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Dishaben K Patel
Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

SL Chawla
Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

TR Ahlawat
Department of Fruit Science, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

Sudha Patil
Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

MA Patel
Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

Correspondence
Dishaben K Patel
Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

Effect of nitrogen and phosphorus on growth, flowering and yield of bird of paradise (*Strelitzia reginae*) under shade net

Dishaben K Patel, SL Chawla, TR Ahlawat, Sudha Patil and MA Patel

Abstract
The effect of three levels of each of nitrogen (20, 30 and 40 g N/plant/year) and phosphorus (10, 15 and 20 g P/plant/year) on growth, flowering and yield of bird of paradise was investigated in factorial completely randomized design with three replications. Result revealed that application of nitrogen and phosphorus @ 30 and 15 g P/plant/year, respectively to bird of paradise plants proved to be the optimum doses for obtaining maximum vegetative growth, best quality of flowers and higher inflorescence per plant per year.

Keywords: Bird of paradise, nitrogen, phosphorus, growth, flowering, yield

1. Introduction
The demand for specialty cut flowers is increasing due to a change in consumer preference and need for novelty. Therefore, concerted efforts require to explore the possibility of cultivating speciality flowers and standardizing the cultural practices for these. Bird of paradise (*Strelitzia reginae*) is one of the majestic flower crops grown in the regions having moderate subtropical and tropical climate. It belonging to the family Strelitziaceae, is one such flower which has great potential globally. This slow growing, evergreen perennial is native to South Africa. The plant produces spectacular blossoms with long stems, bright orange and blue flowers emerging from boat shaped bracts. The flowers have a long vase life and are gaining popularity as an exotic cut flower and therefore cultivated in many parts of the world in order to produce inflorescence for both local and export market. Most of the bird of paradise cultivars take several years to come in flowering as compared to other cut flowers like heliconia, where the flower yield is substantially higher per unit area from the initial year of growth.
Nutrients play a vital role in metabolic activities of plants. Nitrogen is responsible for synthesis of protein, amino acids, nucleic acids, chlorophyll and protoplasm of cell which help in harvesting solar energy through chlorophyll compounds. Phosphorus has a great role in energy storage and transfer. It serves as a structural component of cell constitutes like chloroplast and mitochondria, it is a part of sugar phosphates (ATP & ADP), which plays an inevitable role in photosynthesis and respiration, consequently leading to increase vegetative growth and flower production of plants. In this crop, very little research has been done on the nutritional aspect in India and abroad. Commercial cultivation of this crop is gradually gaining popularity in India and hence, it is important to standardize the nutrient requirement to realize higher yields and marketable quality of cut flowers.

2. Materials and Methods
The present experiment was laid out in Large Plot Technique and data were analyzed in Completely Randomized Design with Factorial concept (FCRD) with three replications under 50 per cent shade net during 2015-16 at Floriculture Research Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat. The experiment consisted three levels of each of nitrogen (20, 30 and 40 g nitrogen/plant/year) and phosphorus (10, 15, 20 g phosphorus/plant/year) with nine treatment combinations. The nitrogen and phosphorus was applied in four and two equal split doses, respectively. Nitrogen was applied in the form of urea and phosphorus in form of Single Super Phosphate. A common dose of potash (10 g/plant/year) was also applied to all plants of experiment. The treatment was imposed on three years old bird of paradise plants with spacing of 1.75m × 1.0 m to know the

effects of nitrogen and phosphorus on growth, flowering and yield. Observations on plant growth, flowering and yield attributing characters were recorded.

3. Results and Discussion

3.1 Effect of Nitrogen

Different levels of nitrogen significantly increased all the vegetative growth, flowering and yield parameters as compared to lower levels of nitrogen (Table 1). Application of N_2 treatment (30 g N/ plant/ year) resulted in maximum the plant height (162.61 cm), leaf length (48.17 cm), leaf width (18.22 cm), leaves/clump (28.33) and suckers/plant (5.64) at 12 month after treatment application while these parameters were minimum with the application of lower level of nitrogen (N_1).

The present findings are in close conformity with Aundkar (2008) [3] and Girish (2006) [8] in heliconia. Naik (2015) [13] also found the best results on vegetative growth parameters in heliconia with the application of N @ 20 g/plant. Increase in plant height and number of tillers/plant due to nitrogen application have also been reported by Singh *et al*. (2005) [19] in tuberose. The results are also accordance with Pandey *et al*. (2006) [14] in tuberose, Singh *et al*. (2015) [18] in carnation and Kumar *et al*. (2006) [10] in gladiolus.

The increase in various vegetative growth parameters of bird of paradise as a result of nitrogen application may be attributed to the association of nitrogen in the synthesis of protoplasm and primarily in the manufacture of amino acids and increase in auxin activities brought about the nitrogen fertilizer as a result of increased meristematic activities and hence the vegetative growth of plant increased (Tisdale and Nelsone, 1975). [21]

It is evident from the data (Table 1) that the different levels of nitrogen had significant effect on various flowering and yield parameters over lower level of nitrogen. Earliest flowering from initiation of inflorescence (41.56 days), maximum florets/bract (8.69), stalk length (102.11 cm) and longevity of inflorescence (26.31 days) were also recorded at N_2 treatment.

