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Effect of different levels of K on physio-chemical parameters of gladiolus (*Gladiolus grandiflorus* L.) cv. Oasis

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Abstract
A field experiment was conducted to determine the response of different levels of potassium on the growth, flowering and yield of gladiolus was carried out at Horticultural Experimental Field of College of Agriculture, Central Agricultural University, Imphal. The experiment was laid out in RBD with eight treatments and replicated thrice. The treatment consist of T_1 (control), T_2 (30 kg/ha K_2O), T_3 (60 kg/ha K_2O), T_4 (90 kg/ha K_2O), T_5 (120 kg/ha K_2O), T_6 (150 kg/ha K_2O), T_7 (180kg/ha K_2O) and T_8 (210 kg/ha K_2O). The results of the experiment revealed that 210 kg/ha K_2O gave the best treatment influenced to vegetative parameters viz. plant height (74.44cm), number of leaves (8.63), length of leaf (52.83cm), flowering parameters viz. minimum number of days taken for flowering (53.35 days), longivity of intact spike (18.93 days), length of the spike (105.86 days), fresh weight of the spike (79.85g), vase life of the cut spike (13.67 days), number of florets per spike (17.07). Similarly, NPK content in leaf tissues were maximum with the application of T_8 (210 kg/ha K_2O).

Keywords: Gladiolus, potassium, growth, flowering, NPK content in leaf

Introduction

Gladiolus (*Gladiolus grandiflorus* L.) also known as queen of bulbous flower with chromosome no. 2n=30, belongs to the family Iridaceae having its origin from South Africa. It is very popular for its sumptuous spike, long vase life, varieties of hues making its own place among the most important cut flower. Potassium is one of the most important macronutrients that affect the growth of gladiolus. After nitrogen and phosphorous, soils are usually most deficient in potassium (Salisbury and Ross, 2011) [16]. Application of suitable nutrients in an optimum amount is important. Potassium is essential for enzyme activation, charge balance and osmotic regulation in plants (Wakeel *et al*., 2011; Zörb *et al*., 2014) [17, 19]. A lack of potassium causes reduced bud count, shortening of the flower stems and delay in flowering of gladiolus, general yellowing of older leaves, and interveinal yellowing of younger leaves (Wilfret, 1980) [18]. Potassium resulted in significantly in maximum length of the leaf and width of the leaf, number of spikes per plot, diameter of floret, corms per plot and cormels per plot (Mahadik *et al*., 2017) [12]. There is a good scope of increasing the growth and vigour of gladiolus by the use of potassium under the agro-ecological conditions of Manipur region. Keeping this in view, the present study was undertaken to investigate the effects of potassium on growth, flowering and yield of gladiolus and to find out the best level of potassium in maximizing corm and corm yield parameters.

Materials and Methods

The field experiment was laid out at the Horticultural Experimental Field of College of Agriculture, Central Agricultural University, Imphal during the year, 2018. The climatic condition of the experimentation site falls under sub-tropical climates and situated at an elevation of 790 m above sea level, at 24°45'N latitude and 93°56'E longitudes. The experiment was laid out in randomized block design with three replications. Eight treatments of potassium are used viz. T_1 (control), T_2 (30 kg/ha K_2O), T_3 (60 kg/ha K_2O), T_4 (90 kg/ha K_2O), T_5 (120 kg/ha K_2O), T_6 (150 kg/ha K_2O), T_7 (180kg/ha K_2O) and T_8 (210 kg/ha K_2O).
Farm yard manure was applied @ 30 tonnes per hectare 15 days prior to planting. Plot sizes of 2.7 sq.m (1.8 m x 1.5 m) were prepared with a spacing of 30 x 30 cm. A basal dose of nitrogen and phosphorous at the rate of 60 Kg/ha each is applied.

The entire amount of phosphorous and potassium levels as per treatment along with half dose of nitrogen were supplied through inorganic fertilizers as basal dose at the time of bed preparation. The remaining half dose of nitrogen is applied one month after planting.

All type of cultural practices such as irrigation, weeding and other plant protection measures were performed as per the requirement. The soil was analysed for physio- chemical properties and the following results were found: Sand (14.95%), silt (32.15%), clay (52.9%), OC (2.92%), pH (4.79), Available N (313.6 Kg/ha), Available P (21.3 Kg/ha) and Available K (147.30 Kg/ha). Healthy corms which are free from diseased infection are selected and planted at the depth of 10 cm (Hartmann *et al*., 1981) [7].

Results and Discussion

In the study the different growth parameters, flowering parameters and chemicals parameters were observed. Under growth parameters there are parameters such as plant height, number of leaves per plant and length of the leaf where the readings are taken and in flowering parameters, number of days taken for the first flowering, maximum longevity of the spike, highest length of the spike, fresh weight of the spike, the number of florets and vase life of the cut spike were observed. For biochemical analysis, NPK content in leaf was recorded.

