Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(5): 1053-1056
Received: 05-06-2020
Accepted: 12-07-2020

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Effect of split application of phosphorus on corm and cormel prodution of Gladiolus (*Gladiolus grandiflorus* L.) "Candyman" under Bhubaneswar condition

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Abstract
The present investigation for knowing the effect of split application of phosphorus on corm and cormel production of Gladiolus (*Gladiolus grandiflorus* L.) "Candyman**"** under Bhubaneswar condition was conducted at College of Agriculture, OUAT, Bhubaneswar, Odisha during the period from 7th November 2018 to 10th April 2019. The experiment was laid out with thirteen treatment and three replications following RBD to study the effect of different doses and number of split application of phosphorus in gladiolus. The treatments include four levels of phosphorus doses (10g, 20g, 30g, 50g) and three levels of number of split application at 15, 30, 45 days after planting with a constant dose of 40g nitrogen in two equal split at 15days and 30 days after planting and 30g. potassium after 15 days of planting and T_{13} as control without any fertilizer application. The results derived from the experiment indicate that application of phosphorus exhibited significant improvements in contrast to which the control plots experienced poor yield of corm and cormels. Among different treatments maximum number of corms per plant, maximum fresh weight of corms, maximum diameter of corm and maximum number of cormels per plant was recorded in T_{11} (30g. phosphorus in 3 equal split at fortnightly interval).

Keywords: Gladiolus, phosphorus, split application, corm and cormels, yield

Introduction
Gladiolus is grown as a cut flower commercially for it's in the state of Odisha as well as in India. In landscape gardening it is used for display due to its various colours. In gardens, it is generally suitable for herbaceous border, bedding, rockeries and pot culture. Among several factors having influence on growth, flowering and corm production of Gladiolus nutrients especially the primary nutrients like nitrogen, phosphorus and potassium plays a very significant role. Fertilizer requirements for rapidly growing gladiolus vary with climatic conditions, irrigation method and soil type (Wilfret, 1980) [13]. It is necessary to provide fertilizer frequently in sandy soil, especially during the rainy season.

Often phosphorus is the limiting element in soil. Primarily it is absorbed as the monovalent phosphate anion ($H_2PO_4^{-1}$) by plants and then after less rapidly as the divalent anion($H_2PO_4^{-2}$). Abundance of these two ions is controlled by soil pH. Acidic pH favours abundance of $H_2PO_4^{1}$ where as pH above 7 favours the $H_2PO_4^{-2}$ ion. Phosphorus deficient plants have stunted growth and in contrast to nitrogen deficient, are often found dark green in colour. Maturity is often delayed compared to plants containing abundant phosphorus. Phosphorus is an important constituent of many sugar phosphates involved in photosynthesis, respiration and other metabolic processes and it is also part of nucleotides and the phospholipids present in the membrane. Being a part of ATP, ADP, AMP and pyrophosphate (PPi) It also plays an essential role in energy metabolism (Salisbury and Ross, 1992) [10]. Phosphorus deficiency also responsible in a loss in cell integrity (Ratnayake *et al*., 1978) [9]. Phosphorus has significant effect in growth of gladiolus and it is observed that phosphorus caused the tallest plants. Phosphorus also increases number of leaves /clump (Pandey et *al*., 2000) [8].

Gladiolus being excellent cut flower of long shelf life gaining popularity in capital city of Odisha like, Bhubaneswar, for decoration of co-operative meeting halls, parties, office tables. On an average 2-3 lakhs of spikes, 2.5- 3lakhs of corms, 15-20lakhs of cormels of gladiolus can be obtained from one hectar area (Shyamal, 2014). Hence regarding both potential production and increasing market demand and price gladiolus is a profitable business for farmers of Odisha and so it is necessary to decide and follow the cultural practices specially the nutrient management for gladiolus in accordance to climate and soils of Odisha especially Bhubaneswar condition. However studies about requirement of phosphorus and application

frequency for better utilization by plants to achieve the higher yield in field condition are limited and detailed information regarding these are inadequate.

Keeping these view, to conduct an experiment on ''Effect of split application of phosphorus on vegetative and reproductive growth of Gladiolus (*Gladiolus Grandiflorus* L.)
"Candyman" under Bhubaneswar condition.'' in was found to be worthwhile.

