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Effect of split application of phosphorus on vegetative and reproductive growth of *Gladiolus* (*Gladiolus grandiflorus* L.) “Candyman” under Bhubaneswar condition

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Abstract

The present investigation entitled “Effect of split application of phosphorus on vegetative and reproductive growth 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 15 days and 30 days after planting and 30g. potassium after 15 days of planting and T₁₃ as control without any fertilizer application. The results derived from the experiment indicate that application of phosphorus exhibited significant improvements in vegetative characteristics, reproductive characteristics and production of corms and cormels. In contrast to this the control plots which are devoid of any fertilizers experienced poor vegetative growth along with inferior quality flower spike with less yield of corm and cormels. Among all the treatment treatment T₄ (50g phosphorus once at time) was shown best result with respect to vegetative parameters, including plant height, number of leaves per plant, leaf width and plant spread. and T₇ (30g phosphorus in two equal splits) was shown better reproductive growth in both quality and quantity (spike length, rachis length, spike per one square meter, number of florets per spike, flowering duration).

Keywords: Gladiolus, phosphorus, split application, growth, odisha

Introduction

Gladiolus is grown as a cut flower commercially for its in the state of Odisha as well as in India. In landscape gardening it is used for display due to its various colour. 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) [12]. 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 ($\text{H}_2\text{PO}_4^{-1}$) by plants and then after less rapidly as the divalent anion ($\text{H}_2\text{PO}_4^{-2}$). Abundance of these two ions is controlled by soil pH. Acidic pH favours abundance of $\text{H}_2\text{PO}_4^{-1}$ where as pH above 7 favours the $\text{H}_2\text{PO}_4^{-2}$ 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) [11]. Phosphorus deficiency also responsible in a loss in cell integrity (Ratnayake *et al.*, 1978) [10]. 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)^[9].

Gladiolus being excellent cut flower of long shelflife gaining popularity in capital city of Odisha like, Bhubaneswar, for decoration of co-operative meeting halls, parties, office tables. 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 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° 15' North latitude and 85° 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 September during the onset of monsoon and the rest 229 mm is received during October to May. The average maximum temperature ranges of 35°C to 40°C in summer particularly during May and June and in winter the minimum temperature fluctuate in between 13°C to 15°C 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 from Govt. Nursery of Kalyani BCKV, West Bengal under AICRP on Floriculture, OUAT, Bhubaneswar. Candyman 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 T₁ (10 g phosphorus/m²), T₂ (20 g phosphorus/m²), T₃ (30 g phosphorus/m² once), T₄ (50 g phosphorus/m² once), T₅ (10 g phosphorus/m² in 2 splits at fortnight interval), T₆ (20 g phosphorus/m² in 2 splits at fortnight interval), T₇ (30 g phosphorus/m² in 2 splits at fortnight interval), T₈ (50 g phosphorus/m² in 2 splits at fortnight interval), T₉ (10 g phosphorus/m² in 3 splits at fortnight interval), T₁₀ (20 g phosphorus/m² in 3 splits at fortnight interval), T₁₁ (30 g phosphorus/m² in 3 splits at fortnight interval), T₁₂ (50 g phosphorus/m² in 3 splits at fortnight interval), T₁₃ (control -No fertilizer application). The whole experimental area comprised of 39 plots of 1m². The gladiolus bulbs are planted with 30×25 cm² 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% P₂O₅), muriate of potash (60% K₂O₅). 40g of nitrogen in two splits at fortnight interval and 30g of potassium once after 15 days 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)^[4].

Result and discussion effect of split dose of phosphorus on vegetative growth of gladiolus (*Gladiolus grandifloras* L.) "Candyman"

It has been observed that application of phosphorus gives better results on vegetative parameters and increased significantly over control. Phosphorus is essential 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)^[9], Baweja *et al.* (2001)^[1], Haokip and Singh (2005)^[6] and Chandana and Dorajeerao (2014)^[7].

Plant height varied significantly among the different treatments and maximum plant height 89.22 cm was recorded in treatment T₄ (50 gram 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 T₄ (50 gram phosphorus applied once) i.e. 9.44 followed by T₈ (50 gram phosphorus in 2split doses at fortnight interval) i.e. 8.88 which are statistically at par. Minimum leaves per plant was recorded in control (7.44). This result was also supported by Pandey *et al.* (2000)^[9] and Chandana and Dorajeerao (2014)^[7].