Growth parameters

The height of the plant at 60 DAP was maximum (74.44 cm) with the application of 210 Kg/ha K_2O which was at par with 150 Kg/ha K_2O (70.05cm). An increase in plant height with the application of potassium may be resulted due to better food intake as a development of a strong root system caused by optimum potassium present in the soil. Application of potassium also gave the maximum height due to more K availability. This finding is in line with that of Carroll and Edward, 2011 [2] and Hussain *et al.,* 2016 [8] in tuberose. The maximum number of leaves per plant was recorded with the application of 210 Kg/ha K_2O which was statistically at par with 180 Kg/ha K_2O at 60 DAP while the minimum number of leaves per plant was recorded in control with values 5.81. An increase in the number of leaves may be due to the application of higher levels of potassium which encourage the number of leaves, lateral growth and number of branches. This finding was consistent with that of Khan *et al.*, 1999 [9] in Zinnia. The maximum length of the leaf (52.83 cm) was observed with 210 Kg/ha K_2O at 60 DAP which was statistically at par with 180 Kg/ha K_2O (49.67 cm) and 150 Kg/ha K_2O (47.42 cm). Potassium plays a composite role in photosynthesis, the process by which plant synthesize energy from sunlight, carbon dioxide, and water. Thus, the optimum supply of potassium helps to improve healthy plant growth in terms of length and width of the leaf. This might have been the reason to increase the leaf length and width of gladiolus with an increased dose of potassium. These results are congruent with the findings of Khan *et al*., 2012 [10] and Mahadik *et al*., 2017 [12] in gladiolus.

Table 1: Growth and flowering of gladiolus as influence as influence by different levels of potassium.

Treatment	Plant height (cm) (60 DAP)	No. of leafs (60 DAP)	Length of the leafs (cm) (60 DAP)	No. of days taken to first flowering	Longivity of the intact spike (days)	Length of the spike (cm)	Fresh weight of the spike (g)	Vase life of the cut spike (days)	No. of florets/spike
T1– 0 (control)	60.75	5.81	41.31	63.53	9.27	86.83	58.95	7.73	10.80
T_2– 30 kg/ha K_2O	62.66	6.16	42.95	60.05	11.47	89.40	58.70	8.80	11.87
T_3– 60 kg/ha K_2O	59.95	6.50	43.37	59.41	12.67	90.89	63.85	9.33	12.67
T_4– 90 kg/ha K_2O	69.08	6.74	45.05	58.67	13.26	94.02	67.00	10.07	13.40
T_5– 120 kg/ha K_2O	65.82	6.94	45.73	57.36	14.87	99.99	71.33	10.53	12.07
T_6– 150 kg/ha K_2O	69.49	6.58	47.42	56.34	15.20	101.20	75.59	11.13	14.27
T_7– 180 kg/ha K_2O	70.04	8.26	49.67	55.82	16.97	102.29	76.56	12.20	15.03
T_8– 210 kg/ha K_2O	74.44	8.63	52.83	53.35	18.93	105.86	79.85	13.67	17.07
S.Ed (±)	3.94	0.61	3.17	2.36	1.21	4.67	4.39	0.92	1.21
CD (0.05)	8.45	1.32	6.80	5.06	2.59	10.02	9.42	1.97	2.59

Table 2: NPK content in leaf tissue as influenced by the different levels of potassium in gladiolus.

Treatment	Nutrient content in leaf		
	N%	P%	K%
T_1– 0 (control)	1.93	0.27	1.73
T_2– 30 kg/ha K_2O	2.17	0.35	2.09
T_3– 60 kg/ha K_2O	2.02	0.48	2.28
T_4– 90 kg/ha K_2O	2.42	0.36	2.30
T_5– 120 kg/ha K_2O	2.17	0.53	2.37
T_6– 120 kg/ha K_2O	2.33	0.56	2.38
T_7– 180 kg/ha K_2O	2.46	0.58	2.49
T_8– 210 kg/ha K_2O	2.97	0.63	2.64
S.Ed (±)	0.31	0.03	0.30
CD (0.05)	NS	0.07	NS

Flowering parameters

The number of days taken for the first flowering in gladiolus was (Table 1) significantly influenced by the different levels of potassium. The minimum days to first flowering was observed with the application of 210 Kg/ha K_2O with recorded value 53.35 days which was statistically at par with 120 Kg/ha K_2O, 150 Kg/ha K_2O and 180 Kg/ha K_2O with value 57.36 days, 56.34 days and 55.82 days respectively while the longest number of days to flowering (63.53 days) was observed in control. The result is in contrast with that of Hussain *et al.,* 2016 [8] who states that increased level of potassium delayed the days to first floret opening as compared to the low level of potassium. Zubair, 2006 [20] also states that an increase in potassium dose delay flowering in bulbous flowers.

