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RESPONSE OF GERBERA TO INORGANIC FERTILIZATION VERSUS ORGANIC MANURING

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ABSTRACT

Field experiment on response of Gerbera to inorganic fertilization versus organic manuring during 2007-09 on Alfisol showed that as much as 50% of RDF, if substituted with organic manures (25% RDF with Cocopith and 25% RDF with Pig manure) out of 100% RDF, produced the best response on floral characteristics, flower yield in addition to leaf nutrient composition and available pool of nutrients in soil. These results were far superior to exclusive use of inorganic fertilizers. Study, hence, advocated the possibility of dual manuring having bipolar nutrient release pattern in order to extend nutrient dynamics in soil.
Keywords: Gerbera, inorganic fertilizer, organic manuring

INTRODUCTION

Botanically known as *Gerbera jamesonii* Bolus ex Hook, it belongs to the family Asteraceae, and is commonly called as Transvaal daisy, Barbeton daisy or African daisy. According to the global trends in floriculture, gerbera occupies the 4th place among cut flowers (Sujatha *et al., 2002*). The recent crisis and hike in the prices of inorganic fertilizers further warranted towards the use of organic of manures in flower crops (Waheeduzzama *et al,* 2007). Singh and Singh (2003) carried out an experiment to partially substitute the chemical fertilizers by organic manures and bio – fertilizers in Rose cv. Gruss – an – Teplitz, and recorded maximum plant height in plants treated with FYM + dose of NPK by chemical fertilizers + *Azotobacter*. In a study on the cut flower yield and quality of *G. jamesonii* by Thane *et al*. (2007) under greenhouse conditions, 100% of the recommended fertilizer rates (RFR; 150:50:150 kg NPK/m^2), 40 or 70% RFR + 0.5 g Azotobacter/m^2, 40 or 70% RFR + 0.5 g PSB [phosphate solubilizing bacteria]/m^2, 40 or 70% RFR + *Azotobacter* + 0.5 g PSB/m^2, and *Azotobacter* + PSB. The application of 70% RFR + *Azotobacter* + PSB resulted in the greatest flower stalk length (52.96 cm), flower stalk diameter (0.70 cm), flower diameter (9.20 cm), number of flowers per plant (7.22) and per m^2 (70.03), and vase life (8.95 days). In spite of these results, information is highly lacking with regard to changes within rhizosphere soil take place as a result of either manuring or inorganic fertilization alone, or even when combined application of both organic manures and inorganic fertilizers are practised. It is with this objective, the present investigation was carried out.

METHODS AND MATERIALS

Experimental Set-up

A field experiment under humid tropical climate (33.9–22.5^{0}C as maximum temperature and 10.9–27.4^{0}C as minimum temperature, 1100 mm rainfall and 80.6–91.7% relative humidity) was conducted during 2006-09 at Government Nursery (25^{0}45´43´´N latitude; 93^{0}53´44´´E longitude at an elevation of 210 m in above mean sea level at Dimpur, Nagaland. The experiment soil belonged to Alfisol (sand 594.0 g/kg, silt 241.5 g/kg, clay 164.5 g/kg, 33 KPa 242.6 g/kg, 1500 KPa 104.3 g/kg, soil pH 5.2, $KMnO_4$-N 148.6 mg/kg, Bray's-P 4.2 mg/kg and neutral NH_4OAc-K 98.9 mg/kg. The experimental plot was ploughed deeply and thoroughly harrowed to a fine tilth. Individual beds of 1·2 m × 1·2 m size, raised to a height of 15 cm were prepared. At the time of planting 7 tons FYM/ha alongwith recommended dose of fertilizer consisting of 60 kg N (urea)–40 kg P_2O_5 (single superphosphate) and 60 kg K_2O/ha were applied uniformly. Healthy suckers of Gerbera cv. Red Gem were collected from experimental farm of Assam Agricultural University, Jorhat, Assam which was used as the planting material for carrying out the research. The individual healthy suckers were separated from the clump, the leaves and roots were trimmed off. Thereafter, the suckers were planted with utmost care not to cover the crown with soil. The suckers were planted at a spacing of 30×30 cm, accommodating around 16 plants in each plot. The experimental field was laid out during 2007-09 following randomized complete block design with three replications per treatment. Different organic manures and inorganic nutrients like N (as urea), P_2O_5 (as single superphosphate, K_2O (as Muriat of Potash), Cocopith (N-equivalent basis), Pig manure (N-equivalent basis) and FYM (N-equivalent basis) were used for the experiment. Eight treatments consisting of: T_0–100% RDF (Recommended doses of fertilizers), T_1–50% RDF+50% Cocopith, T_2 – 50% RDF+50% Pig manure, T_3–50% RDF+50% FYM, T_4–50% RDF+25% Cocopith+25% Pig manure, T_5–50% RDF +25% Pig manure+25% FYM, T_6–50% RDF+25%

FYM+25% Cocopith, T_7 – 50% Cocopith + 25% Pig manure + 25% FYM were tested. The recommended dose of fertilizers (RDF) was applied at the rate of 60 kg N : 40kg P_2O_5: 60 kg K_2O /ha, where half dose of N and full dose of P and K were applied at the time of planting , with remaining half dose of N added one month after planting. Pig manure @ 5kg/m^2, FYM @ 7kg/m^2 and Cocopith @ 6·25kg/m^2 on wet basis were considered as 100%. These doses were worked out and applied accordingly to randomized treatments within each plot before planting. Cocopith was applied after soaking in water for about 20 – 25 minutes.

