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Effect of NPK and Micronutrients on Vegetative Growth and Flower Quality Parameters of Bird of Paradise (*Strelitzia reginae* L.)

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Abstract A field experiment was conducted during 2015-16 to standardize nutrient requirement of bird of paradise comprising twelve treatment combinations with varied levels of NPK in combination with micronutrients ($ZnSO_4$ and Boron). The results revealed that, application of 62.5:25:62.5 g NPK/plant/year along with foliar application of $ZnSO_4$ (0.5%) and Boron (0.25%) resulted significantly maximum plant height (102.43 cm), number of leaves (44.03), plant spread (107.58 cm^2), leaf length (41.19 cm), leaf width (14.78 cm) and number of suckers per plant (7.36). Same treatment also resulted maximum flower spathe length (19.98 cm), stalk thickness (21.62 mm), number of florets per spathe (4.72), stalk length (96.23 cm) and highest number of grade I flowers (67.62%). Also, cut flower yield per plant (9.02) and cut flower yield per hectare (0.40 lakh cut flowers) were highest in the same treatment over other treatments.

Keywords *Strelitzia reginae*, Vegetative growth, Flower quality parameters, Macro, Micronutrients.

Introduction

In recent years some of the unexploited cut flower crops are gaining popularity because of their attractive size, form, color and keeping quality. Among them, bird of paradise has got its own importance both in domestic and international market due to its attractive, remarkably shaped crested head of bird and combination of orange and purple colored flower cluster. Therefore, the crop is cultivated in many parts of the world in order to produce cut flowers for both domestic and international markets. Bird of paradise belongs to family Strelitziaceae and the genus *Strelitzia*. It is indigenous to South Africa and blooming period is from September to May. It is an evergreen perennial herbaceous plant, grown in the regions having moderate subtropical climate.

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Table 1. Effect of NPK and micronutrients combinations on vegetative growth paramaters of bird of paradise.

Treatments	Plant height (cm)	Number of leaves (cm)	Leaf length (cm)	Leaf width (cm)	Plant spread (cm^2)	Number of suckers per plant
T_1–37.5:15:37.5 g NPK/plant/year	81.13	36.46	32.00	9.63	76.36	5.83
T_2–50:20:50 g NPK/plant/year	82.77	37.23	34.13	10.47	78.28	6.26
T_3–62.5:25:62.5 g NPK/plant/year	87.07	38.09	36.07	11.12	83.59	6.83
T_4–37.5:15:37.5 g NPK/plant/year+$ZnSO_4$ (0.5%)	82.39	37.07	34.07	10.07	79.06	5.93
T_5–50:20:50 g NPK/plant/year+$ZnSO_4$ (0.5%)	86.40	37.83	35.23	10.81	81.18	6.40
T_6–62.5:25:62.5 g NPK/plant/year+$ZnSO_4$ (0.5%)	90.23	38.84	36.73	11.56	91.37	6.98
T_7–37.5:15:37.5 g NPK/plant/year+Boron (0.25%)	81.83	36.76	33.00	9.92	78.36	5.98
T_8–50:20:50 g NPK/plant/year+Boron (0.25%)	84.10	37.58	34.93	10.58	80.53	6.43
T_9–62.5:25:62.5 g NPK/plant/year+Boron (0.25%)	89.39	38.76	36.27	11.25	84.30	7.04
T_{10}–37.5:15:37.5 g NPK/plant/year+ $ZnSO_4$ (0.5%)+ Boron (0.25%)	82.62	37.20	34.12	10.24	78.06	6.23
T_{11}–50:20:50 g NPK/plant/year+$ZnSO_4$ (0.5%)+ Boron (0.25%)	94.83	41.13	38.99	13.75	98.10	7.14
T_{12}–62.5:25:62.5 g NPK/plant/year+$ZnSO_4$ (0.5%)+ Boron (0.25%)	102.43	44.03	41.19	14.78	107.58	7.36
SEm±	1.82	0.73	0.63	0.23	2.53	0.24
CD@5%	5.36	2.14	1.86	0.68	7.44	0.70

