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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH PARAMETERS OF BIRD OF PARADISE [*STRELITZIA REGINAE* (L.)]

H. A. YATHINDRA[1], R.KRISHNA MANOHAR[2], A. M. RAJESH[3] AND M. HARSHAVARDHAN[4]
[1]College of Horticulture, Yalawala, Mysore - 571 130, Karnataka, INDIA
[2]Department of Horticulture, University of Agricultural Sciences, Bangalore - 560 065, INDIA
[3]College of Horticulture, Tamaka, Kolar - 563 103, Karnataka, INDIA
[4]College of Horticulture, Banavasi road, Sirsi - 581 401, Karnataka, INDIA
e-mail:discoveryati@gmail.com

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***Corresponding author**

ABSTRACT
A research to know the effect of Integrated Nutrient Management (INM) on growth parameters of Bird of Paradise [*Strelitzia reginae* (L.)]" was conducted at Horticulture Research Station (HRS), University of Agricultural Sciences, GKVK, Bangalore during 2010-2012. One-year-old Bird-of-Paradise plants were supplied with different combinations of organic and inorganic nutrient sources. Spacing of 1.5m X 1.5m was maintained and laid out in Factorial Randomized Complete Block Design with three replications. Among the growth parameters, significantly highest plant height (117.72 cm), maximum leaf length (36.96cm), leaf width (16.14cm), number of leaves (75.77), number of suckers (13.88) and plant spread (9787 cm^2) were recorded in plants receiving 80 per cent RDF through fertigation plus organic source of nutrients like Vermicompost (300g) along with different biofertilizers such as Azotobacter, PSB and KMB (T_{11}), whereas least observations were recorded (73.93 cm, 29.68cm, 10.94cm, 34.33, 5.22 and 3361.67cm^2 respectively) in plants received 100 per cent RDF as normal fertilizers through soil application (T_1). These results clearly indicate the beneficial effect over the conventional method of nutrition management and also suggest that combined application of inorganic fertilizers, biofertilizers and vermicompost was superior over their individual application for better plant growth and development.

INTRODUCTION

Bird-of-Paradise is indigenous to South Africa and is an evergreen perennial, herbaceous, underexploited cut flower plant, grown in the regions having moderate subtropical climate. The brilliant colours and unusual appearance of the flowers have made it exceptionally popular as cut flower. India has been identified as one of the major forces in the world floriculture scenario. Bird of parasdise are grown commercially in India in places having tropical climate in Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Kerala. In Karnataka in and around Bangalore and the entire part of transitional belt seems to be very ideal for cultivation of most of the flowers on account of favourable climate, soil and other factors (UASB, package of practice, 2010). In order to exploit its continuous quality supply and to give some of the improved management practices to the farming community the present study was taken.

Increased flower production, quality of flowers and perfection in the form of plants are the important objectives to be reckoned in commercial flower production. It is impossible to meet the nutrient requirement of the crops, exclusively through the organic farming. In view of the above, there is an increasing awareness about alternative agricultural system in the present decade, known variably as biological/organic/ecological/ regenerative/biodynamic/low external input sustainable agriculture (LEISA) and farmers are showing an inclination to revert back to traditional farming with the least usage of synthetic chemicals (Vanilarasu and Balakrishnamurthy 2014.) Under these circumstances, integrated soil fertility management practices involving judicious combination of organic manures, biofertilizers and chemical fertilizers seems to be a feasible option for sustained Horticulture on a commercial and profitable scale. In addition, they are eco-friendly, easily available and cost effective. Therefore, emphasis is now focused on the use of organic manures such as compost, vermicompost, farm yard manures and biofertilizers like *Azotobacter*, *Azospirillium* and phosphate solubilizing bacteria (PSB), potash mobilising bacteria (KMB). The vermicompost serves as an organic manure, since it is a source of nutrients, such as nitrogen, phosphate, potassium, humic acids and micronutrients. Aryamba (2014) observed that use of organic and inorganic combinations was found to be significantly superior in morphological characters such as plant height, plant spread, number of leaves per plant, number of shoots, flower canopy

height, leaf area, leaf area ratio and leaf area index in Heliconia. Mridubhashini Patanwar *et al.,* (2014) also observed increased vegetative growth parameters in chrysanthemum when

nutrients were supplied in combination with organic and inorganic nutrient sources.

Biofertilizers or more appropriately called 'microbial inoculants' are the preparations containing live or latent cells of efficient strains of microorganisms. These may be biological nitrogen fixers, P-solubilizing, mineralization of nitrogen and transformation of several elements like sulphur and iron into available forms. These biofertilizers benefit agricultural production by supplying nutrients. In line with above advantages, Rajadurai *et al. (*2000) observed increased growth in respect of plant height (144.50 cm) number of leaves (156.20) and laterals per plant (28.30) was observed in pot culture experiments with the application of NPK (45:45:37.5 mg/kg) along with combination of *Azospirillum* and VAM in marigold.