Observations recorded

The observations were recorded from 5(five) randomly selected plants within each treatment of replication. In addition to time taken for full bloom, the diameter of the flower was measured with the help of linear scale at full bloom stage and observations expressed in centimeter. The length of flower stalk was measured in centimeter with the help of linear scale from the base of stalk to the point where the head is joined to the tip of stalk. The fresh weight of flower was recorded by weighing the flower along with its stalk with the help of an electronic balance machine and expressed in gram. The harvested flower / m^2 was weighed with the help of an electronic balance machine, and the yield was expressed in terms of kilogram.

Sampling and analysis

The collected **s**oil samples were subjected to analysis of available N content following $KMnO_4$ alkaline steam distillation method(Subbiah and Asiza, 1956), available P as per procedure of Bray-P using ammonium fluoride extraction by shaking 1g soil in 20 mL of 0.03 N NH_4F in 0.025 N HCl for 30 minutes (Jackson, 1978)and available K following K extracted in 1 N neutral NH_4OAc in 1:2 soil : extractant ratio after shaking for 30 minutes (Jackson, 1978). Fully expanded leaves from were collected. The leaf samples were thoroughly washed (Chapman, 1964), ground using Willey Grinding Machine to obtain homogenous samples and subsequently digested in tri-acid mixture of $HClO_4$: HNO_3: H_2SO_4 in 2:5:1 (Chapman and Pratt, 1961). Analyses made consisted of:leaf N was analysed by auto-nitrogen analyser (Model-Perkin Elmer-2410), concentration of P in leaf was analysed using vanadomolybdo-phosphoric acid method described by Jackson (1978) and leaf K was analysed flame photometrically (Model Elico CL 361) as per procedure described by Jackson (1978).

RESULTS AND DISCUSSION

Floral characteristics

Pooled data when analyzed for both the seasons revealed that T_0 (135.15 days) took maximum time and T_4 (129.38 days) minimum time. The other treatments such as T_5 (130.51 days), T_6 (131.30 days) and T_7 (131.92 days) were statistically on par with each other. Likewise T_1 (133.89 days) and T_3 (133.70 days) showed no significant difference between them (**Table 1**). These results strongly advocated that inorganic fertilization induced plants to consume comparatively longer time for full bloom. The similar pattern of response, with T_0 (7.51 cm) producing lowest flower size and T_4 (9.06 cm) generating the highest flower size. The other treatments such as T_1 (7.95 cm), T_2 (8.07 cm) and T_3 (8.10 cm) showed no significant difference (**Table 1**). The stalk length, however, remained unaffected with different INM-based treatments.

Table 1: Response of different INM-module of substrate on performance of open field Gerbera (Pooled data)

Treatments	Floral characteristics			Flower Yield	
	Full bloom from planting time (No. of days)	Flower size (cm)	Stalk length (cm)	Fresh weight of flower (g)	Flower yield (kg/m^2)
T_0	135.16	7.51	25.59	9.07	1.95
T_1	133.89	7.95	29.80	10.77	2.16
T_2	136.60	8.07	26.79	11.02	2.63
T_3	133.70	8.10	26.99	11.05	2.49
T_4	129.38	9.06	26.29	12.95	3.19
T_5	130.51	7.85	26.27	9.20	1.84
T_6	131.30	7.72	25.67	9.03	1.76
T_7	131.92	7.85	25.56	9.55	2.08
CD (p=0.05)	1.98	0.62	NS	0.98	0.13

Flower yield

Flower yield which is the product of fresh weight of flower and number of flowers, expressed on per m^2 showed a significant response as a result of application of different INM - based treatments (**Table 1**). The flower yield was significantly affected by different treatments. Pooled data analysis of both the seasons revealed T_4 (12.95 g) as most effective treatment and T_0 (9.07 g) as least effective treatment with other treatments such as T_2 (11.02 g)

versus T_3 (11.05 g) and T_5 (9.20 g) versus T_7 (9.55 g) displaying no significant difference amongst them (Table 1). These results strongly warranted that INM-based treatments brought substantial improvements in fresh weight of flower.