Material and Methods

The present experiment was undertaken in the form of field experiment in open condition in front of the administrative block at College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar during the year 2018-2019. The experiment site is situated inside the college campus of College of Agriculture, Odisha University of Agriculture and Technology, Siripur, Bhubaneswar. This capital city of Odisha is situated 63km away from Bay of Bengal, at an altitude of 25.5 m. above the mean sea level. Geographically location of Bhubaneswar is at 20^0 15' North latitude and 85^0 15' East longitude. In Bhubaneswar condition sub tropical climate is experienced. The mean annual precipitation of Bhubaneswar is 1522 mm out of which 1293 mm is received within June to Septmber during the onset of mosoon and the rest 229 mm is received during October to May. The average maximum temperature ranges of 35^0C to 40 ^{0}C in summer particularly during May and June and in winter the minimum temperature fluctuate in between 13^0C to 15^0C during the month of December and January. The relative humidity varies between 50% in summer and 90% in the rainy season. The corms of gladiolus were brought form Govt. Nursey of Kalyani BCKV, West Bengal under AICRP on Floriculture, OUAT, Bhubaneswar. Candiman is exotic variety of gladiolus. It is locally known as Rani.

The experiment was conducted at College of Agriculture, OUAT, Bhubaneswar, Odisha during the period from 7th November 2018 to 10th April 2019. The experiment was laid with 12 treatments and one control treatment (without any fertilizer application) and three replication in RBD. The details of the treatments are T_1 (10g phosphorus/m^2, T_2 -20 g phosphorus/m^2), T_3 (30g phosphorus/m^2 once),T_4 (50 g phosphorus/m^2 once),T_5 (10g phosphorus/m^2 in 2 splits at fortnight interval), T_6(20g phosphorus/m^2 in 2 splits at fortnight interval, T_7- 30g phosphorus/m^2 in 2 splits at fortnight interval), T_8(50g phosphorus/m^2 in 2 splits at fortnight interval), T_9(10g phosphorus/m^2 in 3 splits at fortnight interval), T_{10}(20g phosphorus/m^2 in 3 splits at fortnight interval), T_{11}(30g phosphorus/m^2 in 3 splits at fortnight interval), T_{12}(50g phosphorus/m^2 in 3 splits at fortnight interval), T_{13} (control–No fertilizer application). The whole experimental area comprised of 39 plots of 1m^2. The gladiolus bulbs are planted with 30×25 cm^2 with a depth of 5-7cm depth. Besides phosphorus standard dose of nitrogen and potassium was given. All three nutrients were applied from straight fertilizers urea (46% N), single superphosphate (16% P_2O_5), muriate of potash (60% K_2O_5). 40g of nitrogen in two splits at fortnight interval and 30g of potassium once after 15days of planting was given in each plot except control. Rest half of the nitrogen was given 15 days after first application. For recording various biometric observations, three plants under each treatment and replication were selected at random. The selected plants were labelled properly with steal labels. The data recorded on five plants for various parameters were averaged and the mean values were used for statistical analysis.

Statistical Analysis

Analysis of variance of different variables was carried out to know the degree of variation among all the treatments. The data obtained from various characters under study were analyzed by the method of analysis of variance as described by Gomez and Gomez (1984).

Fig 1: Show the tree

Result and Discussion

It has been observed that application of phosphorus gives better results on vegetative parameters and increased significantly over control. Phosphorus is essesntial for cell division and fat and albumin production and hence it directly improves the vegetative characters like plant height, number of leaves, leaf width and plant spread. Phosphorus being involved in development of lateral fibrous rootlets also help in intake of other nutrients and help in growth and development of plant. Various studies on this aspects revealed that phosphorus application significantly influenced the vegetative characters as reported by Pandey *et al*. (2000) [8], Baweja *et al.* (2001) [1], Haokip and Singh (2005) [5] and Chandana and Dorajeerao (2014) [6].

Plant height varied significantly among the different treatments and maximum plant height 89.22 cm was recorded in treatment T_4 (50gram phosphorus applied once). Minimum plant height was recorded in control i.e. 72.00 cm. The highest plant height observed due to application higher doses of phosphorus as reported by Pandey *et al.* that phosphorus has significant effect in growth of gladiolus and phosphorus caused the tallest plant and also supported by Baweja *et al.* (2001) [1] that phosphorus caused significant increase in plant height.