In order to exploit advantages of integrated nutrient management a study was carried out using different organic and inorganic nutrient sources with the objectives to know the influence of organic manures and biofertilizers with graded levels of inorganic fertilizers on growth parameters of *Strelitzia reginae*.

MATERIALS AND METHODS

The experiment was conducted on one-year-old bird-of-paradise plants and was laid out in RCBD design with 12 treatments and 3 replications during 2010-2012 at Horticulture Research Station (HRS), Division of Horticulture, University of Agricultural Sciences, GKVK, Bangalore-560 065. The experimental station is located between the latitude of $12^0.58'$ N and longitude of $77^0.35'$ E at an altitude of 930 meters above MSL. The maximum and minimum temperature of the station during the experiment period was 33.5^0C and 13.6^0C respectively. The plants were planted at the spacing of 1.5m X 1.5m (UASB, package of practice, 2010); from the plot 180 well-developed plants were selected for the experiment. Irrigation was given through drip irrigation system daily for one hour with a discharge of 12 liter per hour depending on soil moisture conditions. In all the treatments the specified percentage of the recommended dose was provided at fortnight intervals. The recommended quantity of nutrients (according to UASB, package of practice, 2010, RDF is 16:11:6 g NPK/ plant/month) were calculated (100%- 18g:30g:12g-MAP:UREA:SOP, 80%- 14.4g:24g:9.6g-MAP:UREA:SOP, 60%- 10.8g:18g:7.2g-MAP:UREA:SOP) and dissolved in the tank containing irrigation water and supplied through ventury system (once in 15 days). Organic sources of nutrients like Biofertilizers (such as *azotobacter*, phosphate solubilizing bacteria (PSB- *Bacillus megaterium*) and potash mobilising bacteria (KMB- *Frateuria aurantia*) @ 2g/plant), Vermicompost (150g, 300g and 450g/plant) and Farm Yard Manure (5kg/ plant) were calculated and applied once in six months in a trench made by digging around the plant in a circular manner, later covered with top soil. Same method of application of biofertilizers were practiced by Chandrikapure *et al*. (1999) in African marigold and Shivalingappa (1998) in tuberose.

The entire plot was kept weed free by hand weeding as and when required. The soil was raked at least once in six months, without disturbing the root system for better aeration. Observations such as Plant height (cm) (bimonthly), Number of leaves per plant (bimonthly), Leaf length (cm) (bimonthly), Leaf width (cm) (bimonthly), Plant Spread (cm^2) (bimonthly) and Number of suckers produced / plant / year were recorded. The above observations were included in confirmation with earlier reports of Siraj Ali (1998), Jainag (2011) in Bird of Paradise.

RESULTS AND DISCUSSION

In general, the growth of Bird of paradise was better when inorganic fertilizers were supplemented with the Vermicompost, FYM and biofertilizers compared to solitary application of either organic manure or biofertilizers along with inorganic fertilizers.

Significantly highest plant height (117.72cm), leaf length (36.96cm) and leaf width (16.14cm) at 16^{th} month after

Table 5: Effect of integrated nutrient management on growth parameters of Bird of paradise (16 MAIT)

Treatments	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Number of leaves	Number of suckers	Plant spread (cm^2)
T_1: 100% RDF (NF, Soil application)	73.93	29.68	10.94	34.33	5.22	3361.67
T_2: 100% RDF (WSF) + Vc (150g)	97.19	35.51	14.59	72.00	11.77	9726.00
T_3: 80% RDF (WSF) + Vc (300g)	83.33	35.78	12.49	40.22	10.22	8825.55
T_4: 60% RDF (WSF) + Vc (450g)	78.55	31.71	11.41	38.11	7.55	5094.00
T_5: 80% RDF (WSF) + Vc (300g) + *Azotobacter*	89.33	33.04	11.80	44.66	9.22	8543.11
T_6: 60% RDF (WSF) + Vc (450g) + *Azotobacter*	80.57	32.93	11.50	43.00	8.11	8217.11
T_7: 80% RDF (WSF) + Vc (300g) + PSB	84.02	34.07	12.01	49.43	10.22	8593.22
T_8: 60% RDF (WSF) + Vc (450g) PSB	81.27	32.57	11.48	42.87	8.89	7980.22
T_9: 80% RDF (WSF) + Vc (300g)+ KMB	97.17	35.16	14.28	68.89	11.89	8923.78
T_{10}: 60% RDF (WSF) + Vc (450g) + KMB	91.31	33.04	11.87	54.11	10.66	8571.55
T_{11}: 80% RDF (WSF) + Vc (300g) + *Azotobacter* +PSB+ KMB	117.72	36.96	16.14	75.77	13.88	9787.11
T_{12}: 60% RDF (WSF) + Vc (450g) + *Azotobacter* +PSB+ KMB	93.89	35.02	12.57	68.78	11.55	9680.00
F-test	*	*	*	*	*	*
S. Em±	1.67	0.30	0.17	0.85	0.26	96.55
CD@5%	4.92	0.89	0.50	2.51	0.75	283.19

