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INTEGRATED NUTRIENT MANAGEMENT IN COMMERCIAL FLOWER CROPS

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ABSTRACT

Sustainable agriculture has become a concern, due to the pressures of the "energy crisis" and issues of "environmental protection". The use of organic fertilizer made from agricultural waste regenerates natural resources and reduces the consumption of fossil energy as well as phosphorus (P) and potassium (K) deposits. There is scant information available concerning the use of organic fertilizer as the sole source of nutrients in flower production, especially in the cultivation of flowers in a soilless condition. The objective of this study was to develop an organic fertilization management system with recommended dose of chemical fertilizer to replace the chemical fertilization management of the cut flower production cultivated under different agroclimatic condition. Seven fertilization treatments were carried out consisting of recommended dose of fertilizer chemical fertilizers along with FYM (Farm Yard Manure) and three organic fertilizers i.e. Vermicompost, *Azospirillum* and PSB. The effects of the various fertilizations on different flowers were evaluated based on plant growth, nutrient uptake, and flower quality during the 3-year experimental period. The results show that plants receiving only the recommended dose of chemical fertilizer (100% RDF) along with FYM (2 kg/m^2/y) were responsible for reduction the growth and flowering in almost all the flowers, indicating that the requirement of organic N and P or other minerals cannot be substituted only with chemical fertilizer. A nutrient source from reduced RDF (75%) along with organic manure i.e. FYM (2 kg/m^2/y) and combination of Vermicompost (300 g/ m^2) + *Azospirillum* (2 g/pl/y) + PSB (2 g/pl/y) for cut flower production gave the superior result in all aspects. As per example in gladiolus, in cv. IIHR-22-1 the plants that received T_4 treatment had a significantly increased the plant height (58.5 cm), stalk length (72.7 cm), plant yield (1.021 kg spikes/m^2) and vase life (7.17 days) compared to other treatment compared to the other treatment. Therefore, it can be concluded that In short, it can be said that by reducing the level of chemical fertilizer and optimizing the dose of different organic fertilizer can improve the yield in ornamental crops and Improve soil health as well.

Key words : *RDF, azospirillum, vermicompost, PSB, cut flowers.*

The commercial flower market in India has been changed dramatically over the last few years. In India, there is a profitable production system for standard crops like gladiolus, mums, carnations, tuberose and roses. The domestic flower consumption as well as market, though not nearly as demanding as the international market, has incredible potential for expansion. The quality and quantity of applied fertilizer are the key factor affecting the growth, yield and quality of the cut flower (1). Use of high yielding varieties and other management practices aimed at higher production from unit area involves a high application rate of nutrients and excess amount of fertilizer that leaches from the soil affects quality for both the environment and human health (2).

The sustainability in agriculture system is a global issue. Practice of INM is the better option for the improvement of physical (structure and water retention capacity), chemical (nutrients and cation exchange capacity) and biological (microflora and microfauna) properties. (3). Further, it has been proved time and again under a limited range of soil organic matter contents, the crops yield for a given soil increases with the increase in soil organic matter (4). To maintain productivity and reduce the application of chemical fertilizers is increasingly becoming important to flower growers. However, little information is available concerning flower production using organic fertilizer, even now when the concern is being raised more often (5).

Thus, the objective of this study was to develop an INM management system with minimum application of Recommended Dose of chemical Fertilizer (RDF) for cut flower production of rose, gladiolus, carnation, chrysanthemum, tuberose, and gerbera at different coordinated centres of AICRP research station in India on floriculture spread all over India.

Table-1 : Effect of Various INM combinations on Plant height different AICRPF Centre.