Among all the treatment maximum number of leaves per plant was recorded in treatment T_4 (50 gram phosphorus applied once) i.e. 9.44 followed by T_8 (50 gram phosphorus in 2split doses at fortnight interval) i.e. 8.88 which are statistically at par. Minimum number of leaves per plant was recorded in control (7.44). This result was also supported by by Pandey *et al*. (2000) [8] and Chandana and Dorajeerao (2014) [6].

The leaf width varied significantly among different doses and number of split application phosphorus. Leaf width was significant increased by fertilizer application over control. Among all the treatments maximum leaf width (3.24cm) was recorded in treatment T_4 (50gram phosphorus once). Minimum leaf width was recorded in control plot(2.53cm). The result was well supported by Haokip and Singh (2005) [5] that application of phosphorus increases leaf area hence also the leaf width and was well supported by Chandana and Dorajeerao (2014) [6].

Among all the treatment maximum plant spread was recorded in treatment T_8 (50gram phosphorus in 2split doses at fortnight interval) i.e. 31.83 cm and second highest plant spread (30.33cm) was recorded in treatment T_4 (50gram phosphorus once) which is statistically at par with T_8. Minimum plant (24.33cm.) spread was recorded in control. This result was suppoetrd by Chandana and Dorajeerao, 2014

[6] that phosphorus influenced vegetative parameters and growth parameters like crop growth rate and net assimilation rate.

From the result, it can be observed that reproductive characteristics of gladiolus was significantly influenced by application of different doses of phosphorus and their of split application as phosphorus important for flowering, fruiting including seed formation. The result shows application of phosphorus in higher levels improved the quality of flower which is well supported by Bhattacharjee (1981). The result was also well supported by Gowda, Jayanthi and Raju (1988) [4], Baweja *et al*. (2001) [1], Mishra (2004) [7].

The number of florets per spike was recorded maximum in treatment T_7 (30gram phosphorus in 2 split at fortnightly interval) i.e. 15.11 florets per spike and followed by treatment T_3 (30 gram phosphorus applied once) i.e. 13.77 florets per spike which is statistically at par with treatment T_7. Minimum number of floret (10.33) was recorded in control. The result was well supported by Baweja *et al*., 2001 [1] and Chauhan *et al.*, 2014.

Maximum number of spike per m^2 was recorded in treatment T_7 (30gram phosphorus in 2 split at fortnightly interval) i.e. 15.66 and minimum number of spike per m^2 (11.33) was recorded in control plot. The similar result was found by Gowda, Jayanthi and Raju (1988) [4].

The number of corms per plant varied significantly among different doses and number of split application of phosphorus. Number of corns per plant was significantly increased by fertilizer application over control. Maximum number of corms per plant (1.88) was recorded in T_{11}(30gram phosphorus in 3 split at fortnightly interval) followed by both T_3 (30 gram phosphorus applied once) and T_7 (30gram phosphorus in 2 split at fortnightly interval) i.e. 1.55 which is statistically at par with T_{11}. The result was well supported by Mishra (2004) [7] and Sharma and Singh (2007) [11].

The fresh weight of corm varied significantly among different doses and number of split application of phosphorus. Fresh weight of corm was significantly increased over control by application phosphorus. Maximum fresh weight of corm(97.33 grams) was recorded in T_{11}(30gram phosphorus in 3 split at fortnightly interval) minimum fresh weight of corm(61grams) was recorded in control plot. The similar result was reported Mishra (2004) [7] and Sharma and Singh (2007) [11], The diameter of corms per plant varied significantly among different doses and number of split application of phosphorus. Diameter of corm per plant was significantly increased by fertilizer application over control. Maximum diameter of corm (7.32 cm.) was recorded in T_{11}(30gram phosphorus in 3 split at fortnightly interval) followed T_3 (30 gram phosphorus applied once) i.e. 6.99cm, which is statistically at par with T_{11}. Minimum diameter of corm was recorded in control plot. The similar result found by Sharma and Singh (2007) [11].

