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Influence of various potassium rates in growth and yield characteristics of gladiolus corm under the acidic soil condition of Manipur

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Abstract
An experiment was laid out at the Horticultural Experimental Field of College of Agriculture, Central Agricultural University, Imphal during 2018 to examine the effect on different levels of potassium on growth and yield of gladiolus corm under the o acidic soil condition. The experiment was conducted assigning eight treatments in a randomized block design with three replications. The results generated from the experiment showed that the application of 210 Kg K_2O/ha gave the maximum number of leaves (8.63), plant height (74.44 cm), length of the leaves (52.83), corm weight (59.27 g), corm diameter(6.12 cm), number of cormels (22.33 Nos.), corm yield per ha in tones (0.219506 tonnes) and also gave the highest benefit-cost ratio (0.85). However, the control (without potassium) gives minimum growth, yield and benefit-cost ratio.

Keywords: Gladiolus, potassium, growth, corm, economic, yield

Introduction
Gladiolus (*Gladiolus grandiflorus* L.) is a classic perennial flower belongs to the family Iridaceae with its origin from South Africa. Also known as 'Sword lily', its wide variety of shades, erects spikes and large-sized blooms plus greater keeping quality makes it suitable to adorn for a room decoration and bouquet. It grows best on a site in sandy loam soil with bright sun. It is one of the important cut flower crops grown in India. It is the only flower crop which was accepted in European countries when grown in open field conditions. Hence as a cut flower, it has great potentially for export to European countries during winter months to earn valuable foreign exchange for the country (Mahadik *et al*., 2017) [10]. Potassium is one of the important nutrients which is required for growth and development of gladiolus crop. Potassium supplemented plants exhibited better vegetative and reproductive growth (Yasin *et al*., 2018) [14]. Wilfert (1980) [16] also asserted that potassium helps in reducing of bulb rotting underground. In ornamental geophytes, the size of the bulb is a critical factor, impacting plant growth and quality. In the absence of potassium, other major nutrient (nitrogen and phosphorous) alone cannot produce good quality corm due to imbalance nutrition. Therefore, the present investigation was carried out to find out the best level of potassium to be applied on Gladiolus in acidic soil to maximize the growth and yield characteristics of Gladiolus corm.

Materials and Methods
The present study was conducted in clay soil of Horticultural Experimental Field of College of Agriculture, Central Agricultural University, Imphal during the year, 2018. The experimental site was situated at 24°45´N latitude and 93°56´E longitudes at an elevation of 790 m above sea level where it falls under the Eastern Himalayan Region (ll) and the agro-climatic zone Sub-Tropical Zone (NEH-4) of Manipur (Experimental Agromet Advisory Service ICAR Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal). During the course of growing season, highest rainfall was recorded in the month of June (365.7 mm) and the maximum mean temperature (30 ºC) and minimum mean temperature (12 ºC) was found to be in the month of September and March, respectively. The relevant soil properties of the experimental field was determined. The mechanical analysis of the soils is determined by hydrometer method (Bouyoucos, 1951). The collected sample was analyzed for pH, P_2O_5, and K_2O using standard procedures as described by Jackson (1973) and available N (Subbiah and Asija, 1956) [13]. Organic carbon was determined by wet oxidation method of Walkley and

Black (1934). The experiment was laid out in Randomized Block Design (RBD) consisting of eight treatments and three replications. The treatments used in the study were 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 (180 kg/ha K_2O) and T_8 (210 kg/ha K_2O).

Thirty tones FYM per hectare were applied uniformly to all the plots two weeks ahead of planting. A uniform dose of N and P_2O_5 were applied to all the plots. Full doses of P, K and half dose of N were applied one week prior of planting and remaining half dose of n was applied after a month of planting. Cultivar "Oasis" was selected as test variety for the study. Required cultural practices viz. weeding, irrigation and other plant protection practices are being performed as and when needed. For vegetative growth parameters were taken at an interval of 30, 60 and 90 DAP.

Table 1: Physico-chemical characteristics of soil of the experimental site

Sand (%)	**14.95**
Silt (%)	32.15
Clay (%)	52.9
pH	4.79
Organic carbon (%)	2.93
Available N (kg/ha)	313.6
Available P_2O_5 (kg/ha)	21.3
Available K_2O (Kg/ha)	147.3

Results and Discussion

All the parameters, such as vegetative growth, corm and corm yield of Gladiolus recorded were significantly influenced by different application of potassium levels.

Effect on vegetative parameters

The variation in number of leaves per plant was significantly influenced by the different levels of potassium. The highest number of leaves per plant (8.63) was recorded with the application of 210 Kg K_2O/ha at 60 days after planting (DAP), was statistically at par with 180 Kg K_2O/ha (8.26). The minimum number of leaves per plant was recorded in control with values 5.81. The height of plant showed positive correlation with balanced doses of fertilizers simultaneously, high levels of potassium application encourage the lateral growth, number of branches and number of leaves (Khan *et al*., 1999) [17] in zinnia.