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 T₄ (50 gram phosphorus once). Minimum leaf width was recorded in control plot (2.53cm). The result was well supported by Haokip and Singh (2005)^[6] that application of phosphorus increases leaf area hence also the leaf width and was well supported by Chandana and Dorajeerao (2014)^[7].

Among all the treatment maximum plant spread was recorded in treatment T₈ (50 gram phosphorus in 2split doses at fortnight interval) i.e. 31.83 cm and second highest plant spread (30.33cm) was recorded in treatment T₄ (50 gram phosphorus once) which is statistically at par with T₈. Minimum plant (24.33cm.) spread was recorded in control. This result was supported by Chandana and Dorajeerao, 2014^[7] that phosphorus influenced vegetative parameters and growth parameters like crop growth rate and net assimilation rate.

Table 1: Effect of split dose of phosphorus on vegetative growth of gladiolus (*Gladiolus grandifloras* L.) “Candyman”

Treatments	Plant height (cm)	Number of leaves per plant	Leaf width(cm)	Plant spread in N-Sdirection (cm)
T ₁	77.92	8.33	2.89	25.55
T ₂	79.66	7.55	2.88	27.66
T ₃	77.11	8.44	3.00	29.03
T ₄	89.22	9.44	3.24	30.33
T ₅	72.64	8.44	2.80	28.66
T ₆	79.22	8.10	2.87	28.88
T ₇	77.66	8.00	2.95	28.90
T ₈	78.55	8.88	2.98	31.83
T ₉	73.22	7.66	2.68	28.33
T ₁₀	80.33	8.55	2.82	28.55
T ₁₁	76.32	8.55	2.88	28.17
T ₁₂	76.99	8.33	2.96	27.77
Control	72.00	7.44	2.53	24.33
C.D.	7.53	0.86	0.24	2.66
SE(m)	2.56	0.29	0.08	0.90

Significant at 5%

Effect of split dose of phosphorus on reproductive growth of gladiolus (*Gladiolus grandifloras* L.) “Candyman”

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)^[2]. The result was also well supported by Gowda, Jayanthi and Raju (1988)^[5], Baweja *et al.* (2001)^[1], Mishra (2004)^[8]

Maximum spike length was recorded in treatment T₁₁ (30gram phosphorus in 3 split at fortnightly interval) i.e. 147.60cm. followed by treatment T₇ (30gram phosphorus in 2 split at fortnightly interval) i.e. 136.33cm which is statistically at par with T₁₁. Minimum spike length was recorded in control (121.66cm). The same result was also found by Mishra (2004)^[8] that 30 g phosphorus per 1 square meter gives maximum spike length and significant increase occurs due to phosphorus application which was supported by Baweja *et al.*, 2001^[1] and also supported by Gowda, Jayanthi and Raju (1988)^[5] that higher dose of phosphorus gave better result.

Maximum rachis length was recorded in treatment T₇ (30gram phosphorus in 2 split at fortnightly interval) i.e. 58.10 cm. followed by treatment T₁₁ (30gram phosphorus in 3 split at fortnightly interval) i.e. 55.44 cm which is statistically at par with T₇. Minimum rachis length was recorded in control plot (45.33cm). This result was supported by Baweja *et al.*, 2001^[1] and Gowda, Jayanthi and Raju (1988)^[5]

Maximum flower diameter of second floret (12.33cm) was recorded in treatment T₃ (30 gram phosphorus applied once) and minimum diameter of second floret was recorded in control i.e. 10.13cm. There is a significant difference in flower diameter among different doses and split application of phosphorus which was well supported by Baweja *et al.*, 2001^[1] and Gowda, Jayanthi and Raju (1988)^[5]

The number of florets per spike was recorded maximum in treatment T₇ (30gram phosphorus in 2 split at fortnightly interval) i.e. 15.11 florets per spike and followed by treatment T₃ (30 gram phosphorus applied once) i.e. 13.77 florets per spike which is statistically at par with treatment T₇. 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^[3].

Maximum number of spike per m² was recorded in treatment T₇ (30gram phosphorus in 2 split at fortnightly interval) i.e. 15.66 and minimum number of spike per m² (11.33) was recorded in control plot. The similar result was found by Gowda, Jayanthi and Raju (1988)^[5]

The spike circumference varied significantly among different doses and number of split application of phosphorus. Circumference of spike was significantly increased over control by application phosphorus. Maximum spike circumference (3.2cm) was recorded in treatment T₁₁ (30gram phosphorus in 3 split at fortnightly interval) followed by T₃ (30 gram phosphorus applied once) i.e. 3.02cm which is statistically at par with T₁₁ (30gram phosphorus in 3 split at fortnightly interval). Minimum spike circumference (2.40cm) was recorded in control.

