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Effect of variable doses of nitrogen and phosphorus on gladiolus variety Candyman

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Abstract
The present investigation entitled "Effect of variable doses of nitrogen and phosphorus on gladiolus variety Candyman" was conducted in College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, during the period of October 2019 to March 2020. The experiment was laid out in Randomized block design, Replicated three times with 12 treatments each and control. The treatments include different levels of nitrogen (10 g, 20 g, 30 g and 50 g) and phosphorus (10 g, 20 g, 30 g and 50 g) and three split applications at 15, 30, 45 days after planting with a constant dose of potassium 30 g. Experimental results indicate that application of nitrogen and phosphorus improved the vegetative and reproductive parameters. Among all the treatments treatment T_7 gave the best results in terms of vegetative and reproductive parameters.

Keywords: Gladiolus, nitrogen, phosphorus, variable doses, Candyman

Introduction
Gladiolus (*Gladiolus grandiflorus* L.) is a South African native that belongs to the family Iridaceae and the subfamily Oxioideae. Pliny the Elder (A.D. 23-79) coined the name gladiolus to describe the shape of the leaves, which resembles that of a sword (the Latin word "gladius" means "sword"). Other names for it include sword lily and corn flag. Gladiolus is a popular herbaceous bulbous annual flowering plant. It is a very important commercial flower crop, with a significant role as a cut flower in both the domestic and international markets. It is second only to the tulip in the Netherlands and other European countries in the trade of bulbous crops for use as cut flowers, and fourth in the international trade of ornamental for cut flowers. Its long vase life makes it a popular cut flower after the rose. When compared to other cut flowers, gladiolus has the highest return (Singh, 2006) [1].

Nutrition is one of the most significant variables that directly determines spike yield and quality. Different agro-techniques play a vital part in the growth and development of the gladiolus crop. Gladiolus, a highly responsive crop to nutrition, necessitates considerable amounts of macronutrients such as nitrogen, phosphorus, and potassium (Shankar and Dubey, 2005) [2].

Nitrogen is a critical plant nutrient; plants typically contain 1-5 percent nitrogen by weight. It is a necessary component of protein and is found in a variety of other compounds that are vital to plant metabolism. Chlorophyll, which is the major absorber of light energy required for photosynthesis, contains nitrogen. Nitrogen promotes vigorous vegetative development and a dark green colour in plants, as well as early growth and plant maturation. Nitrogen also controls how potassium, phosphorus, and other elements are used. Nitrogen availability is linked to carbohydrate usage; when nitrogen levels are high enough, carbohydrates will be deposited in vegetative cells, causing them to thicken.

Phosphorus plays an important part in the storage and transfer of energy. Phosphorus is directly linked to cell division and development; it promotes early root formation and growth, which aids in the rapid establishment of seedlings. 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) [3]. Phosphorus deficiency also responsible in a loss in cell integrity (Ratnayake

et al. 1978) [4]. 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) [5].

Gladiolus flowers are becoming increasingly popular in Orissa, as they are in other parts of the country. Farmers in Orissa, particularly on the outskirts of Bhubaneshwar a great opportunity to diversify their agriculture and earn more money from their agricultural enterprise. Gladiolus, as a cut flower with a long shelf life, offers a good alternative for farmers looking to transition from traditional crops to high-value crops. Gladiolus has the potential to earn foreign currency. It has a short lifespan (110-120 days) Its wide varietal wealth, higher economic returns than conventional crops, and wide range of climatic conditions have all contributed to its growth potential. Seasonal marketing and employment in cities have increased as a result of the introduction of new social values.

The current study aims to determine the effect of various doses of Nitrogen and phosphorus levels on gladiolus flower growth, yield, and quality.