The present findings for appearance of first flower bud and duration of flowering are in accordance with the findings of Bhattacharjee *et al*. (1982) [5]; they observed that the application of 20 g N/m^2 induced early flower bud appearance in hippeastrum. Kumar and Singh (1998) [11] also observed the maximum periodicity of flowering (18.55 days) with the application of 300 kg N/ha as compared to control (13.80 days) in tuberose. The days to flowering from initiation of inflorescence may be explained by the fact that higher content of nitrogen might have also accelerated protein synthesis which promotes earlier floral primordial development (Vijay Kumar and Shanmungavelu, 1978) [22]. Increase in duration of flowering due to application of nitrogen, results in greater assimilation of carbohydrates in plant, which would have increased duration of flowering (Saini *et al*., 1978) [17].

Likewise, the number of flowers per plant was significantly increased due to application of different nitrogen levels. The maximum number of flowers/plant/year (3.50) was recorded in N_2 treatment.

These findings are in accordance with the results obtained by Nagaraju *et al*. (2003) [12] in rose cv. Gladiator, Ritu Jain and Gupta (2004) [16] also reported the similar increase in number of flowers per plant with increased rates of nitrogen in African marigold. The increase in number of flowers and yield with application of nitrogen might be due to the fact that applied nitrogen significantly increased the growth parameters, which might have synthesized more plant metabolites which ultimately lead to increase in flower production (Chan, 1959) [6].

Table 1: Effect of nitrogen and phosphorus on vegetative growth, flowering and yield of bird of paradise.

Treatments	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Leaves/ clump	Suckers/ plant	Days to flowering from initiation of inflorescence	Florets/ bract	Stalk length (cm)	Longevity of inflorescence (days)	Inflorescences /plant/ year
Nitrogen levels (N)										
N_1	152.08	42.69	15.08	24.25	4.86	43.44	7.97	99.89	24.61	2.94
N_2	162.61	48.17	18.22	28.33	5.64	41.56	8.69	102.11	26.31	3.50
N_3	161.25	47.69	17.39	27.06	5.42	43.03	8.42	101.42	25.97	3.19
C.D. at 5%	1.88	1.68	0.78	1.14	0.25	0.97	0.45	1.74	0.96	0.18
Phosphorus levels (P)										
P_1	156.25	43.75	16.11	25.33	5.08	44.22	8.00	100.08	25.03	2.94
P_2	163.25	48.53	17.97	28.33	5.69	41.72	8.81	102.25	26.25	3.58
P_3	156.67	46.28	16.61	25.97	5.14	42.08	8.28	101.08	25.61	3.11
C.D. at 5%	1.88	1.68	0.78	1.14	0.25	0.97	0.45	1.74	0.96	0.18

3.2 Effect of phosphorus

Application of phosphorus at P_2 level (15 g P/plant/year) significantly influenced various vegetative growth, flowering and yield attributes of bird of paradise (Table 1).

The application of P_2 treatment resulted in maximum plant height (163.25 cm), leaf length (48.53 cm), leaf width (17.97 cm), leaves/clump (28.33) and suckers per plant (5.69). The similar increase in plant height due to application of phosphorus was recorded by Ahirwar *et al*. (2012) [1] in marigold.

The possible explanation for increase in various vegetative growth parameters of bird of paradise due to application phosphorus may be attributed to some of the established fact that the phosphorus is one of the major element and being a constituent of nucleoprotein, known to play a leading role in photosynthesis, cell division and tissue formation (Arnon, 1959) [2]. Phosphorus is also an integral part of sugar phosphate (ATP and ADP) which is necessary for photosynthetic and respiratory processes.

The increase in vegetative growth by phosphorus has been reported by Chawla *et al*. (2007) [7] in chrysanthemum, Baboo and Singh (2006) [4] in gladiolus and Patel *et al*. (2006) [15] in tuberose.

Among all the levels of phosphorus, P_2 level required significantly minimum days to flowering from initiation of inflorescence (41.72 days). The maximum florets/bract (8.81), stalk length (102.25 cm) and longevity of inflorescence (26.25 days) recorded with the application of 15 g phosphorus/plant/year (P_2) in present investigation (Table 1).

As far as concerned of flower yield, the maximum flowers per plant per year (3.58) were recorded in the same treatment (P_2). The findings of present investigation are supported by Joy *et al*. (2002) [9] in Alpinia and Talukdar *et al*. (2003) [20] in tuberose cv. Single. A vigorous plant with increased number of green leaf containing high amount of chlorophyll is likely to increase the assimilation of carbohydrate. This improves the source sink relationship with greater portioning coefficient which might increase the number of flowers per plant per year. Carbohydrate is also a constituent part of nucleoprotein and sugar phosphate (ATP and ADP). Thus, it appears that increased plant metabolites might have produced more inflorescences.

4. References

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