Proper plant nutrition is essential for successful production of flower crops in open and also under protected conditions. Inadequate plant nutrition causes serious disorders and may eventually lead to decline of plant vigor and yield. Integrated supply of micronutrients with macronutrients in adequate amount and suitable proportions is one of the most important factors that control the plant growth in flower crops. Studies to assess the nutrient requirement of bird of paradise grown under open field condition in India are meager. A suitable nutrition dose will certainly help in deciding the ideal quantities and period of fertilizer application for higher yield and quality flower production in bird of paradise. Hence, a study was carried out to standardize suitable dose of nutrients for bird of paradise under Eastern dry

Table 2. Effect of NPK and micronutrients combinations on flower quality paramaters of bird of paradise.

Treatments	Flower spathe length (cm)	Stalk thickness (mm)	Number of florets per spathe	Stalk length (cm)
T_1–37.5:15:37.5 g NPK/plant/year	17.02	15.00	3.14	77.27
T_2–50:20:50 g NPK/plant/year	17.27	17.69	3.27	80.23
T_3–62.5:25:62.5 g NPK/plant/year	17.45	18.22	3.45	84.36
T_4–37.5:15:37.5 g NPK/plant/year+$ZnSO_4$ (0.5%)	17.32	16.03	3.32	80.18
T_5–50:20:50 g NPK/plant/year+$ZnSO_4$ (0.5%)	17.50	18.08	3.51	82.32
T_6–62.5:25:62.5 g NPK/plant/year+$ZnSO_4$ (0.5%)	17.84	18.33	3.74	86.47
T_7–37.5:15:37.5 g NPK/plant/year+Boron (0.25%)	17.43	16.42	3.45	79.31
T_8–50:20:50 g NPK/plant/year+Boron (0.25%)	17.67	16.93	3.67	80.82
T_9–62.5:25:62.5 g NPK/plant/year+Boron (0.25%)	18.08	18.23	4.12	84.64
T_{10}–37.5:15:37.5 g NPK/plant/year+ $ZnSO_4$ (0.5%)+Boron (0.25%)	17.80	16.73	3.58	82.02
T_{11}–50:20:50 g NPK/plant/year+$ZnSO_4$ (0.5%)+Boron (0.25%)	18.83	20.38	4.32	92.70
T_{12}–62.5:25:62.5 g NPK/plant/year+$ZnSO_4$ (0.5%)+Boron (0.25%)	19.98	21.62	4.72	96.23
SEm±	0.33	0.41	0.11	1.15
CD@5%	0.97	1.20	0.34	3.37

Table 3. Effect of NPK and micronutrients combinations on yield paramaters and cost benefit ratio of bird of paradise.

Treatments	Cut flower yield per six months per Plant	Hectare (Lakh)
T_1–37.5:15:37.5 g NPK/plant/year	6.24	0.27
T_2–50:20:50 g NPK/plant/year	6.98	0.31
T_3–62.5:25:62.5 g NPK/plant/year	7.53	0.33
T_4–37.5:15:37.5 g NPK/plant/year+$ZnSO_4$ (0.5%)	7.24	0.32
T_5–50:20:50 g NPK/plant/year+$ZnSO_4$ (0.5%)	7.72	0.34
T_6–62.5:25:62.5 g NPK/plant/year+$ZnSO_4$ (0.5%)	8.17	0.36
T_7–37.5:15:37.5 g NPK/plant/year+Boron (0.25%)	7.15	0.31
T_8–50:20:50 g NPK/plant/year+Boron (0.25%)	7.60	0.33
T_9–62.5:25:62.5 g NPK/plant/year+Boron (0.25%)	7.83	0.34
T_{10}–37.5:15:37.5 g NPK/plant/year+ $ZnSO_4$ (0.5%) + Boron (0.25%)	7.38	0.32
T_{11}–50:20:50 g NPK/plant/year+$ZnSO_4$ (0.5%)+Boron (0.25%)	8.35	0.37
T_{12}–62.5:25:62.5 g NPK/plant/year+$ZnSO_4$ (0.5%)+Boron (0.25%)	9.02	0.40
SEm±	0.15	0.01
CD@5%	0.46	0.03

zone of Karnataka.