Materials and Methods

The field experiment was carried out from October 2019 to March 2020 to investigate the "Effect of variable doses of nitrogen and phosphorus on gladiolus variety candyman." The research was carried out in an open field in front of a new examination hall at the College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar. This chapter thoroughly describes the materials and method used to conduct the experiment. The experiment site is on the campus of the College of Agriculture, Odisha University of Agriculture and Technology in Bhubaneswar, Odisha's capital city, which is 63 kilometres from the Bay of Bengal and 25.5 metres above mean sea level (MSL). Bhubaneswar is located at latitude 20o 15' north and longitude 85o 15' east. Bhubaneswar experiences subtropical weather. Bhubaneswar receives an average of 1522 mm of precipitation per year. The average maximum temperature in summer ranges from 35°C to 40°C, particularly in May and June, and the minimum temperature in winter ranges from 13°C to 15°C in December and January. The relative humidity varies between 92% to 72%. The experiment was conducted The present experiment consisted 13 treatments (12+control) of different dose of Nitrogen and phosphorus fertilizers and a constant dose of potassium. The detailed information regarding the treatments is as follows

T_1 -10 g nitrogen+10 g phosphorus + 30 g potassium/m^2 once,
T_2 -20 g nitrogen+20 g phosphorus + 30 g potassium /m^2 once,
T_3 -30 g nitrogen+30 g phosphorus + 30 g potassium /m^2 once,
T_4 -50 g nitrogen+50 g phosphorus+ 30 g potassium /m^2 once
T_5 -10 g nitrogen+10 g phosphorus+ 30 g potassium /m^2 in 2 splits at fortnight interval T_6- 20 g nitrogen+20 g phosphorus + 30 g potassium /m^2 in 2 splits at fortnight interval T_7- 30 g nitrogen+30 g phosphorus + 30 g potassium /m^2 in 2 splits at fortnight interval T_8- 50 g nitrogen+50 g phosphorus + 30 g potassium /m^2 in 2 splits at fortnight interval T_9- 10 g nitrogen+10 g phosphorus + 30 g potassium /m^2 in 3 splits at fortnight interval T_{10}-20 g nitrogen+20 g phosphorus + 30 g potassium /m^2 in 3 splits at fortnight interval T_{11}-30 g nitrogen+30 g phosphorus + 30 g potassium /m^2 in 3 splits at fortnight interval T_{12}-50 g nitrogen+50 g phosphorus + 30 g potassium /m^2 in 3 splits at fortnight interval T_{13}- Control The experiment is comprised of 37 plots.

The bulbs are planted with a spacing of 30x25 cm. All the three nutrients were applied in the form of urea, single super phosphate and muriate of potash. For recording various biometric observations, three plants under each treatment and replication were selected and were averaged and their mean values are used for statistical analysis.

Results and Discussion

Nitrogen and phosphorus both the nutrients are essential for plant growth and development. Nitrogen had a positive effect on plant height because it is an important constituent of proteins, chlorophyll and amino acids, as evidenced by nitrogen content data. This could have resulted in improved photosynthesis. Phosphorus promotes the formation of rootlets and the growth of roots. It is also an important constituent of energy- rich compounds, making it an essential component of energy metabolism. This is involved in the synthesis of growth-stimulating compounds, nutrient absorption, cell division, and cell growth, all of which can lead to rapid growth. Plants with low levels of nitrogen and phosphorus, on the other hand, were underdeveloped and shorter in stature. These results were supported by the findings of Pandey *et al.* (2000) [5], Sharma *et al.*, Niengboihaokip and Singh and Chandana and Dorajeerao (2014) [11].

The plant height varied significantly with application of different doses and split application of nitrogen and phosphorus in different treatments maximum plant height was observed in treatment T_7 i.e., 66.87 cm (30 grams of nitrogen and 30 grams of phosphorus was applied twice). The minimum plant height was in T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 52.51cm. Patel *et al*. (2010) has observed that there is positive interaction of nitrogen and phosphorus which has significantly increased the plant height and this was also supported by Chandana and Dorajeerao (2014) [11].

Treatments	Plant height (cm)	Number of leaves per plant	Leaf width(cm)	Leaf length(cm)	Plant spread in N-S direction (cm)
T_1	52.50	5.97	2.12	36.42	36.42
T_2	57.33	6.75	2.38	43.30	43.70
T_3	55.62	6.64	2.43	43.35	43.35
T_4	59.82	6.64	2.50	43.09	43.09
T_5	58.84	6.75	2.60	41.65	41.65
T_6	61.78	6.81	2.63	43.70	43.49
T_7	66.87	7.01	3.05	48.27	48.27
T_8	58.82	6.67	2.49	40.62	40.62
T_9	60.22	6.44	2.49	42.49	42.49
T_{10}	59.84	6.30	2.35	41.43	41.43
T_{11}	60.18	6.46	2.33	40.55	40.55
T_{12}	56.58	6.36	2.46	43.49	43.30
Control	53.83	6.00	2.47	43.06	43.06
C.D.	5.726	0.402	0.343	1.752	1.752
SE (m)	1.962	0.138	0.465	0.666	2.375

