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Effect of GA_3 and urea on growth, and yield of gladiolus (*Gladiolus grandiflorus* L.) cv. Novalux

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Abstract
The present investigation was carried out at Main Experimental Station, Department of Floriculture and Landscape, A.N.D.U.A. &T., Kumarganj, Ayodhya (U.P.), 224229 during the year 2018-19 to investigate the "Effect of GA_3 and urea on growth, and yield of gladiolus (*Gladiolus grandiflorus* L.) cv. Novalux". The experiment was laid out in Randomized Block Design (Factorial) with three replications and twelve treatment combinations comprising three levels of GA_3 (0, 150 and 300 ppm) and four levels of urea (0%, 1.00% , 2.00% and 3.00%) as foliar spraying at 30 and 60 days after sowing. The results revealed that 300 ppm GA_3 and 3% urea resulted maximum plant height 76.93 (cm), maximum number of leaves 7.30 (cm) per plant, number of spike 2.20 per plant and 2.75 (lacks) per hectare, maximum number of corms 2.47 per plant and 3.08 lacks per hectare, maximum yield of cormels 48.46 (lacks) per hectare.

Keywords: GA_3, urea gladiolus, spike, corm, Cormel etc.

Introduction
India has a long tradition of floriculture. References to flowers and gardens are found in ancient Sanskrit classics like Rigveda, Ramayana and Mahabharata. The social and economic aspects of flower growing were however, recognized much later. With changing life style and increased urban affluence, floriculture has assumed a definite commercial status in recent times and it has emerged as an important horti.-business venture. In this regard gladiolus has gained much importance as it is the 'Queen of bulbous flowers'. The Latin word 'Gladius' means sword and hence, it is often called as 'sword lily' because of the shape of its leaves. Gladiolus was also called 'xiphium' based on the Greek word 'Xiphos' also meaning sword. The gladiolus has a long and noble history. The history of gladiolus cultivation dates back to 2000 years, when some species commonly known as 'corn lily' were grown in parts of Asia Minor. Most of these species are native to Mediterranean region and tropical part of South Africa, particularly the region of the 'Cape of Good Hope'. It was introduced into cultivation towards the end of 16th century. However, in India its cultivation dates back to 19th century as 'Foreigners Manual of Gardening in India' published in 1863, mentions that, Mr. Charles Gray of Coonoor was first person to grow gladiolus in India during nineteen century. First it was thought that only hilly tracts of country were suitable but later on plains were also found suitable for growing it commercially.

The total area of flower in India is according area 339 thousands ha and total production of loose flower 1991 MT and cut flower production 867 thousand MT in India. In Uttar Pradesh total area of cultivation of flower are 21.31 ha and total production of loose flower 46.68 MT and cut flower production 65.51MT according to NHB DATA Base (2018-19).

This flower crop possesses a great potential for export market, to European countries especially during winter. It is also a popular decorative plant for use in herbaceous borders, bedding and for growing in pots and bowls. These also make good cut flowers as they bear smaller spikes to look elegant on the tables. Gladiolus is grown throughout the world and belongs to family 'Iridaceae'. Large scale production of gladiolus cut flowers is seen in USA, Holland, Italy, France, Poland, Bulgaria, Brazil, Australia and also Israel. It stands fourth in the international cut flower trade after carnation, rose and chrysanthemum. The spikes of gladiolus are mainly used for garden and interior decoration and for making bouquets. Gladiolus produce flowers with their beautiful spikes, from October to March in plains and from June to September in hills in India. The gladiolus is a romantic flower as it signifies remembrance and it also expresses infatuation.

The roots of the gladiolus plants were thought to be an aphrodisiac. The upright growth habit of plants lends itself to any manner of floral arrangements, from minimalist Japanese 'Ikebana' and 'Bouquet' bouquets and it excels as a cut flower. India has suitable agro-climatic conditions for gladiolus cultivation. In India, it is commercially cultivated in West Bengal, Himachal Pradesh, Sikkim, Karnataka, Uttar Pradesh, Tamil Nadu, Punjab and Delhi. In the eastern states like Tripura, Assam, Manipur, Meghalaya and Nagaland, this flower has established itself as a commercial proposition. There is a sizeable area under gladiolus in Jammu-Kashmir, Andhra Pradesh and Gujarat also.