The maximum length of the leaf was observed with 210 Kg K_2O/ha (52.83 cm) which was statistically at par with 180 Kg K_2O/ha (49.67 cm) and 150 Kg K_2O/ha (47.42 cm). This might be due to the 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) [8] and Mahadik *et al*. (2017) [10] in gladiolus.

The variations in the height of the plants were significantly influenced by the different levels of potassium. Application of 210 Kg K_2O/ha recorded the maximum height (74.44 cm) of the plant at 60 DAP which was at par with 150 Kg K_2O/ha (70.05 cm). This might have been due to the outcome of better food intake as result of strong root system caused by optimum potassium present in soil. Similar finding has been reported by Carroll and Edward in tuberose.

Table 2: Influence of various potassium rate on vegetative growth parameters of Gladiolus

Treatment	**No. of leafs (60 DAP)**	**Length of the leafs (cm) (60 DAP)**	**Plant height (cm) (60 DAP)**
T_1– 0 (control)	5.81	41.31	60.75
T_2– 30 kg K_2O/ha	6.16	42.95	62.66
T_3– 60 kg K_2O/ha	6.50	43.37	59.95
T_4– 90 kg K_2O/ha	6.74	45.05	69.08
T_5–120kg K_2O/ha	6.94	45.73	65.82
T_6–150kg K_2O/ha	6.58	47.42	69.49
T_7–180kg K_2O/ha	8.26	49.67	70.04
T_8–210kg K_2O/ha	8.63	52.83	74.44
S.Ed (±)	0.61	3.17	3.94
CD (0.05)	1.32	6.80	8.45

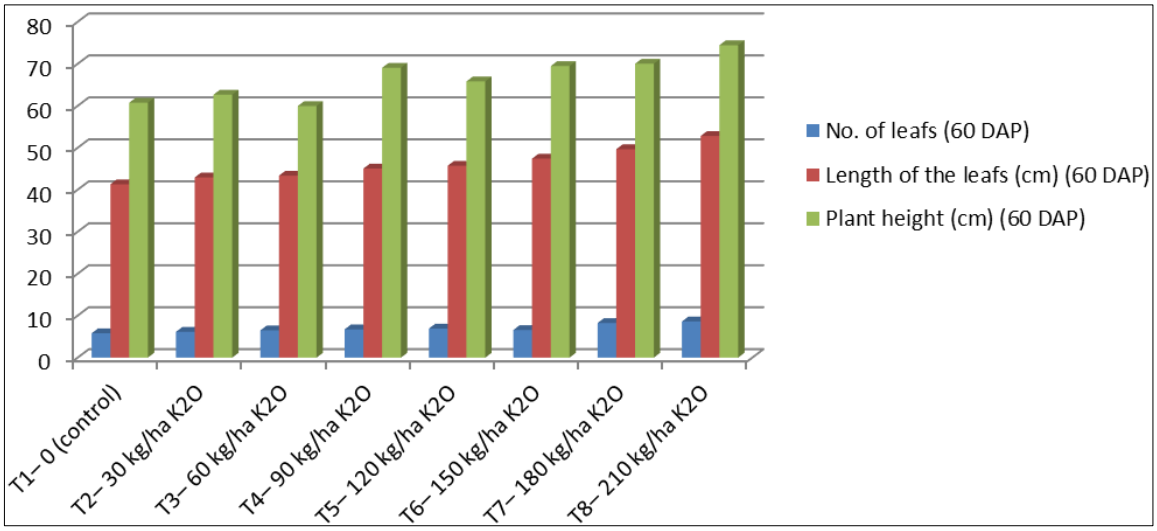

Fig 1: Influence of various potassium rate on vegetative growth parameters of Gladiolus

Effect on corm quality

At 60 DAP, the diameter of the corm was found increasing with the increasing levels of potassium. Best result was obtained from 210 Kg/ha K_2O with value 6.12 cm followed by 90 Kg/ha K_2O (5.27 cm), 120 Kg/ha K_2O (5.59 cm) and 180 Kg/ha K_2O (5.65 cm). The minimum diameter of corm was in control with value 4.39 cm. The increase in diameter of corm with increase in level of potassium might be due to the fact that potassium promotes bigger corm size by increasing water accumulation in the underground plant parts resulting in higher weight of corms and cormels as it regulates water conditions within the plant cell. These results are in conformity with those of Mahadik and Chopde (2015) [9] and Barman *et al.*, (2005) [2] in gladiolus.

The weight of the corm, the highest corm weight at 60 DAP is observed in 210 Kg/ha K_2O with value 59.27 g which was statistically at par with 180 Kg/ha K_2O (54.73 g). The minimum weight of the corm (40.52 g) was recorded with the application of 30 Kg/ha K_2O. Increase in the weight of the corm might be due to application of optimum amount of potassium as it is essential in the formation and transfer of starches and sugars. Similar finding has been attributed with that of Mukesh *et al.*, (2001) [12] in Gladiolus (*Gladiolus grandiflorus*). Barma *et al*., (1998) [1] also conclude that effects of K were much more pronounced on size and weight of corms and cormels.