Materials and Methods

The field experiment was conducted on three year old bird of paradise plants at Regional Horticultural Research and Extension Center, University of Horticultural Sciences campus, Gandhi Krishi Vignana Kendra, Bengaluru during 2015-16. The treatments consisting of three NPK fertilizer levels (37.5:15:37.5 g, 50:20:50 g and 62.5:25:62.5 g NPK/plant/year) with combination of two micronutrients [$ZnSO_4$ (0.5%) and Boron (0.25%)] were assessed along with FYM @ 5 kg/plant. The experiment was laid out in randomized complete block design (RCBD) and replicated thrice. Uniform and healthy plants planted at a spacing of 1.5 m × 1.5 m; were selected for the experiment. Nitrogen and potash were applied to the soil in split doses at three months interval whereas, phosphorus was applied as basal dose. The micronutrients zinc and boron were applied as foliar spray at monthly interval.

Weeding and plant protection measures were taken up as and when required. From each treatment five plants were selected at random for recording growth parameters (plant height, plant spread, number of leaves, leaf length, leaf width and number of suckers per plant), quality parameters (flower spathe length, stalk thickness, number of florets per spathe, stalk length and flower grades) and yield parameters (yield/plant and yield/ha).

Results and Discussion

The results indicated that, plants applied with different levels of NPK with combination of micronutrients showed significant differences among different treatment combinations. The treatment combination of 62.5:25:62.5 g NPK/plant/year + $ZnSO_4$ (0.5%) + Boron (0.25%) has resulted the highest plant height (102.43 cm), plant spread (107.58 cm^2), number of leaves per plant (44.03), leaf length (41.19 cm), leaf width (14.78 cm), number of suckers per plant (7.36), flower spathe length (19.98 cm), stalk thickness (21.62 mm), number of florets per spathe (4.72), stalk length (96.23 cm), number flowers per plant (9.02) and per hectare (0.40 lakh) and also hieghest number of grade I flower (67.62%) (Tables 1, 2, 3 and 4).

The plants which received higher dose of NPK might have stored more carbohydrates through effective photosynthesis intern resulted improvement in vegetative growth parameters [1]. Higher availability of nitrogen favors apical dominance and maintains proper rate of cell division, which in turn leads to increased rate of meristamatic activity and due to

Table 4. Effect of NPK and micronutrients combinations on flower grades of bird of paradise. Values in the parentheses are angular transformed values.