Treat ment	Rose Pune	Gladiolus					Carnation		Chrysanthemum		Tuberose		Gerbera	
		Hyderabad	Pantnagar	Pune	New Delhi	Hyderabad	Pune	Kalimpong	IIHR, Bangalore	Hyderabad	Phule Rajni	Suvasini	Kalyani	Pune
T_1	102.4	56.1	54.59	140.2	109.66	64.6	68.763	71.437	32.03	15.67	87.4	90.40	35.3	16.7
T_2	95.7	56.1	50.16	125.2	101.33	57.0	69.770	68.763	35.62	15.00	83.3	86.80	30.9	14.4
T_3	98.4	59.9	52.67	135.1	109.66	66.4	75.900	69.770	34.67	14.67	84.5	91.00	34.0	14.7
T_4	104.6	58.5	57.13	138.3	111.00	72.8	70.670	75.900	34.67	15.00	86.2	93.50	36.7	16.0
T_5	92.2	55.3	49.83	120.2	109.33	56.2	67.517	70.670	33.89	15.67	81.6	85.70	26.7	11.0
T_6	94.6	55.5	52.09	126.6	105.33	62.8	69.870	67.517	34.89	14.67	82.4	84.60	31.5	12.8
T_7	100.0	56.7	55.73	127.2	107.33	66.0	71.437	69.870	35.51	15.00	83.5	83.50	32.0	13.7
CD(p=0.05)	1.50	2.76	6.37	1.29	6.04	0.017			2.32	NS	0.23	1.34	0.54	1.09

Table-2 : Effect of Various INM combinations on Flower Stalk length different AICRPF Centre.

Treatment	Rose				Gladiolus		Carnation		Tuberose		Gerbera	
	Pune	Hyderabad	Pantnagar	Pune	New Delhi	Hyderabad	Pune	Kalimpong	Pune	Kalyani	Kalyani	Pune
T_1	58.8	88.60	86.45	107.5	95.66	57.8	67.2	64.087	77.4	108.05	51.2	40.00
T_2	52.5	88.05	79.39	92.7	88.33	54.4	64.7	58.777	73.5	105.33	48.5	35.73
T_3	54.8	89.89	84.56	102.4	93.66	60.2	65.5	61.937	75.2	112.0	49.4	38.20
T_4	64.0	91.10	89.46	105.8	95.66	65.4	70.60	67.523	76.7	120.83	52.4	41.20
T_5	49.7	88.53	78.26	87.6	93.33	49.6	62.4	61.907	71.73	104.55	44.6	31.20
T_6	51.8	90.52	83.51	93.33	85.66	54.2	65.0	57.200	72.4	109.83	48.0	35.66
T_7	55.5	91.40	85.38	94.26	90.33	59.2	66.8	59.683	73.6	115.89	49.0	37.65
CD (p = 0.05)	0.41	1.55	3.31	0.29	12.27	0.023	0.53	0.6877	0.26	4.19	1.70	3.01

Table-3: Effect of Various INM combinations on Flower yield at different AICRPF Centre.

Treatment	Rose	Gladiolus				Carnation			Chrysanthemum		Tuberose		Gerbera	
	Pune fl/pl	Hydera-sbad spike/m^2	Pant-nagar spike/pl	Pune spike/pl	New Delhi spike/m^2	Hyderab ad flower/pl	Pune Flower /m^2/y	Kalimpo ng	IIHR, Bangalore (kg)/bed (2.4 m^2)	Hyderab ad fl/pl	Pune stalk/ plant/y	Kalyani spike/ m^2	Kalyani Flowers (/m^2)	Pune Flowers (/m^2)
T1	29.67	0.970	15.96	1.8	2.43	4.1	190.0	4.830	4.12	198.00	10.2	70.2	50.0	252.0
T2	24.33	0.953	15.42	1.44	2.83	3.7	140.0	4.397	4.17	200.67	7.7	66.6	44.0	193.96
T3	25.67	1.02	15.45	1.69	3.00	4.8	170.0	3.783	4.38	198.55	8.3	74.4	53.3	246.0
T4	32.0	1.021	17.26	1.8	3.53	5.1	210.0	5.420	4.57	178.60	9.4	73.8	59.0	261.0
T5	20.33	0.913	14.60	1.33	3.53	3.5	124.0	4.300	3.38	145.80	5.6	60.5	47.7	158.13
T6	22.67	0.987	15.56	1.40	3.43	4.4	130.0	3.677	3.63	169.20	6.7	64.8	45.7	177.0
T7	24.67	0.99	15.00	1.5	3.36	4.6	136.0	3.760	4.02	176.60	7.0	63.0	47.0	183.0
CD(p=0.05)	0.09	0.023	NS	0.02	0.74	0.12	3.69	0.3071	0.47	13.83	0.13	NS	3.49	1.15

MATERIALS AND METHODS

Plant material and growing condition

The experiment was conducted under open conditions at following coordinated centres of AICRP on Floriculture during 2009-2010.

