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Standardization of Integrated Nutrient Management Practices to Improve Flower Yield and Quality in *Anthurium andreanum* cv. Meringue

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The effect of integrated nutrients to improve flower yield and quality of flower crop *Anthurium andreanum* cv. Meringue was carried out under 75 per cent shade net house condition. The experiment was conducted with six kinds of organic substrates along with inorganic fertilizers. The treatment combination of *panchagavya* 4 per cent + 50 per cent recommended dose of fertilizers (RDF) favourbly influenced the plant height (32 .40 cm), suckers per plant (4.20) and flower yield per plant (5.90). Same treatment had showed the increase in flower quality in terms of spathe length (7.50 cm), spathe breadth (7.00 cm), spike length (32.10 cm). The INM Practice of application of vermicompost 100 g plant^{-1} + 50 per cent RDF recorded the highest vase life of flower by more number of days for gloss loss (17.50), spathe blueing (18.50) and spadix necrosis (21.60) respectively.

Key words: *Anthurium andreanum*, organic substrates, recommended dose of fertilizers, plant growth, flower yield, vase life of flower.

Anthurium is the native to Central and South America mainly, Columbia which was brought to Europe in 1876 (Singh, 1987). This crop was introduced to India *via* England by tea and coffee planters. The genus Anthurium consists of about 500-600 species but only few are of economic importance. The two commercial species are *Anthurium andreanum* (tail flower, pale flower) and *Anthurium scherzerianum* (Flamingo flower or flame plant) which possesses attractive long lasting spikes. Several other species like *A. magnificum*, *A. digitatum*, *A. crystallinum* and *A. clarinervium* are grown for their magnificent foliage. The popularity of growing anthurium as cut flowers has risen tremendously in the past few years and it has now become an important export oriented cash crop. The cultivation of anthurium is highly profitable if it is well maintained. The key to successful production of anthurium depends on the effective application of nutrients. Greater scope for integration of chemical fertilizers with organic supplements obtained through biological sources was reported by Rani Perumal *et al*. (1991) and Gupta *et al*. (1992). INM would facilitate in achieving the required productivity and sustainability through applied plant nutrients. The recent energy crisis and the hike in the prices of the inorganic fertilizer further necessitate the use of organic source of manure in flower crops. Among the organic source, FYM, vermicompost, digested coir compost (DCC), neem cake, manchurian tea, panchagavya provide good quantity of organic matter, plant nutrients and also act as biostimulant. Field loss up to 50 per cent and losses after shipments to the overseas market up to 20 per cent had been reported (Higaki, 1977). The market loss of cut flowers due to inefficient post harvest management in our country is estimated to be around 20-40 per cent. Hence in this organic era, use of INM needs to be effectively used both in increasing the production and improving the quality and longevity of flowers thereby accounting for an effective post harvest management. Though attempts have been made in the past, the direct effect of organic fertilizer along with inorganic fertilizers on the field crops is very meager in India. In view of the above background, the present study was undertaken to find out the best INM practice to improve growth and yield of anthurium, to find out the efficacy of different INM practices on flower production and post harvest quality of flowers

Materials and Methods

Planting material

The Experiment was conducted at Department of Floriculture and Landscaping, Coimbatore, at Tamil Nadu Agricultural University Campus. The cultivar used was Meringue of *A. andreanum* Lind. Which is a popular genotype having good demand in the domestic and international market due to its attractive red coloured spathe. One year old uniform suckers obtained from the Department of Floriculture and Landscaping, TNAU, Coimbatore were used for this study. Pots of 30 cm size diameter with holes at the bottom were used for planting. Each treatment consists of six plants and the treatments were replicated three times in a completely randomized block design (CRD). Irrigation was done with overhead sprinklers. Fresh medium was applied once in two months. The growth regulator GA_3 (100 ppm)