Significantly the maximum number of cormels per plant was in 210 Kg/ha K_2O with value 22.33 numbers, which was statistically at par with 150 Kg/ha K_2O and 180 Kg/ha K_2O with values 19.37 and 20.20 numbers respectively. The minimum number of cormels per plant (10.93 nos.) was recorded in control. Cormlets formation and development is based on foliage and when the foliage is good enough, with proper plant height and number of leaves, the plant produce sufficient photosynthates that support cormel formation. This finding is in harmony with that of Misra (1994) [11] in gladiolus. Furthermore, Bhandal and Malik (1998) [3] also support a similar finding which states that higher amount of potassium might have had a beneficial effect on translocation of newly synthesized photosynthates and mobilization of stored material present in the mother corm and consequently increased the production of cormels.

Effect on corm yield

There is significant effect on yield of corm per ha in tonnes with the application of potassium. The highest yield was recorded in 210 Kg K_2O/ha with value 6.52 tonnes followed by 180 Kg K_2O/ha with value 6.02 tonnes. The minimum yield of corm per hectare was found in 30 Kg K_2O/ha with recorded value 4.46 tonnes. Yield of corms and cormels in gladiolus were increased with better vegetative growth which might have increased photosynthesis resulting in assimilation of more carbohydrates and their translocation to the corms and this might be the probable cause for increase in corms and cormels yield. Similar increase in corm yield due to higher dose of potassium was also reported by Mahadik and Chopde (2015) [9], Zubair (2012) [17] and Barman *et al*., 2005 in gladiolus.

Table 2: Influence of various potassium rates on corm quality and corm yield parameters of Gladiolus

Treatment	Corm weight (g)	Corm diameter(cm)	No. of cormels per plant	Corm yield per ha in tonnes
T_1– 0 (control)	42.68	4.39	10.93	4.69
T_2– 30 kg/ha K_2O	40.52	5.19	11.94	4.46
T_3– 60 kg/ha K_2O	45.86	5.10	13.33	5.04
T_4– 90 kg/ha K_2O	47.87	5.22	15.00	5.26
T_5– 120 kg/ha K_2O	51.56	5.27	16.20	5.67
T_6– 150 kg/ha K_2O	53.02	5.59	19.37	5.83
T_7– 180 kg/ha K_2O	54.73	5.65	20.20	6.02
T_8– 210 kg/ha K_2O	59.27	6.12	22.33	6.52
S.Ed (±)	2.50	0.35	1.66	0.27
CD $_{(0.05)}$	5.36	0.75	3.56	0.67

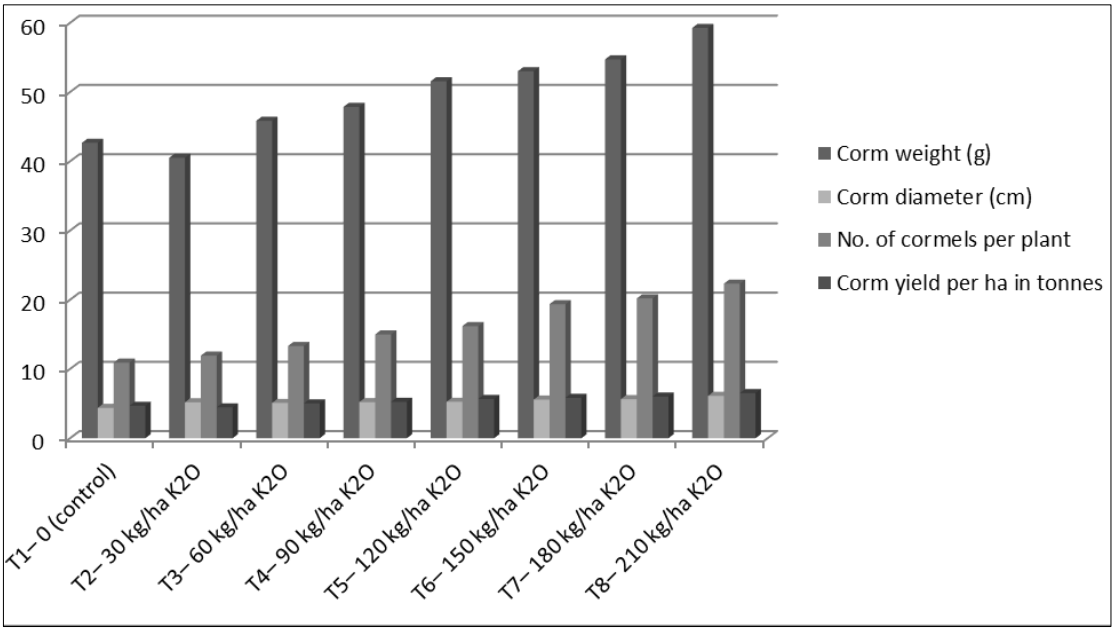

Fig 2: Influence of various potassium rates on corm quality and corm yield parameters of Gladiolus.

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