Crop	Variety	Centre
Rose	Nobless	Pune
Gladiolus	White Prosperity	Delhi
	Peter Pears	Pant Nagar
	IIHR-22-1	Hyderabad
Chrysanthemum	Chandni	IIHR
	Basanthi	Hyderabad
Carnation	IIHR P-1	Hyderbad
	Gaudina	Pune
	Sunrise	Kalimpong
Tuberose	Phule Rajni	IIHR
	Suvasini	Kalyani
Gerbera	Rosalin	Kalyani
	Elegant	Pune

Combination of nutrient doses

The treatments consisted of recommended doses of inorganic fertilizer (RDF) ranging from full dose to 75% and 50% in combination with organic manure such as Farm Yard Manure (FYM), Vermicompost, oilcakes and bio-fertilizer like *Azospirillium,* PSB (Phosphate Solubilizing Bacteria) and *Trichoderma*. The details of the treatments are as follows.

Sl No.	Treatment
T_1	100% Recommended dose of inorganic fertilizers (RDF) + FYM (2 kg/m^2/y)
T_2	75% RDF + FYM (2 kg/m^2/y)
T_3	75% RDF+ FYM (1 kg / m^2/y)+ Vermicompost (300 g/ m^2)
T_4	75% RDF + FYM (1 kg / m^2/y)+ Vermicompost (300 g/ m^2) + *Azospirillum* (2g/pl/y) + PSB (2g/pl)
T_5	50% RDF + FYM (1 kg / m^2/y)
T_6	50% RDF + FYM (1 kg / m^2/y)+ Vermicompost (300 g/ m^2)
T^7	50% RDF + FYM (1 kg / m^2/y)+ Vermicompost (300 g/ m^2) + *Azospirillum*(2g/pl/y) + PSB(2g/pl)

Fig. 1: Effect of Various INM combinations on Vase Life at Different AICRPF Centre.

Experimental design

In T_1, Recommended Dose of Fertilizer (RDF) means location specific recommendations i.e., chemical fertilizer supplementing NPK in 30:40:40 ratio along with *Trichoderma* (20 g/ m^2/ y) which was applied after mixing with FYM, slightly moisted and covered with polythene sheet for a week; Any oil cake (200 g/ m^2/ y) was applied along with the FYM. In other treatments (T_2-T_7). Biofertilisers like *Azospirillum* and PSB (Phosphate Solubulizing Bacteria) each @ 2 g /plant were also recommended. FYM was supplied at 50% along with the recommended dose i.e., 2 kg / m^2/y and remaining 50% is through crop growth phase. The application of vermicompost, *Azospirillum* and PSB were made as per the required treatments at the time of planting and once a year.

Plant analysis

At the time of flowering seven plants of each treatment were sampled. Vegetative data (Plant height, stalk length) and floral data (yield of flower and vase life at room temperature) were taken.

Statistical design

The experiment was laid out in randomized block design (RBD) with three replications. The data were subjected to the analysis of variance (ANOVA) using the software package (SAS 8.1, Cary, NC, USA). In case of significant treatment effects, a comparison of means was performed by means of Duncan's multiple range test method at a significance level of 5% (p = 0.05).

RESULTS AND DISCUSSION

The results of the experiment conducted in integrated nutrient management for growth, flowering and yield of different flower crops during 2011-12 at various AICRP research station are presented under the following headings.

Effects of fertilization on plant height growth

In Pune, in Rose cv. Nobless, the treatment T_4 [75 % RDF + FYM (1kg/m^2) + Vermicompost (300g/m^2) + *Azospirillum* + PSB (2g/pl./y)] recorded more plant height (104.60 cm), compared to the treatment T_1 [100% Recommended dose of inorganic fertilizers (RDF) + FYM (2 kg/m^2/y) i.e. 102.4 cm. In Gladiolus the treatment T_4 resulted in longer plant height in all the centre i.e., Hyderabad cv. IIHR-22-1 (58.5 cm), Pantnagar cv. Peter Pears (57.13 cm) and New Delhi cv (Table-1). White Prosperity (111.00 cm) compared to the T_1 i.e. 56.1 cm, 54.59 cm and 109.66 cm respectively. In carnation, similar kind of response have been observed in all the three centres i.e. in T4 gave higher plant height in IIHR P-1 (Hyderabad), Gaudina (Pune) and Sunrise (Kalimpong) of 72.8 cm, 70.670 cm, and 75.90 cm respectively, whereas, their respective control gave shorter plant height i.e. 64.6 cm 68.763 cm and 71.437 cm. In chrysanthemum the plant height for the cv. Chandni (Hessarghatta) increased with T4 treatment (34.67 cm) compared to the control (32.03 cm). In tuberose, the two cvs. Phule Rajni and Suvasini gave higher plant height with T_4 treatment i.e. 86.2cm and 93.50cm respectively compared to their T_1 (87.4cm and 90.40 cm respectively). The treatment T_4 could successfully enhance the plant height in both the cvs. of gerbera i.e. Rosalin (36.7 cm) and Elegant (16.0 cm) compared to other treatment.