Number of leaves per plant varied significantly in different treatments the maximum number of leaves were recorded in treatment T_7 (30 grams of nitrogen and 30 grams of phosphorus was applied twice) i.e., 7.01 and followed by T_6 (20 grams of nitrogen and 20 grams of phosphorus in 2 split doses at fortnight interval) i.e., 6.81 which is statistically at par with T_7.Minimum leaves per plant was recorded in T_1 (10 grams of nitrogen and 10 grams phosphorus applied once) i.e., 5.97.These results were supported by the Chaungrahvy (2002) [6], Shah and Seth (2002) [7] and Deswai, *et al*.

Among all the treatments maximum leaf width was observed in treatment T_7 Treatment T_7 had the largest leaf width (3.5 cm) of all the treatments (30 grams of nitrogen and 30 grams phosphorus applied twice). In T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) the minimum leaf width was measured (2.12 cm). These was well supported by findings of Rajiv *et al*. (2003) and Chandana and Dorajeerao (2014) [11].

Leaf length varied significantly among the different treatments. The highest leaf length (48.27cm) was observed in treatment T_7 (30 gram of nitrogen and 30 grams of phosphorus applied twice) while the second highest plant spread (43.70 cm) was found in treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus twice). Minimum leaf length was found in T_1(10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 2.12 cm. These results were supported by findings of Bose and Yadav (2004) [8] and Afifty (2003) [9] who reported that length of leaves increased with application of nitrogen.

There is a significance difference observed in plant spread the maximum plant spread was observed in T_7 (30 grams of nitrogen and 30 grams phosphorus applied twice) i.e., 48.27 cm, while the second highest plant spread (43.49 cm) was found in treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice), which is statistically at par to T_7. The T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) plant had a minimum spread 36.42 cm. These results were further proved by the findings of Chandana and Dorajeerao, (2014) [11] that the nitrogen and phosphorus influenced the vegetative and growth parameters.

Treatments	Spike initiation (days)	Spike length (cm)	Spike thickness (mm)	Rachis length (cm)	Flower bud initiation (days)	1st floret to second floret opening (days)	No of florets per spike	2nd floret diameter (cm)	Flowering duration (days)	Vase life (days)
T_1	70.90	92.52	5.42	31.76	6.33	2.67	8.52	8.68	8.49	4.11
T_2	64.30	97.55	7.11	37.44	5.33	2.22	10.22	9.44	9.33	4.67
T_3	63.59	110.01	7.14	33.21	5.00	2.22	9.52	9.74	9.56	4.44
T_4	63.33	115.28	7.30	32.62	5.22	2.44	8.56	9.91	9.44	4.67
T_5	62.39	105.77	6.76	36.79	5.55	2.44	10.00	9.94	9.71	4.55
T_6	61.37	119.55	7.34	38.12	4.89	2.22	10.40	10.12	10.45	4.78
T_7	60.73	127.79	8.47	42.73	4.67	2.00	11.80	10.61	11.11	5.56
T_8	61.67	101.39	7.33	32.27	5.56	2.45	9.63	9.37	10.11	4.67
T_9	63.67	104.37	7.16	34.47	5.78	2.22	9.82	9.83	10.44	4.33
T_{10}	63.33	111.67	7.04	32.79	5.44	2.44	9.42	9.76	9.87	4.45
T_{11}	64.56	114.73	6.93	32.69	5.55	2.44	9.37	9.68	10.44	4.67
T_{12}	63.56	104.58	7.11	32.89	5.78	2.44	9.18	9.93	10.00	4.56
Control	61.50	94.56	5.53	32.93	5.22	2.22	8.61	9.24	8.97	4.22
C.D.	2.768	13.469	1.182	4.014	0.688	N/A	1.373	0.781	0.919	0.427
SE(m)	0.948	4.614	0.405	1.375	0.236	0.178	1.860	0.267	0.315	0.146

Treatment T_7 (30 gram of nitrogen and 30 grams of phosphorus applied twice) had the maximum spike length of 127.59 cm followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) with 119.5 cm which is statistically at par with T_7. Minimum spike length was found in treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 92.52 cm. These results are supported with the findings of Anserwedekar and Patil (2004) [10], Afifty (2003) [9]. They all were of the opinion that increased Nitrogen-Phosphorus had significant impact on spike length.