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was sprayed with nutrient spray at weekly intervals. The treatment combination of inorganic nutrients namely ammonium nitrate, ortho phosphoric acid and potassium nitrate were taken as a source for nutrient mixture. The stock solution of the above fertilizers was prepared based on the molecular weight of the respective nutrients used. Half of the recommended dose of fertilizers were sprayed on the plants at weekly intervals *i.e*., 15:5:5 at 0.25 per cent along with organic manures at monthly interval. The different combinations of various organic with inorganic nutrients are as follows. T_1- vermicompost 100g pot^{-1}+50 percent of Recommended dose of fertilizers (RDF). T_2- Neem cake 100g pot^{-1} +50 percent RDF.T_3- FYM 200 g pot^{-1} +50 per cent RDF. T_4- DCC 100 g pot^{-1} +50 per cent RDF. T_5-Manchurian tea 100 per cent+50 per cent RDF.T_6 Manchurian tea 50 per cent +50 per cent RDF.T_7 Panchagavya 2 per cent drenching+50 per cent RDF. T_8 Panchagavya 2 per cent foliar spray +50 per cent RDF. T_9- Panchagavya 4 per cent drenching + 50 per cent RDF T_{10}- Panchagavya 4 per cent drenching+ 50 per cent RDF. T_{11}-Control-NPK30:10:10 @ 0.25 per cent (Recommended dose of Fertilizers). The observations recorded in this study are plant height between 3, 6, 9 and 12 months after planting and the mean height was calculated. The total number of daughter suckers produced per plant under each treatment was recorded. Flower character such as the days to first emergence of flower, longevity of flowers i.e. The number of days taken from unfurling of the spathe to the senescence of flower, length and width of spathe, length of flower stalk was recorded from the date of imposing treatments. The fresh weight of the plant was determined for plants which were pulled out from pot. For the dry weight determination, the plant tissues were dried in hot air oven at 50°C. The yield character was recorded by the total number of spikes produced in a single plant during the period of investigation was counted and expressed in number as yield of flowers per plant.

Post harvest observation recorded at 7 a.m. and the cut end of the stalks were dipped in fresh water in a beaker and brought to the laboratory immediately. A slanting cut of one cm length was given to the base of stalk for easy absorption of floral preservatives. Initial stalk length, spathe size, length and breadth, as well as colour of spathe and spadix were recorded. Preservative solutions of 200 ml were taken in 250 ml beakers. Once in two days a slight cut was given to remove decayed tissues and blackened areas of the stalk. The data were subjected to statistical analysis by following the methods described by Panse and Sukhatme (1985).

Results and Discussion

The plant height varied significantly at all the four stages of growth *viz*., 3rd, 6th, 9th and 12th MAP in (Table 2). The plants which received the INM treatment of panchagavya 4 per cent foliar spray + 50 per cent recommended dose of fertilizers (RDF) (T_{10}) recorded the highest plant height This was closely followed by the treatment (T_{11}) where the full dose of chemical fertilizers (NPK 30:30:10@ 0.25). Data pertaining to the effect of INM practices are presented in Table 2. The analysis of chemical properties of media namely, pH, EC and organic carbon revealed that there was no significant difference observed in pH and EC. However there was significant difference observed in organic carbon percentage among the treatments. The treatment which received vermicompost 100 g plant^{-1} + 50 per cent RDF (T_1) recorded the highest organic carbon 5.40 per cent which was on par with T_2 (Neem cake 100 g plant + 50 per cent RDF) 5.24 percent, followed by T_3 and T_4 with the lowest in T_6. Addition of organic substrates such as vermicompost, neem cake, FYM and DCC had caused the increase in organic carbon per cent. This may be attributed to enhance microbial activity thereby the increase in the microbiological process. This is in line with the reports of Bagyaraj and Rangaswami (1967), where application of fertilizers and organic manures had direct influence on microbial population and consequently the microbiological processes. In contrary, the addition of manchurian tea did not increase the organic carbon, this might be due to the increase in the load of heterotrophic microorganisms. It is obvious that flare up of heterotrophic microorganisms, would have utilized carbon source for its nourishment which eventually resulted in decrease of soil organic carbon content (Brady, 1995).

Table 1. Effect of INM practices on chemical properties of media of *A. andreanum* cv. Meringue

Treatment	pH	EC (dsm^{-1})	Organic carbon(per cent)
T-$_1$	6.78	0.40	5.40
T$_2$	6.60	0.34	5.24
T$_3$	6.70	0.39	5.14
T_4	6.50	0.32	5.09
T_5	7.28	0.46	3.81
T$_6$	7.33	0.42	3.70
T_7	7.20	0.43	3.92
T_8	7.25	0.38	4.30
T$_9$	7.24	0.36	4.20
I$_{10}$	7.20	0.35	4.40
I$_{11}$ (control)	7.06	0.52	4.50
Mean	7.02	0.39	4.51
SEd	0.25	0.25	0.22
CD(5%)	0.53	0.53	0.46