The fresh weight of spike varied significantly among different doses and number of split application of phosphorus. Fresh weight of spike was significantly increased by fertilizer application over control. Maximum fresh weight of spike (140gm) was recorded in treatment T₁₁ (30gram phosphorus in 3 split at fortnightly interval) followed by T₃ (30 gram phosphorus applied once) i.e. 128gram which is statistically at par with T₁₁ (30gram phosphorus in 3 split at fortnightly interval). Maximum spike length and maximum spike circumference also caused maximum fresh weight of spike. Therefore this result also well supported by Mishra, (2004)^[8].

Maximum flowering duration of 15 days was recorded in both T₁₁ (30gram phosphorus in 3 split at fortnightly interval) and T₃ (30 gram phosphorus applied once) and then followed by treatment T₇ (30gram phosphorus in 2 split at fortnightly interval) i.e. 14days which is statistically at par with T₁₁ and T₃ and minimum duration of flowering (10days) found in control. This result was well supported by Mishra, (2004)^[8].

The vasselife of gladiolus varied significantly among different doses and number of split application of phosphorus. Circumference of spike of was significantly increased over control by application phosphorus. Maximum vase life (7days 12 hours) was recorded in treatment T₁₁(30gram phosphorus in 3 split at fortnightly interval). Minimum vase life (4days 16 hours) was recorded in control plot which was well supported by Chouhan *et al.* (2014)^[3]

Table 2: Effect of split dose of phosphorus on reproductive growth of gladiolus (*Gladiolus grandifloras* L.) "Candyman"

Treatments	Spike length (cm)	Rachis length (cm)	Flower diameter of second floret (cm)	Number of florets per spike	Number of spike per m ²
T ₁	129.78	51.33	11.03	13.11	12.66
T ₂	124.66	47.66	11.14	13.22	12.66
T ₃	128.89	48.16	12.33	13.77	13.66
T ₄	130.22	47.91	11.18	12.11	12.33
T ₅	132.05	51.43	11.15	12.66	12.33
T ₆	135.00	49.80	11.27	12.77	13.66
T ₇	136.33	58.10	10.80	15.11	15.66
T ₈	135.11	51.54	10.83	13.11	11.33
T ₉	131.33	49.55	11.13	13.00	12.00
T ₁₀	133.49	51.33	11.25	13.11	11.66
T ₁₁	147.60	55.44	11.28	13.22	12.00
T ₁₂	132.11	51.33	11.20	13.11	12.33
Control	121.66	45.33	10.13	10.33	11.33
C.D.	12.30	6.07	0.93	1.65	2.10
SE(m)	4.19	2.06	0.31	0.56	0.71

Significant at 5%

Table 3: Effect of split dose of phosphorus on reproductive growth of gladiolus (*Gladiolus grandifloras* L.) "Candyman"

Treatments	Spike circumference (cm)	Fresh weight of Spike(g)	Flowering duration	Vaselif
T ₁	2.67	120.00	11days16 hours	4days 18hours
T ₂	2.83	123.33	12days16hours	5days 20hours
T ₃	3.02	128.33	15days	5.18hours
T ₄	2.78	118.33	11days	5days 12hours
T ₅	2.65	112.33	10days16hours	4days 17hours
T ₆	2.82	100.667	11days 8hours	4days14hours
T ₇	2.84	108.33	14days	5days
T ₈	2.71	101.67	11days 8hours	5days 12hours
T ₉	2.73	98.33	11days 16hours	5days 4hours
T ₁₀	2.74	91.67	11days16hours	4days 16hours
T ₁₁	3.20	140.00	15days	7days 12hours
T ₁₂	2.83	88.33	11days 8hours	5days 23hours
Control	2.40	138.33	10days	4days 16 hours
C.D.	0.34	15.35	2.00	1.42
SE(m)	0.11	5.22	0.68	0.48

Significant at 5%

Conclusion

From the result and discussion it can be summerized that application of 50g. once at a time produced better vegetative growth (plant height, number of leaves per plant, width of leaves, plant spread) and From commercial point of view longer spike and rachis and more number of spike per one square meter per plant have great importance and all these characters combinly observed with application 30g. phosphorus in two equal splits at 15days interval. So we can recommend to apply 30g. phosphorus in two equal splits at 15 days interval for cultivation of gladiolus in Bhubaneswar condition.

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