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Impact of GA_3 on corm nutrient and yield of gladiolus (*Gladiolus hortensis*) (cv. Punjab Dawn)

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Gladiolus (*Gladiolus hortensis* L.) Queen of bulbous flowers belongs to family Iridaceae. It contains approximately 260 species (Singh 2014). Gladiolus is world famous for cut flower with attractive spikes and long vase life. It is the second most important flower after rose (Sajjad *et al.* 2014). Plant growth regulators have vital role to improve the growth, yield and quality of flowers and also important in increasing intensity of nutrient uptake (Janowska *et al.* 2018). Gladiolus is propagated from their underground storage structure which is commercially known as corm. It has capacity to store food and uptake nutrient in reserved form. Due to their low rate of multiplication and higher rate of corms spoilage during storage, there is an insufficient availability of propagating material (Memon *et al.* 2009) to meet the demand of growers. Therefore, keeping in view the importance of gibberellic acid and plant propagules the present investigation was undertaken to assess the effect of gibberellic acid and number of buds in corm on nutrient status (nitrogen, phosphorus and potassium) and corm yield.

An experiment was conducted during 2017–18 and 2018–19 at the Horticulture Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. Experiment was conducted on gladiolus cultivar Punjab Dawn. The experiment was laid out in Randomized Block Design (RBD) and replicated thrice utilizing combination of three levels of GA_3 (control, 100 ppm and 200 ppm) and different number of buds in corm (1 bud, 2 bud, 3 bud, 4 bud, 5 bud and 6 bud). Corms were cut for 1-3 buds per corm, whereas whole corms were used for plantation having 4-6 buds. Before plantation corms were treated with GA_3 100 ppm, 200 ppm and control (distilled water) for 24 h. Corms were planted at 30 cm × 20 cm distance and 10 cm deep. Uniform cultural practices were followed to grow the crops. Corms sample were collected after digging of corms during the month of March in each year of experimentation (2017–19). Collected samples (corms) were washed then dried 4 days in sun light after then oven dried at 65–80°C for 48 h. After that corms were grinded using standard procedure for analysis of nitrogen, phosphorus and potassium. Digestion of plant samples was done as per described protocol by Singh *et al.* (2005). Data received from the lab and field experiment were statistically analysed using standard methods at 5% level of significance.

Nutrient status of corm: Impact of GA_3 and number of bud of corms on nutrient uptake were found significant to each other (Fig 1). Maximum percent of nitrogen was observed in 5 bud corm (8.89% and 8.02%) and minimum was recorded in 3 bud corm (5.94%) and 6 bud corm (6.41%) during both the year of experiment. Treatment GA_3 200 ppm showed higher N uptake (8.06% and 7.91%) in corm which was at par with GA_3 100 ppm and least in untreated corm. Maximum accumulation of N was found from the treatment combination of 5 bud and GA_3 200 ppm (10.99% and 9.24%) during first and second year of the experiment, respectively. Minimum nitrogen percent (3.36%) in first and second year (5.37%) was found with 2 bud 100 ppm GA_3. In context of phosphorus, its maximum accumulation was observed in 5 bud corm (16.59% and 19.68%) and minimum was recorded with 3 bud (10.06%) and 1 bud (12.44%) respectively and in case of GA_3 application maximum P uptake was found at 200 ppm concentration of GA_3 and minimum was recorded under control. Maximum and significantly more phosphorus content was recorded 17.26% and 21.88% at 200 ppm GA_3 and 6 bud corm and 200 ppm GA_3 and 5 bud corm during first and second year of trial, respectively. However, single bud and control corms in both the year of experiment have least percent of phosphorus (4.25% and 7.11%).

Number of bud and GA_3 treatment influenced the percentage of potassium uptake in the corm. Higher content of K was observed in 6 bud i.e. 7.41% and 5.82% in GA_3 200 ppm during first year of trial, and during second year of investigation maximum percentage of K (9.57%) was observed in 6 bud and (8.16%) 200 ppm GA_3. During first as well as second year of experiment highest potassium percent (11.93% and 15.87%) accumulation recorded in treatment combination of 6 bud and 200 ppm GA_3. Treatment

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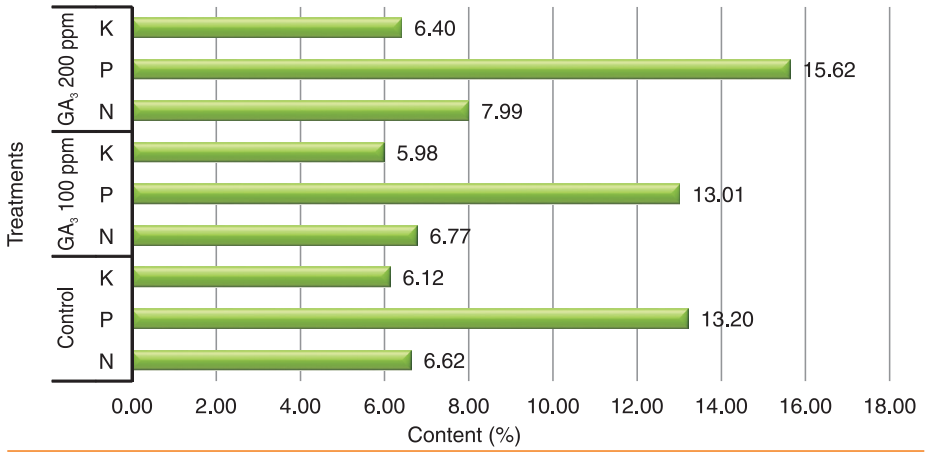