Among all the treatments T_7 (30 gram of nitrogen and 30 grams of phosphorus applied twice) took minimum Number of days for spike initiation from planting i.e., 60.73 days and followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) took minimum no. of days for spike initiation from planting i.e., 61.37 days which is statistically at par with T_7. Maximum number of days is taken by treatment T_1(10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 70.90 days. Chanda *et al*. (2000) [11] reported that increase the doses of nitrogen resulted delayed the emergence of spike and nitrogen promote vegetative growth in gladiolus.

Maximum spike thickness was recorded in treatment T_7 (30 grams of nitrogen and 30 grams of phosphorus applied twice) i.e., 8.47mm and the second highest was found with treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) which is statistically at par with treatment T_7. Minimum spike thickness was recorded treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 5.12 cm. Similar results were found by Dhakal *et al.* (2017) [12] in Gladiolus.

Maximum rachis length was found in treatment T_7 (30 gram nitrogen and 30 grams of phosphorus applied twice) i.e., 42.73 cm followed by treatment T_6 (20 grams of nitrogen and phosphorus applied twice) i.e., 38.12 cm which is statistically at par with T_7. Minimum rachis length was observed in T_1 (10 grams of nitrogen and phosphorus applied once) i.e., 31.76 cm. These results were supported by findings of Lehri *et al.* (2011) [13] in gladiolus. Kumar *et al*. reported higher rachis length and spike length with higher dose of Nitrogen (148.26 kg/ha).

Minimum number of days taken for flower bud initiation was recorded in treatment T_7 (30 grams of nitrogen and 30 grams of phosphorus applied twice) i.e., 4.67 days followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 4.89 days which is statistically at par with T_7. Maximum number of days taken for flower bud initiation was recorded in treatment T_1 (10 grams of nitrogen and phosphorus applied once) i.e., 6.33 days. Similar observation was found by Pandhare *et al*. (2009) in tuberose and Gayithri *et al*. (2004) in statice.

Though there is no significance difference observed in first floret to second floret opening minimum number of days is recorded in T_7 (30 grams of nitrogen and 30 grams of phosphorus applied twice) i.e., 2 days and maximum number of

days is recorded in T_1 2.67 days.

Maximum number of florets were observed in treatment T_7 (30 grams nitrogen and 30 grams phosphorus applied twice) i.e., 11.80 florets per spike followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 10.40 florets per spike which is statistically at par with T_7. Minimum number of florets was recorded in T_1 i.e., 8.52 florets per spike. These results are in confirmation with the findings of Najjar and Rahalia (2005) [14] and Bhattacharjee (2001) [15]. They stated that the maximum number of florets per spike and large flowers were obtained with application of Nitrogen and phosphorus. Lehri *et al.* (2011) [13] also agreed with these results.

Maximum diameter of second floret was recorded in treatment T_7 (30 grams Nitrogen and 30 grams of phosphorus applied twice) i.e., 10.61 cm followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 10.12 cm which is statistically at par with T_7. Minimum diameter was observed in treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 8.68 cm. Regar *et al*. observed the higher floret width at higher dose of nitrogen (250 kg/ha) in cultivar American beauty.

Maximum flowering duration was observed in treatment T_7 (30 gram nitrogen and 30 grams of phosphorus applied twice) i.e.,11.11 days followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 10.45 days which is statistically at par with T_7. Minimum diameter was observed in treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 8.49 days.