From the data presented, in Table 2 gives an account of the effect of INM practice on number of flowers, suckers per plant and the size of flowers. Flowers produced by anthurium plants. was significantly altered by the spray of biostimulants compared to application of organics along with inorganic fertilizers. The Plants which received panchagavya 4 per cent + 50 per cent of recommended dose of fertilizers (T_{10})- produced highest number of flowers per plant (5.90), significantly influenced the length and breadth of spathe, there of the size of the flowers and highest number of suckers per

Table 2. Effect of INM practices on plant height, days to first flowering, inflorence longevity, spathe length, spathe breadth, number of flowers and suckers of *A.andreanum* cv. Meringue

	Plant height (cm)									
Treatment	3rd MAP	6th MAP	9th MAP	12th MAP	Days to first flowering	Inflorence longivity (days)	Spathe length	Spathe Breadth	No. of Flowers Plant^{-1}	No. of Suckers Plant^{-1}
T_1	9.20	14.10	20.20	25.40	216.2	88.3	6.8	6.2	4.80	2.70
T_2	9.00	14.30	19.80	26.60	218.4	84.2	6.6	6.1	4.34	2.50
T_3	8.90	14.20	18.90	28.40	224.1	75.2	6.2	5.5	3.80	4.00
T_4	9.50	15.40	21.20	31.40	228.4	73.6	5.8	5.3	3.92	3.50
T_5	7.80	13.80	20.40	30.20	227.0	72.8	6.4	5.8	3.10	3.70
T_6	7.26	11.90	15.90	23.90	250.2	71.8	6.1	5	2.50	2.60
T_7	8.01	12.10	16.30	25.30	240.1	74.1	5.5	5.8	1.83	3.00
T_8	8.80	14.50	18.10	29.40	212.0	81.4	6.5	6.3	4.82	2.40
T_9	8.30	13.20	17.20	25.10	215.5	78.2	6.0	6.0	2.20	4.00
T_{10}	11.2	17.98	24.20	32.40	206.5	83.9	7.5	7.0	5.90	4.20
T_{11} (control)	10.50	16.82	23.40	31.80	208.1	85.2	7.0	6.5	5.60	4.02
Mean	8.95	14.39	19.6	28.17	222.4	78.97	6.4	5.95	3.89	3.329
SEd	0.66	0.82	1.29	1.61	10.9	4.52	0.47	0.29	0.23	0.19
CD(5%)	1.37	1.71	2.67	3.35	22.6	9.38	0.97	0.60	0.48	0.40

plant (4.20). The pronounced increase in yield with spray of panchagavya + 50 per cent RDF be due to the presence of N, P, K and growth promoting substance kinetin (cytokinin) (presence of coconut water) in panchagavya that has caused cell division and elongation, sustained availability of N throughout the growing phase and also due to enhanced carbohydrate synthesis and effective translocation of photosynthates to the developing sink *i.e.* flower. This is in agreement with the findings of Kanimozhi (2003) in *Coleus forskholli and* Beaulah (2001) in moringa.

The anthurium plants were carefully monitored for the first appearance of the flower. The time taken to attain first flowering was significantly differed among the treatments. The treatment which received panchagavya 4 per cent foliar spray + 50 per cent RDF (T_{10}) took the lowest number of days to give first flowering (206.50 days) which was closely followed by T_{11}.(Table 2).The treatment which received vermicompost 100 g plant^{-1} + 50 per cent RDF (T_1) showed the highest floral longevity (88.30 days) on the plants. This was followed by T_{11}**.** Effect of INM practices on fresh and dry weight of shoots, presented in Table 3. Application of organic biostimulant along with inorganic fertilizers significantly increased the dry matter production (DMP) compared to most of the treatments. The treatment which received panchagavya 4 per cent foliar spray + 50 per cent RDF (T_{10}) recorded the highest fresh weight (40.20 g plant^{-1}), and Dry weight of shoot (6.00 g) which was closely followed by T_{11} with 5.62 g, with the lowest value in T_6 (2.80g). Higher NPK uptake due to panchagavya along with inorganic fertilizers might be due to well established root systems in addition to the improved plant height, number of leaves and shoots. Supportive evidence comes from Sridhar (2003) that application of panchagavya increased the DMP ultimately leading to higher yield in *Solanum nigrum* and Kanimozhi (2003) in *Coleus forkhollii* due to panchagavya spray.