Fig 1 Average effect of GA_3 and corm division on NPK content (%) in corms during both the growing season.

number of daughter corms and cormels (Bharti *et al.* 2017).The maximum weight of corms per hill was observed in 4 bud (35.17 g and 23.97 g) during both the year of investigation and weight of corms (36.76 g and 23.61 g) increased with higher dose of GA_3 (200 ppm) during first and second year of experimentation and the weight of cormels (4.03 g and 2.79 g) per hill was highest in 4 bud both the year of trial and higher dose of GA_3 (200 ppm) showed maximum weight of cormel (2.84 g and 2.79 g)

Table 1 Average effect of GA_3 and corm division on number of corms and cormels/hill during both the growing season

Treatment	Control		GA_3 (100 ppm)		GA_3 (200 ppm)	
	Corms/ hill	Corms/ hill	Corms/ hill	Corms/ hill	Corms/ hill	Corms/ hill
1 bud	25.36	3.15	27.39	3.515	29.61	6.91
2 bud	24.435	7.46	25.195	6.655	29.66	10.24
3 bud	21.67	5.89	20.775	6.025	28.64	9.375
4 bud	26.965	6.11	28.245	6.11	33.5	12.145
5 bud	25.305	7.95	27.485	10	32.715	9.885
6 bud	25.235	11.50	26.765	11.735	26.97	14.215
Mean	24.83	7.01	25.975	7.34	30.185	10.46

combination of 1 bud and 200 ppm GA_3 gave minimum (2.75% and 3.90%) potassium content during both the years.

In context of GA_3, an increase in nutrient uptake due to application of higher concentration of GA_3 showed maximum accumulation of macro nutrients. GA_3 signalling was involved in adjustment of plants under adverse environmental conditions and maintains source-sink relation according to Iqbal *et al.* (2011). These findings are similar to the observations made by Badge *et al.* (2015) in marigold i.e. GA_3 amplified the accumulation of nutrients in reserved form.

Corm and cormel parameters: Whole corm (4 bud, 5 bud and 6 bud) and higher dose of GA_3 i.e. 200 ppm significantly increased number of corms, weight, diameter, number of cormels and weight of cormels per hill (Table 1). Number of buds of different corm size (whole as well as cut) also influenced the yield of corms. Maximum number of corms (4.79 and 4.95) per hill was observed in 6 bud and in context of GA_3, high dose of GA_3 i.e. 200 ppm GA_3 showed maximum number of corm (3.03 and 3.30) during first and second year of experimentation and least number of corms per hill was recorded in cut corm. Whole corm showed maximum number of cormels per hill (12.52 and 12.44) and treatment of 200 ppm GA_3 recorded more number of cormels per hill (10.46) than other doses of GA_3. Large size of parental corms produced maximum during first and second year of experiment. These results are in agreement with the findings by Khan *et al.* (2011). Corm diameter was significantly influenced by application of GA_3 and corm division, was also stated by Laishram and Hatibarua (2009). GA_3 treatments might help in enhancing mobilization of stored reserve materials (Bhalla and Kumar 2008 and Thapa *et al.* 2019). Weight and diameter of corms were increased mainly due to storage of adequate amount of food material which was translocate to the daughter corms from mother corm (Mahasen *et al.* 2015). Highly significant effect of cut corm technique was reported on number of corm/plant (Memon *et al.* 2009).

SUMMARY

Nutrient status in gladiolus corms were assessed following GA_3 treatment and number of bud of corm (cut as well as whole corm). The experiment was laid out in randomized block design involve factorial combination with three replications. Result revealed that 5 bud and GA_3 200 ppm showed maximum (10.99% and 9.24%) nitrogen uptake whereas phosphorus accumulation (17.26% and 21.88%) was recorded maximum in 200 ppm GA_3 and 6 bud corm and 5 bud with 200 ppm GA_3 gave maximum (11.93% and 15.87%) potassium content. Minimum (3.36% and 5.37%) nitrogen accumulation was exhibited with 1 bud and control and 2 bud and 100 ppm GA_3 application,

in context of phosphorus, minimum (4.25%) and (7.11%) was observed with 1 bud and control (distilled water) corms and also potassium uptake was least (2.75%) and (3.90%) in 1 bud and 200 ppm GA_3. Similarly corm and cormel parameters were influenced by whole corms which were treated with 200 ppm GA_3 in the both year of experiment. Hence, whole corm as well as higher concentrations of GA_3 (200 ppm) enhanced uptake of N, P, K in harvested gladiolus corm as well as corm yield due to potential of enhancing the source-sink relationship.

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