The use of plant growth regulators has brought a sort of revolution in the floriculture industry. Many beneficial effects of different plant growth regulators have been reported on different horticultural crops including control of growth and flowering in many floral crops to produce high quality product. Use of growth regulators in gladiolus has received due attention only in the recent past and still information's available are meager. Gibberellic acid is known to be involved in increasing stem height, number of leaves per plant, leaf area, shoot dry weight and flower diameter. GA_3 delays senescence of flowers by reducing the senescence-promoting effect of ethylene. However, the role of GA_3 in plants is complicated. Attempts have been made to explore the role of GA_3 in growth and flowering of gladiolus by various workers and the application of GA_3 was found to vegetative growth yield significantly. It is known fact that application of growth regulators such GA_3 had positive effects on growth and development of gladiolus plants at different concentrations. The reports indicated that the growth, yield and quality of gladiolus were enhanced by application of GA_3. Urea plays a key role in agriculture by increasing of crop yield. Urea not only enhances the yield but also improves the quality of flowers. Optimum, rate of urea increases photosynthetic processes, leaf area production, leaf area duration as well as net assimilation rate. The maximum leaf area and total leaf biomass of plants are a determinant of higher crop yield. Hence, the keeping in view the importance of GA_3 and urea (N) spraying present experiment had been conducted with the objective to assess the effect on growth and yield of gladiolus (*Gladiolus grandiflorus* L.) cv. Novalux.

Materials and methods

The present investigation on effect of GA_3 and urea on growth and yield of gladiolus (*Gladiolus grandiflorus* L.) cv. Novalux was carried out in the year 2018-19 at Main Experimental Station, Department of Floriculture and Landscape, A.N.D.U.A. & T., Kumarganj, Ayodhya (U.P.). The experiment was laid out in Randomized Block Design (Factorial) with three replications and twelve treatment combinations comprising three levels of GA_3 (0, 150 and 300 ppm) and four levels of urea (0, 1.00 , 2.00 and 3.00%) as foliar spraying at 30 and 60 days after sowing. Corms were selected at 4.00 to 6.00 cm size and sown at spacing 40 cm × 20 cm with 8-10 cm deepness in the month of September. Recommended dose of fertilizers required weeding hoeing; earthling, irrigation and other cultural operation were done properly. Data were recorded on selected five pants and average was used for analyzing the data. Analysis of data were done the processor adopted Chandel (1951) [3].

Result and Discussion

It is clear from the data presented in table-1, that height of plant (cm) and number of leaves per plant was significantly effective with application of GA_3. Plant height and number of leaves per plant was significantly maximum 76.93 cm and 7.30 with GA_3 300 ppm and minimum were recorded 65.57 cm and 6.13 in control. Plant height and number of leaves enhanced because of increase in the endogenous level of gibberellins in different phases of growth and development of plants which promotes vegetative growth by inducing active cell division and cell elongation in the apical meristem. It is clear from the data presented that number of spikes per plant and per hectare was significantly effective with GA_3 (2.20 and 2.75 lack). Number of corm per plant 2.47 and per hectare 3.08 was significantly effective with GA_3 300 ppm. Number of cormel per hectare (48.46 lack) were dig out from the plant treated with GA_3 300 ppm. The superiority of the treatment (GA_3 300 ppm) with regards to number of spike, corms and cormels per plant and per hectare was due to application of GA_3 can be attributed to the ability to increase the number of leaves which in turn after thorough photosynthesis, increased the photosynthetic assimilates. These assimilates are transported to the resulting daughter corms, thereby, increasing the number of spike, corms and cormels. These results are in corroboration with the findings of Gaur *et al*. (2003) [4] *on* gladiolus cv. Eurovision, Baskaran and Misra (2007) [1], Umrao *et al*. (2007) [11] on gladiolus cv. Nova Lux, Ramachandrudu and Thangam (2007) [9], Bhalla and Kumar (2008) [2] on gladiolus cv. White Prosperity, Kumar *et al*. (2008) [2] on gladiolus cv. Snow Princess.