Table 4 gives an account of the effect of INM practices on N content of leaves. The treatment that received vermicompost 100 g plant^{-1} + 50 per cent recommended dose of fertilizers recorded the highest N and P content. This might be due to increase in microbial population in the addition of organic matter which eventually made more availability of nutrients by the process of mineralization (Bagyaraj and Rangaswami, 1967) and (James *et al*., 2011) Subramanian and Kumaraswamy (1989) reported appreciable increase in available P with integrated nutrient application may be attributed to increase in the labile P through complex action with cations such as Ca^{2+}, Mg^{2+}, Fe^{3+} and Al^{3+} which are responsible for fixation of soil phosphorus. Whereas, the Potassium content and total uptake of K were highest in the treatment that received panchagavya 4 per cent + 50

Table 3. Effect of INM practices on days to gloss loss, spathe blueing, spadix necrosis fresh and dry weight of shoot of *A.andreanum* cv. Meringue

Treat-ment	Gloss loss (days)	Spathe blueing (days)	Spadix necrosis (days)	Fresh weight (g plant^{-1})	Dry weight (g plant^{-1})
T_1	17.5	18.5	21.6	33.1	5.10
T_2	16.5	17.0	19.5	32.1	4.80
T_3	15.0	15.5	18.0	37.4	5.17
T_4	14.5	15.2	17.7	34.92	5.13
T_5	12.0	12.5	15.5	30.2	3.60
T_6	11.8	12.2	14.5	26.1	2.80
T_7	12.2	12.8	16.0	32.4	4.91
T_8	16.1	16.5	18.5	34.1	4.98
T_9	15.5	15.8	18.0	36.2	5.14
T_{10}	16.3	16.8	19.3	40.2	6.00
I_{11} (control)	16.9	17.5	20.4	38.9	5.62
Mean	14.8	15.4	18.0	34.0	4.82
SEd	1.19	0.8	1.3	2.7	0.38
CD(5%)	2.47	1.8	2.7	5.6	0.80

per cent recommended dose of fertilizers. The increase in K content and uptake might be due to constant uptake of nutrients when sprayed through panchagavya as it carries both macro and micronutrients along with inorganic fertilizer . This is in conformity with the results obtained by Kanimozhi (2003) in *Coleus forskholii.*

Regarding the vase life of the flower (Table 3) there was significant effect of INM practices on gloss loss of flowers was observed. The treatment T_1 (Vermicompost 100 g plant + 50 per cent RDF) took 17.50 days to show the symptom of gloss loss, spathe blueing and spadix necrosis which was highly significant over most of the treatments and was closely followed by T_{11}. The addition of organic manure altered the nutrient availability and water release pattern of the soil. As a result, slow and steady releases of nutrient, and moisture to the plant assist in maintenance of turgor in the leaf and flower which would favourably extended the vase life of anthurium flower. Hauser and Aswala (1999) supports the hypothesis, that addition of vermicompost favourably removed micropores in the soil which had direct impact on the turgidity maintenance of plants. This corroborates with the findings of Paull *et al*. (1992) who reported increase in vase life of flowers from 13 to 17 per cent which was due to the application of N and K and improvement in pineapple quality, on addition of organic manure (Liu and Liu, 2012) similar

Table 4. Effect of INM practices on the nutrient content of leaves of *A. andreanum* cv. Meringue

Treatment	Nitrogen (percent)	Phosphorous (percent)	Potassium (percent)
T_1	2.48	0.42	2.20
T_2	2.28	0.38	2.10
T_3	1.94	0.31	1.29
T_4	1.93	0.32	2.00
T_5	1.90	0.29	1.20
T_6	1.40	0.28	0.99
T_7	1.70	0.29	1.03
T_8	2.15	0.36	1.25
T_9	1.92	0.35	1.24
T_{10}	2.15	0.37	2.70
T_{11} (control)	2.42	0.41	2.60
Mean	2.01	0.33	1.68
SEd	0.16	0.01	0.14
CD(5%)	0.33	0.03	0.29

observation on significant sensory related quality difference in bio-organically and conventionally grown winter wheat were made by (Christine *et al*., 2012)

Conclusion

Higher concentration spray of organic biostimulant (panchagavya 4 percent) and organic source (vermicompost 100 g plant^{-1}) along with 50 per cent recommended dose of inorganic fertilizers (RDF) significantly influenced the various growth parameters like plant height (32.40 cm), no. of leaves (5.80), primary root production(12.50), leaf area (336.9 cm^2), sucker production (4.20) flower yield (5.90) and vase life of flower by more number of days to gloss loss (17.50), spathe blueing (18.50), and spadix necrosis (21.60). Further sustainable and economical crop yield can be achieved on long term basis by the usage of organic source of nutrients combined with inorganic fertilizers and is the best way for enhancing effect of both the source of nutrients supplied.

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