Treatments	Flower grades Grade–I (>90 cm)	Grade–II (81-90 cm)	Grade–III (<80 cm)
T_1–37.5:15:37.5 g NPK/plant/year	3.68 (11.06)	23.23 (28.81)	73.07 (58.74)
T_2–50:20:50 g NPK/plant/year	4.44 (12.16)	42.69 (40.80)	52.86 (46.64)
T_3–62.5:25:62.5 g NPK/plant/year	23.37 (28.91)	48.73 (44.27)	37.18 (37.57)
T_4–37.5:15:37.5 g NPK/plant/year +$ZnSO_4$ (0.5%)	7.18 (15.54)	50.00 (45.00)	42.81 (40.87)
T_5–50:20:50 g NPK/plant/year +$ZnSO_4$ (0.5%)	21.76 (27.81)	55.44 (48.12)	22.79 (28.51)
T_6–62.5:25:62.5 g NPK/plant/year + $ZnSO_4$ (0.5%)	30.35 (33.43)	59.13 (50.26)	10.52 (18.93)
T_7–37.5:15:37.5 g NPK/plant/year + Boron (0.25%)	6.71 (15.01)	47.97 (43.84)	45.31 (42.31)
T_8–50:20:50 g NPK/plant/year + Boron (0.25)	16.18 (25.72)	52.36 (46.35)	31.44 (34.11)
T_9–62.5:25:62.5 g NPK/plant/year + Boron (0.25%)	23.49 (28.99)	58.01 (49.61)	18.50 (25.47)
T_{10}–37.5:15:37.5 g NPK/plant/year+$ZnSO_4$ (0.5%)+Boron (0.25%)	7.38 (15.76)	52.03 (46.16)	34.82 (36.16)
T_{11}–50:20:50 g NPK/plant/year + $ZnSO_4$ (0.5%) + Boron (0.25%)	55.44 (48.12)	37.60 (37.82)	6.94 (15.27)
T_{12}–62.5:25:62.5 g NPK/plant/year+ $ZnSO_4$ (0.5%)+Boron (0.25%)	67.62 (55.32)	28.82 (32.47)	3.54 (10.84)
SEm±	0.78	1.11	1.09
CD @ 5%	2.30	3.27	3.22

synergistic interaction of nitrogen with available endogenous auxin resulting in increased cell wall plasticity and cell elongation helps in better vegetative growth. Phosphorus plays a role in photosynthesis, respiration, energy storage and transfer [2]. Potassium helps in formation of starch and sugar in plants which promote the growth of the tender growing points, adjust the stomata movement and balance water relationship as reported by Singh et al. [3] in lilium.

Foliar application of zinc and boron along with NPK had a significant effect on vagetative parameters. Similar results were obtained by Iftikhar et al. [4] in rose. Application of zinc was found to increase the green pigments of necrotic leaf of plants. Boron performs an essential role in the biosynthesis of auxins within the plant meristem, leading to increased translocation of sugar and results in auxin stimulated growth [5].

The increase in yield parameters in the treatment combination of 62.5:25:62.5 g NPK/plant/year +$ZnSO_4$ (0.5%) + Boron (0.25%) might be due to the reason that better nitrogen availability, better root proliferation which in turn increased the uptake of nutrients. Phosphorus in associated with phosphorylation and is a constituent of energy rich compounds like ATP, ADP and NADH. These energy rich metabolites ultimately increased the number of flowers and weight [6, 7]. Potassium is involved in photo and oxidative phosphorylation thus, augmenting the energy requirement for growth and yield [8, 9]. Zinc help in inflorescence development and translocation of metabolites to itself or to the site of bud development [10]. Boron helps in the translocation of sugars [11].

The increase in flower quality parameters viz., flower spathe length (19.98 cm), stalk thickness (21.62 mm), number of florest per spathe (4.72), stalk length (96.23 cm) and highest number of grade I flowers (67.62%) recorded in treatment combination of 62.5:25:62.5 g NPK/plant/year + $ZnSO_4$ (0.5%) + Boron (0.25%) which might be due to NPK which have a major role in amino acid and nucleic acid synthesis which is essential for cell division and cell elongation [12], zinc might have helped in synthesis of more carbohydrates thereby inducing production of good vegetative growth and also boron found in the meristematic regions of plants and helps in translocation of sugars. So higher C:N ratio will be observed. Higher carbohydrate level in the upper part will probably force the plants to produce better quality flowers [13].

It was concluded that overall growth and flower production performance of bird of paradise was re-

markable when plants were supplied with higher doses of macronutrients along with combination of micronutrients and lowest performance was noted in the plants supplied with lower levels of NPK without micronutrient spray. Hence, for achieving high performance in bird of paradise, plants may be fertilized with 62.5:25:62.5 g NPK/plant/year + $ZnSO_4$ (0.5%) + Boron (0.25%).

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