Inorganic fertilizers as 100% RDF in form of treatment T_0 (1.84 – 2.07 kg/m^2 with mean value of 1.95 kg/m^2) proved significantly inferior to treatment T_1 (1.97-2.36 kg/m^2 with a mean value of 2.16 kg/m^2) where 50% RDF was replaced with Cocopith. The treatments such as T_2 (2.46 – 2.80 kg/m^2 with a mean value of 2.63 kg/m^2) and T_3(2.36 – 2.64 kg/m^2 with a mean value of 2.49 kg/m^2) produced a significantly higher flower yield compared to treatments like T_0 or T_1. These results are suggestive some conspicuous advantage with Pig manure or FYM when used in combination with 50% RDF. The above responses touched a still higher magnitude with treatment T_4 (3.04 -3.35 kg/m^2 with a mean value of 3.19 kg/m^2) where 25% Pig manure + 25% FYM was used in combination with 50% RDF. However, using similar concept of dual organic manuring, other combinations viz., 25% Cocopith + 25% Pig manure with 50% RDF as T_5(1.69 -1.99 kg/m^2 with a mean value of 1.84 kg/m^2) or 25% FYM + 25% Cocopith with 50% RDF as T_6(1.65-1.87 kg/m^2 with a mean value of 1.76 kg/m^2) found no superior response over T_4 including the treatment T_7(1.96 – 2.20 kg/m^2 with a mean value of 2.08 kg/m^2).

Leaf nutrient concentration

Different treatments produced significant response on leaf nutrient composition. Interestingly, 100% RDF as T_0 on N-equivalent basis has not been so effective with regard to maintaining higher concentration of nutrients in index leaves (2.0% N, 0.16% P and 1.7% K). Incidently, when 50% cocopith is incorporated into 50% RDF as treatment T_2 (1.5% N, 0.13% P and 1.3% K), showing no superiority over T_1. But when T_1, T_2 and T_3 are compared, carrying coco pith, Pig manure and FYM as 50% RDF replacement to T_0, T_2 turned out to be the most effective treatment (2.2% N, 0.19% P and 1.9% K) over T_3 (2.0% N, 0.17% and 1.8% K). In subsequent treatments carrying both combination two organic manures, Pig manure + FYM, along with 50% RDF, e.g. T_4 registered all the three nutrients in highest concentration (2.6% N, 0.26% P and 2.5% K), significantly superior to rest of the treatments (Table 2).

Table 2: Response of INM treatments on leaf nutrient composition (fully expanded leaves) and available soil macronutrients of Gerbera

Treatments	Leaf nutrient composition (%)			Available nutrients (mg kg^{-1})		
	N	P	K	N	P	K
T_0	2.0	0.16	1.7	147.2	5.7	105.5
T_1	1.5	0.13	1.3	150.1	4.7	104.3
T_2	2.2	0.19	1.9	156.6	6.3	111.5
T_3	2.0	0.17	1.8	149.8	5.5	107.3
T_4	2.6	0.26	2.5	158.3	6.6	115.1
T_5	2.3	0.19	2.1	150.1	5.4	105.9
T_6	2.3	0.19	2.1	145.7	4.9	116.8
T_7	2.1	0.18	1.9	147.9	5.2	104.3
CD (p = 0.05)	0.17	0.014	0.24	2.0	0.21	1.1

Soil available pool of nutrients

Execution of different treatment induced favourable changes in available pool of nutrients like $KMNO_4$-N, Bray-P and NH_4OAc-K (**Table 2**). Out of different treatments, T_4 induced maximum favourable changes on available supply of nutrients in soil (158.3 mg/kg $KMnO_4$-N, 6.6 mg kg^{-1} Bray-P and 115.1 mg kg^{-1} NH_4OAc-K) indicating that these organic manures when linked with inorganic fertilizers turned out to be more effective than either of the two when applied alone. Even exclusive use of inorganic fertilizers (147.2 mg kg^{-1} $KMnO_4$-N, 5.7 mg kg^{-1} Bray-P and 105.5 mg kg^{-1} NH_4OAc-K) have not proved superior over organic manures T_7 (147.9 mg kg^{-1} $KMnO_4$-N, 5.2 mg kg^{-1} Bray-P and with 104.3 mg kg^{-1} NH_4OAc-K). The discernible reason is that when organic manures along with inorganic fertilizers are used, the native supply of nutrients is also mobilized towards available pool of nutrients. Thus is how the value addition of both inorganic fertilizers as well as organic manures is being done through combined use of both the sources of nutrients. In rest of the other treatments these processes did not operate. The another reason is that out of the base nutrient level of different organic manures, pig manure contained both macro- as well as micronutrients, whereas in rest of the organic manure sources, the nutrient level was comparatively low. Hence, these results suggested better response with dual organic manuring along with inorganic fertilization over 100% inorganic fertilization to harness upon quality production of Gerbera.

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