The number of cormels varied significantly among different doses and number of split application of phosphorus. Number of cormels was significantly increased over control by application phosphorus. Maximum number of cormels (9.55) per plant was recorded in T_{11}(30gram phosphorus in 3 split at fortnightly interval) and minimum number of cormels was recorded in control i.e. 0.88. Mishra (2004) [7] also reported the same result.

Though there is no significance difference observed in weight of cormel and diameter of cormel Maximum weight (0.89 gram) was recorded in T_{11} (30gram phosphorus in 3 split at fortnightly interval) and minimum cormel weight (0.13gram) was recorded in control and also maximum diameter of cormel was recorded in treatment T_{11} (30gram phosphorus in 3 split at fortnightly interval) and the minimum diameter of cormel (0.11cm) was recorded in control. The result was similar with the result found by Singh and Sharma (2007) [11].

Table 1: Effect of split doses of phosphorus on corm and cormel production of Gladiolus cv. Candyman

Treatments	Plant height (cm)	Number of leaves per plant	Leaf width(cm)	Plant spread in N-Sdirection (cm)	Number of florets per spike	Number of spike per m^2
T_1	77.92	8.33	2.89	25.55	13.11	12.66
T_2	79.66	7.55	2.88	27.66	13.22	12.66
T_3	77.11	8.44	3.00	29.03	13.77	13.66
T_4	89.22	9.44	3.24	30.33	12.11	12.33
T_5	72.64	8.44	2.80	28.66	12.66	12.33
T_6	79.22	8.10	2.87	28.88	12.77	13.66
T_7	77.66	8.00	2.95	28.90	15.11	15.66
T_8	78.55	8.88	2.98	31.83	13.11	11.33
T_9	73.22	7.66	2.68	28.33	13.00	12.00
T_{10}	80.33	8.55	2.82	28.55	13.11	11.66
T_{11}	76.32	8.55	2.88	28.17	13.22	12.00
T_{12}	76.99	8.33	2.96	27.77	13.11	12.33
Control	72.00	7.44	2.53	24.33	10.33	11.33
C.D.	7.53	0.86	0.24	2.66	1.65	2.10
SE(m)	2.56	0.29	0.08	0.90	0.56	0.71

Significant at 5%

Treatments	Number of corms per plant	Fresh weight of corm(g)	Diameter of corm (cm)	Number of cormels per plant	Weight of cormel (g)	Diameter of cormel(cm)
T_1	1.33	66.38	6.14	2.88	0.42	0.35
T_2	1.44	78.05	6.21	2.22	0.53	0.53
T_3	1.55	48.40	6.99	1.55	0.41	0.28
T_4	1.00	82.66	5.74	2.33	0.72	0.62
T_5	1.33	43.51	5.76	2.51	0.08	0.21
T_6	1.44	60.16	5.83	6.88	0.34	0.26
T_7	1.55	67.05	6.33	1.99	0.33	0.37
T_8	1.44	66.36	6.19	2.77	0.36	0.51
T_9	1.22	64.49	6.06	3.00	0.27	0.22

T_{10}	1.33	69.88	6.16	6.66	0.62	0.60
T_{11}	1.88	97.33	7.32	9.55	0.89	1.12
T_{12}	1.55	61.49	6.20	1.88	0.70	0.68
Control	1.00	61.00	5.44	0.88	0.13	0.11
C.D.	0.44	10.78	0.98	0.75	N /A	N/A
SE(m)	0.15	3.67	0.33	0.25	0.24	0.23

Significant at 5% Nonsignificant 5%

Conclusion

The experiment is confirmed that application phosphorus in split application significantly increases corm and cormels production and application of 30g phosphorus in three equal splits gives highest yield of corm and cormels. Though application of 40g. Phosphorus show better vegetative growth but corm and cormels are the product of commerce. Hence we can suggest farmers to apply 30g phosphorus in three equal splits, who engaged in commercial Gladiolus planting material production in Bhubaneswar and nearby coastal Odisha.

Acknowledgement

I am very much thankful to my M.Sc. guide Dr. Manas Ranjan Nath for his ever willing help in preparation of this manuscript. I am also grateful to Dr. (Mrs.) Sashikala Beura, Dr. Siddarth Kumar Palai, Dr. Narayan Panda for their help and guidance during the period of investigation.

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