scope of the study

Varietal responses may differ, hence more research is required to confirm the efficacy of CCC on other gladiolus types. Research using a greater variety of CCC concentrations and combinations with other plant growth regulators may aid in the development of the most cost-effective and efficient dose. Corm and cormel shelf-life, sprouting, and post-harvest storage behavior should all be examined in relation to CCC. CCC and balanced nutrition management together may improve corm quality and productivity even further. Its cost-effectiveness and practicality for commercial gladiolus production will need to be confirmed through extensive testing conducted on farmers' fields.

Conflict of interest

The authors declare no conflict of interest.

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