* Significant at 5%, NS – Non Significant; MAIT-Months After Imposing the Treatment , Vc- Vermicompost, PSB- Phosphorus Solubalising Bacteria; KMB- Potassium Mobilizing Bacteria, WSF-Water soluble fertilizers, RDF-Recommended Dose of fertilizers

imposing the treatment were recorded in treatment receiving 80 per cent RDF (WSF) + Vc (300g) + Azotobacter + PSB + KMB (T_{11}) followed by (T_2) 100 per cent RDF (WSF) + Vc (150g) (97.19cm, 29.68cm and 10.94cm respectively) at 16th month after treatment imposition) (Table.1). Increased observations in treatment T_{11} might be due to the supplementation of balanced nutrition for crop growth. Combined application of bio fertilizers (*Azatobacter*, *Bacillus megaterium* (PSB) and *Frateuria aurantia* (KMB)), organic manures and water soluble fertilizers through drip irrigation, might have helped in progressive mineralization of nutrients which in turn was available constantly throughout the crop growth. Higher availability of nitrogen favours apical dominance and maintains proper rate of cell division, which inturn leads to increased rate of meristamatic activity resulting in better plant growth parameters. Apart from the role of nitrogen, vermicompost might have helped to increase the plant height, leaf length and leaf width as vermicompost is a rich source of readily available macronutrients and chelated form of micronutrients such as Fe and Zn (Mamta bohra and Ajit Kumar,2014). And also it serves as source of organic matter and food for heterotrophic rhizosphere microflora which inturn enhances the microbial activity, which might have augmented the plant growth. This is in confirmation with earlier reports of Siraj Ali (1998) in Bird of Paradise, Shivalingappa (1998) in tuberose Chandrikapure *et al*. (1999) in African marigold, Jainag (2011) in Bird of Paradise, Ravindra *et al.,* (2013) in China aster and

Different treatments significantly influenced the number of leaves, number of suckers and spread of plant at 16th month after imposition of treatment. Maximum results (75.77, 13.88 and 9787.11cm^2) were recorded in T_{11} throughout the period of crop growth which was on par with T_9 and T_2, while T_1 had least observations (34.33, 5.22 and 3361.67cm^2) on above said growth parameters of plant at 16 month after imposition of treatment. There was increase in plant spread with higher levels of RDF. However, the higher plant spread was recorded in T_{11} with 80 percent recommended dose of fertilizers and further increased and decreased levels of fertigation had no beneficial effects. Similarly the spread was maximum when biofertilizers were applied along with water soluble fertilizers compared to use of biofertilizers alone.

The increased number of suckers per plant may be due to continuous supply and uptake of nutrients with higher moisture content, conversion of non available nutrients to available forms by biofertilizers during different growth stages which stimulate more cell elongation and cell division lead to more number of leaves. Leaves are the main photosynthetic apparatus in plants, synthesizing various metabolites required for plant growth and development. Nitrogen being a constituent of chlorophyll might have increased the leaf area (Sindhu and Gupta, 1993) there by more synthesis of carbohydrates, which are utilized in building up of new cells then finally leads to more sucker production. These results are in agreement with that of Krishna *et al*. (1999) in Carnation and Pansuriya (2015) in gladiolus. Role of KMB is also very important in mineralization of available potassium in soil which in turn helps in easy absorption and helps in forming carbohydrates and translocating the starch resulting in improved plant growth reported by Singh *et al*. (2008) in lilium. Increased plant spread might be due to availability of more nutrients from water soluble form at higher levels of fertigation, improved soil moisture maintenance when irrigated through drip irrigation, use of biofertilizers and vermicompost at different intervals throughout the crop growth period which could have induced plants to produce more number of suckers and which in turn increased wider plant spread. These results are in confirmation with the works of Ravindra *et al.,* (2013) in China aster, Renukaradhya (2006) in carnation and Ranjan and Srivastava and Mansee Govil (2007) in gladiolus.