The rose cv. Nobless (Pune) produced highest stem length (64.0 cm) with the application of T_4 treatment which is at par with the T_1 (58.8 cm). In gladiolus IIHR-22-1 and Peter Pears produced longest spike with the treatment T4 and resulted in 91.10 cm and 89.46 cm stem respectivly (Table-2). In tuberose in Kalyani cv. Suvasini produced longest spike lenght (120. 83 cm) with the treatment of T_4 compared to the T_1 (108.05 cm). In Gerbera both the cvs. Rosalin and Elegant gave superior result in stem length increase with the treatment T_4 i.e. 41.20 cm and 52.4 cm.

(1, 6) showed that retarding leaf growth results in a reduction of the yield of cut flowers. Compared with chemical fertilization treatments (T_1), the T_4 treatment showed the same or higher efficiency of nutrient supply

for plant growth. However, the T_1 could not supply sufficient nutrients to meet the leaf growth requirement. To supply adequate amounts of N is important for the growth and flowering (1). When the N supply is suboptimal, the growth of the plant is retarded due to the reduction in net assimilation rate (Marschner, 1993), and so is the elongation rate of the plant stalk (Aulakh and Grant, 2008).

Effects of fertilization on flower yield

The data in this direction (Table-3) for different flower crops in every centre has been taken under different parameter. Like rose (cv. Nobless) in Pune, yield per plant was significantly highest (32.0 in number) in T_4 compared to the T_1 (29.67 in number). In gladiolus cv. IIHR-22-1 (Hyderabad) and White Prosperity (Delhi) gave highest yield i.e. 1.021 (non significantly) and 3.53 spike/m^2 (significantly) spikes /m^2 respectively with the treatment T_4 compared to T_1 (0.970 and 2.43 spikes/m^2 respectively). In carnation, cvs. Gaudina from Pune and IIHR P-1 from Hyderabad produced highest flower/m^2 (210.0) and number of flowers /plants (5.1) with T4 treatment compared to other. In chrysanthemum cv. Chandni (IIHR, Bangalore) gave highest yield in kg/ m^2 i.e. (4.57 kg) compared to control (4.12) significantly. In tuberose, cv. Suvasini (Kalyani) nonsignificantly produced higher yield (73.8 spike/m^2) with the application of T_4 treatment compared to control (70.2 spike/ m^2). Yield of gerbera increased with the application of T_4 treatment for both the cvs. Rosalin at Kalyani (52.4 Flower/m^2) and Elegant at Pune (261.0 Flowers/m^2) compared to the T_1 (50.0 and 252.0 flowers/m^2 respectively).

The subtending plant vegetative growth acts as the C source required for the developing flower (8). The significant differences in the amount of C accumulated and the number of flowers between the T_1 and T_4 treatments indicated that plants treated with T_4 had a higher capability of C assimilation than those with the T_1 for developing flowers (Table-3). From the result, it is obvious that the T4 was superior to the T1 to substitute for C and nutrient source for cut flower production of almost all flowers.

Effects of fertilization on Vase life

The comparative study in between two treatments i.e. T_1 and T_4 is presented in the Fig.-1. In all the treatment T_4 shows better vase life compared to the T_1. In gladiolus, the cultivar White prosperity gave significantly superior vase life (19.0 days) compared to the control (14.0 days). In tuberose the cv. Prajwal gave superior result in vase life with the treatment T_4 (7 days) compared to the T_1 (5.2 days). However, the plant height increased, the flower stalk increased the dry weight, and the amounts of C and N accumulated in the T_4 treatment were all significantly higher than those that received the T_1 treatment (Tables-1 and 2). It is obvious that the low concentration of N and P in the plants that received the T_1 treatment gave lower vase life.

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