Urea contains nitrogen 46.4% is one of the major nutrient plays an important role in enhancing vegetative as well as economical yields of gladiolus. 3% urea spraying at 30 and 60 days after transplanting had increased maximum plant height 79.84 cm, number of leaves 7.73, number of spike 2.27 per plant and 2.83 lacks per hectare, number of corms 2.51 per plant and 3.14 lacks and cormels 49.40 lacks per hectare. The improvement of vegetative and economical characters with application of urea attributed to ammonium ions which have been reported to increase nitrate absorption and ammonium absorption in plants. Nitrogen is constituent of nucleic acid, protoplasm and chlorophyll its might have increased carbohydrate synthesis, amino acid, plant metabolic activities etc, which resulted to more photosynthetic efficiency and also favored to initiation and extension of effective plant part. From which the phyto-hormones like auxins, gibberellins, cytokinins have been synthesized resulting in increased plant growth. These results are in corroboration with the findings of Kumar and Mishra (2003), Khan and Ahamad (2004) [6], Jamwal *el al.* (2008a) [5].

The interaction effects of GA_3 and urea were found non-significant in most of the characters. However interaction effect of GA_3 and urea were found significant effect in height of plant. The maximum plant height 85.53 cm were recorded with GA_3 300 ppm + urea 3%. This finding may be the results of joint effect of GA_3 and urea. Result is in accordance with the result of Salim *et al*. (2004) [10] in gladiolus.

Table 1: Effect of GA_3 and Urea on growth, and yield of gladiolus (*Gladiolus grandiflorus* L.) cv. Novalux

Treatments	Plant Height (cm)	No. of leaves/ plants	No. of spike/ plant	No. of spike/ha (lack)	No. of corms/ plant	No. of corms/ha (lack)	No. of cormels/ ha (lack)
G_0 - GA_3 0 ppm	65.57	6.13	1.65	2.06	1.90	2.38	29.59
G_1 - GA_3 150 ppm	74.97	6.82	1.92	2.40	2.23	2.81	40.39
G_2 - GA_3 300 ppm	76.93	7.30	2.20	2.75	2.47	3.08	48.46
SEm±	0.48	0.21	0.05	0.06	0.05	0.06	0.95
C. D. at 5%	1.42	0.62	0.15	0.19	0.16	0.19	2.79
U_0- Urea 0%	64.02	5.64	1.53	1.92	1.80	2.25	27.92
U_1- Urea 1%	70.16	6.42	1.82	2.28	2.13	2.67	36.48
U_2- Urea 2%	75.93	7.20	2.07	2.58	2.36	2.97	44.11
U_3- Urea 3%	79.84	7.73	2.27	2.83	2.51	3.14	49.40
SEm±	0.56	0.24	0.06	0.07	0.06	0.07	1.10
C. D. at 5%	1.64	0.71	0.18	0.23	0.19	0.23	3.24
G_0U_0 - GA_3 0 ppm + Urea 0	58.40	5.20	1.20	1.50	1.60	2.00	21.56
G_0U_1 - GA_3 0 ppm + Urea 1%	64.13	5.73	1.53	1.92	1.80	2.25	26.57
G_0U_2 - GA_3 0 ppm + Urea 2%	68.20	6.53	1.80	2.25	2.00	2.50	32.39
G_0U_3- GA_3 0 ppm + Urea 3%	71.53	7.07	2.07	2.58	2.20	2.75	37.83
G_1U_0- GA_3 150 ppm + Urea 0%	65.93	5.60	1.60	2.00	1.80	2.25	27.58
G_1U_1- GA_3 150 ppm + Urea 1%	71.93	6.40	1.80	2.25	2.20	2.75	37.80
G_1U_2- GA_3 150 ppm + Urea 2%	79.53	7.47	2.07	2.58	2.40	3.08	45.94
G_1U_3- GA_3 150 ppm + Urea 3%	82.47	7.80	2.20	2.75	2.53	3.17	50.25
G_2U_0- GA_3 300 ppm + Urea 0%	67.73	6.13	1.80	2.25	2.00	2.50	34.63
G_2U_1- GA_3 150 ppm + Urea 3%	74.40	7.13	2.13	2.67	2.40	3.00	45.08
G_2U_2- GA3 300 ppm + Urea 2%	80.07	7.60	2.33	2.92	2.67	3.33	54.00
G_2U_3- GA_3 300 ppm + Urea 3%	85.53	8.33	2.53	3.17	2.80	3.50	60.12
SEm±	0.97	0.42	0.11	0.14	0.11	0.14	1.90
C. D. at 5%	2.85	NS	NS	NS	NS	NS	NS

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