Results have clearly showed that the application of recommended nitrogen, phosphorous and potassium can be saved when applied through watersoluble form with microbial inoculation of *Azatobacter,* PSB and KMB besides obtaining higher Bird of paradise growth. Therefore, it may be concluded that the use of *Azatobacter,* PSB, KMB and vermicompost along with 80 per cent recommended nitrogen, phosphorous and potassium helped in realizing better plant growth, in the economic production of Bird of paradise [*Strelitzia reginae* (L.)]" under open field condition and also suggest that combined application of inorganic fertilizers, biofertilizers and vermicompost was superior over their individual application for better plant growth and development.

REFERENCES

Aryamba. 2014. Integrated nutrient management for heliconia (Heliconia angusta cv. Christmas Red), *M, Sc. Thiesis* submitted to Kerala Agri. University.

Chandrikapure, K. R., Sadawarte, K. T., Panchabh, D. M. and Shelke, B. D. 1999. Effect of bioinoculants and graded doses of nitrogen on growth and flower yield of marigold (*Tagetes erecta* L.). *Orissa J. Horticulture*. **27(2):** 31-34.

Jainag, K., Jayaprasad, K. V., Manohar, R. K., Shivanand Hongal and Prakash, K. 2011. Effect of levels of fertigation on growth and yield of bird-of-paradise [*Strelitzia reginae* Ait.]. *Asian J. Horticulture*. **6(1):** 118-121.

Krishna, B., Krishnappa, K. S., Shiva Reddy, N. and Anjanappa, M. 1999. Effect fertigation on growth and yield in carnation cultivars grown under polyhouse. *Mysore J. agric. Sci*. **33:** 33-38.

Mamta bohra and Ajit Kumar. 2014. Studies on effect of organic manures and biinoculants on vegetative and floral attributes of Chrysanthemum cv. Little darling. *The Bioscan*. **9(3):** 1007-1010.

Mridubhashini Patanwar, Gaurav Sharma, Chetna Banjare, Deepika Chandravanshi and Eshu Sahu 2014. Growth and development of chrysanthemum (Dendranthema grandiflora) as influenced by integrated nutrient management. *The Ecoscan*. **6:** 459-462.

Package of practice. 2010. Sudharitha Totagaarika Paddathigalu. *Uni of Agric. Sci, Bangalore.*

Pansuriya, P. B. 2015. Effect of Integrated Nutrient Management on Growth, Yield and Quality of Gladiolus (Gladiolus grandifloru L.) Cv. Psittacinus Hybrid. *J Horticulture*. **2:** 128.

Rajadurai, K. R., Manivannan, K., Jawaharalal, N. and Beaurah, A. 2000. Effect of *Azospirillum* and VAM on growth characters of African marigold (*Tagetes erecta* L.). *South Indian Horticulture*. **48(1-6):** 83-87.

Ravindra, S. P., Hanumanthappa, M., Hegde, J. N., Maheshwar, K. J. and Nagesha, L. 2013. Effect of integrated nutrient management on growth, yield and vase life of China aster (*Callistephus chinensis* L. Nees) for coastal Karnataka. *Environment and Ecology*. **31:** 1104-

1106.

Renukaradhya. 2006. Integrated nutrient management in carnation (*Dianthus caryophyllus* Cv. Desio under greenhouse. *M,Sc. Thiesis submitted to Uni. Agric. Sci, Bangalore*

Shivalingappa. 1998. Influence of biofertilizers on growth, yield and essential oil content in tuberose (*Polyanthus tubarosa*), *M,Sc. Thiesis* submitted to Uni. Agric. Sci, Bangalore.

Sindhu, S. S. and Gupta A. K. 1993. Effect of different levels of nitrogen phosphorus and potassium on flower production in hybrid tea rose Cv. Super star. *Haryana. Agric. Univ. J. Res.* **23:** 47-50.

Singh, M. K., Sanjay, K. and Raja, R. 2008. Effect of nitrogen and potassium on growth, flowering and bulb production in aciatic hybrid lily cv. Novecento. *J. Orn. Hort*. **11(1):** 45-48.

Sirajali, M.S. 1998. Effect of Singral and nitrophoska fertilizers on growth, flowering and mineral composition of bird of paradise (*Strelitzia reginae* Ait) plants. *Indian Hort*. **55(3):** 257-262.

Srivastava, R., Mansee Govil 2007. Influence of biofertilizers on growth and flowering in gladiolus cv. American Beauty. *Acta Horticulture.* **742:** 183-188.

Vanilarasu, K. and Balakrishnamurthy, G. 2014. Influences of organic manures and amendments in soil physiochemical properties and their impact on growth, yield and nutrient uptake of banana. *The Bioscan*. **9(2):** 525-529.