Among the treatment, the maximum longevity of the spike (Table 1) was recorded in 210 Kg/ha K_2O with value 18.93 days which was statistically at par with 180 Kg/ha K_2O (16.97 days) while the minimum longevity of intact spike (9.27 days) was found in control. An increased in levels of potassium might have taken more days for the flower to bloom. These results are in harmony with Wilfret (1980) [18] in Gladiolus and Hussain *et al*., 2016 [8] in tuberose.

The highest length of the spike (Table 1) was recorded with 210 Kg/ha K_2O with value 105.86 cm which was statistically at par with 120 Kg/ha K_2O, 150 Kg/ha K_2O and 180 Kg/ha K_2O with value 99.99 cm, 101.20 cm and 102.29 cm respectively. The lowest length of spike (86.83 cm) was observed in in control. The application of higher doses of K in gladiolus increased the length of spike due to the higher levels resulting in production of more number of leaves in plants which in turn produced more photosynthesis and those higher levels photosynthates that might have been utilized for production of longer spikes (Pradhan *et al.,* 2004) [15]. Besides this, Wilfret, 1980 [18] also report that potassium increases the flower stem height.

The Table 1 showed significant variation in the fresh weight of the spike. Maximum fresh weight of the spike (79.85 g) was observed in 210 Kg/ha K_2O which was statistically at par with 120 Kg/ha K_2O (71.33 g), 150 Kg/ha K_2O (75.59 g) and 180 Kg/ha K_2O (76.56 g) while the minimum fresh weight of the spike was observed in in 30 Kg/ha K_2O (58.70 g). The improvement in fresh weight may be attributed to important role of potassium in nutrient and sugar translocation in plant and turgor pressure of plant cells. Also, potassium leads to active numerous enzyme systems involved in formation of organic substances and in build- up of compounds such as carbohydrates (Chhokar *et al*., 2006) [3].

The number of florets was significantly influenced among various treatments. The highest number of florets per spike was recorded in 210 Kg/ha K_2O (17.07) which were statistically at par with 180 Kg/ha K_2O (15.03). The minimum number of florets per spike was recorded in control (10.80). Increased in number of floret maybe be resulted due to the manufacturing of chlorophyll synthesis, amino acids, and swift carbohydrates conversion, which outcome as better growth and maximum number of florets (Parmer, 2007) [14]. Gowthami *et al.* (2018) [6] also states that elevated potassium level accelerated many bio-chemical reactions and led to the more number of florets per spike.

The longest vase life was observed in 210 Kg/ha K_2O recording 13.67 days which was statistically at par with 180 Kg/ha K_2O recording 12.20 days while the minimum vase life is recorded in control with value 7.73 days. Superior quality and extended vase life of flowers were noticed in the plots supplied with the highest rates of potassium whereas inferior vase life was observed in the plots where fertilizers were not applied (Amin *et al.*, 2015) [1] in gerbera.

Plant Analysis

The result (Table 2) indicated that there were no significance differences in leaf N content among the treatments. However, the nitrogen content in leaves were maximum with the application of highest levels of potassium as recorded by Chouhan *et al.*, 2014 [4] in gladiolus, El-Naggar (2009) [5] in carnation, Naik and Barman (2006) [13] in orchid. But in term of P content in leaf, there was significant difference among the levels of potassium. The maximum leaf P content was recorded in 210 Kg/ha K_2O with value 0.63% followed by 180 Kg/ha K_2O with value 0.58%. The minimum P content in leaf (Table 2) is observed in control with recorded value 0.27%. The increase in P content in leaf might have been associated with the enhancement of potassium levels. This finding has been in agreement with Lin and Danfeng (2003) [11] in muskmelon. And there is no significant effect in leaf K content (Table 2) among the treatments. The finding in scontradiction with the findings of Lin and Danfeng (2003) [11] who reported that an increase in K contents in leaf leads to enhancement of K levels in muskmelon.

Conclusion and Recommendation

It is concluded from the experiment that application of 210 Kg/ha K_2O gives superior result in the growth, flowering and biochemical characteristics in Gladiolus (*Gladiolus grandiflorus* L.). In some parameters, treatments that are at par can also be suggested to apply based on the suitability of the soil and environment prevailing in the area. It is an upmost important to use an optimum levels of potassium along with nitrogen and phosphorous in order to give better result in the physiology of the gladiolus.

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