Maximum vase life was observed in treatment T_7 (30 grams of nitrogen and 30 grams of phosphorus applied twice) i.e., 5.56 days. Minimum vase life was found in

Treatments	Number of corms per plant	Weight of corm (gm)	Diameter of corm (cm)	Number of cormels per plant	Weight of cormel (gm)	Diameter of cormel (cm)
T_1	1.00	26.23	2.68	9.22	0.60	0.62
T_2	1.11	46.20	4.40	10.44	1.10	0.76
T_3	1.11	46.53	4.27	10.52	1.32	0.91
T_4	1.22	44.07	4.39	11.33	1.23	0.88
T_5	1.22	42.27	4.57	11.78	1.29	0.92
T_6	1.33	54.87	4.96	12.78	1.42	0.98
T_7	1.78	61.13	5.46	14.22	1.64	1.08
T_8	1.22	48.13	4.71	13.78	1.33	0.87
T_9	1.22	51.07	4.44	10.67	1.27	0.88
T_{10}	1.11	50.73	4.38	13.11	1.41	0.91
T_{11}	1.11	52.57	4.27	10.22	1.29	0.93
T_{12}	1.11	46.53	4.42	12.00	1.27	0.84
Control	1.11	26.81	2.82	10.00	0.87	0.70
C.D.	0.277	10.407	1.185	1.862	0.302	0.159
SE(m)	0.095	3.565	0.406	0.638	0.103	0.054

treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 4.11 days. Chauhan *et al.* (2015) [17] observed higher vase life (14.32 days) with higher dose of nitrogen (225 kg/ha) and higher dose of phosphorous (112.5 kg/ha).

Maximum number of corms were observed in treatment T_7 (30 grams nitrogen and 30 grams of phosphorus applied twice) i.e., 1.78 corms followed by T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 1.33 corms which is statistically at par with T_7. Minimum number of corms were observed in T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 1.00. The present experimental findings are in line with the findings of Basnet *et al.* (2018) [18]

Maximum weight of the corm is recorded in treatment T_7 (30 gram nitrogen and 30 grams of phosphorus in 2 splits at fortnightly interval) i.e., 61.13 gm followed by T_6 (20 grams of nitrogen and 20 grams of phosphorus twice) i.e., 54.87 gm which is statistically at par with T_7. Minimum weight of the corm is recorded in treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 26.23 gm. Similar results were reported by Chandana and Dorajeerao (2014) [11].

Maximum diameter of corm observed in treatment T_7 30 grams of nitrogen and 30 grams of phosphorus applied twice) i.e., 5.46 cm followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 4.96 cm which is statistically at par with T_7. Minimum diameter of corm was observed in treatment T_1 (10 grams of nitrogen and phosphorus applied once) i.e., 2.68cm. Similar results were found by Ramesh and Singh (2006) [19].

Maximum number of cormels was recorded in treatment T_7 (30 gram of nitrogen and 30 grams of phosphorus applied twice) i.e., 14.22 followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 12.78 which is statistically at par with T_7. Minimum diameter of corm was observed in treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 9.22. Similar observations were found by Pant, and Sharma *et al.*

Maximum weight of the cormel is recorded in treatment T_7 (30 grams of nitrogen and 30 grams of phosphorus applied twice) i.e., 1.64 gm followed by T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 1.42 gm which is statistically at par with T_7. Minimum weight of the cormel is recorded in treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 0.60 gm.

Maximum diameter of cormel was observed in treatment T_7 (30 grams of nitrogen and gladiolus variety candyman" it may be 30 grams of phosphorus applied twice) i.e., 1.08 cm followed by treatment T_6 (20 grams of nitrogen and 20 grams of phosphorus applied twice) i.e., 0.98 cm which is statistically at par with T_7. Minimum diameter of cormel was observed in treatment T_1 (10 grams of nitrogen and 10 grams of phosphorus applied once) i.e., 0.62 cm.

Conclusion

From the present investigation "The effect of variable doses of nitrogen and phosphorus on concluded that application of 30 gram of nitrogen and 30 gram of phosphorus applied twice at fortnight interval enhance the vegetative parameters (Plant height, Number of leaves per plant, Leaf width, Leaf length and Plant spread), Reproductive parameters (Spike initiation, Spike

length, Spike thickness, Rachis length, Flower bud initiation, 1st floret to 2nd floret opening, Diameter of 2nd floret, Number of florets per spike and Vase life) and Corm parameters (Number of corms per plant, Fresh weight of corm, Diameter of corm, Number of cormels per plant, Fresh weight of cormel and Diameter of cormel) of gladiolus variety Candyman.

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