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Influence of organic sources of nutrients on flower of marigold and soil properties

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Abstract

Marigold flower is a most popular for worship, ornamental and after those other many uses in human society. In this respect, a pot experiment was conducted on influence of organic sources of nutrients on quality of marigold and soil properties in eight treatment combination with three replications under randomized block design in sandy loam soil by the use of organic sources of nutrients to affect the flower quantity and quality. The application of different organic and RDF and S doses had positive effects on the growth, floral nature and yield parameters of marigold. application of sulphure @ 30 kg/ha with 100% RDF of NPK (150: 120: 100 kg/ha) showed better effect on the growth, floral and yield parameters. Soil fertility of flower grown soil was favorably influence by the different combination of organic manures and inorganic fertilizer (RDF+ S) in terms of status of soil pH, EC, soil organic carbon, buildup of available N, P, K and S and reduces the calcium carbonate content.

Keywords Organic sources, inorganic sources of nutrients, flower yield, number of flowers

Introduction

Marigold is the popular flower plant and growing today as commercially important source of carotenoid pigments and other great medicinal value. Both leaves and flower have been reported to be medicinally important. Flower extract is used as blood purifier and against bleeding piles. It is also good remedy for eye disease and ulcers (Singh *et al.*, 2015). Marigold also produces thiophenes, which are naturally occurring biocides that active against nematodes (Dahiya *et al.*, 1998). Now, Indian agriculture, which largely depends on chemical fertilizers, pesticides, herbicides etc. Though resulted in increased production, has adversely affected the soil productivity and environmental quality. The heavy use of chemical fertilizer, pesticides and fungicides caused health hazard and environmental pollution. Now a days the organic sources of plant nutrients are gaining great importance. Consequently, many farmers are seeking alternatively practices like organic sources for farming such as poultry manure, farm yard manure, vermicompost and other compost to make sustainable crop cultivation (Chandra *et al.*, 2018). Organic sources under farming, helps in soil health improvement, proper energy flow in soil, crop, water environment system, keeps biological life cycle alive and helps in sustaining considerable levels of yield. Application of organic, inorganic and integrated source which are important component in modern farming practices, apart from improving the soil physical, chemical and biological properties with direct impact on moisture retention, root growth and nutrient conservation, can also be reduce the cost of production of crop and quality of

flower also. Hence, keeping the above points in view, the present pot culture investigation was undertaken.

Materials and methods

The experimental site Ballia district lies between the parallel of 25°33' and 26°11' N latitude and 83° 38 E longitudes and situated at 59 m elevation. The mean annual rainfall ranges from 950-1150 mm. The winter is cold and minimum temperature reaches as low 5.2°C in December to January. Occasionally light rains are experienced during the winter season in this region. Soil was collected in September 2020 after harvesting of crops in field where no rainfall occurred in past 12-24 hours. Before starting the experiment, soil was obtained from village Khoripakar, District Ballia. Soil was collected from 0-15 cm depth, by the help of spade, bucket and heavy-large bags. The collected soil was subjected to initial analysis of physico-chemical and chemical properties of the soil. Soil sample was analyzed in the laboratory of the Department of Agricultural Chemistry and Soil Science of Shri Murli Manohar Town P.G. College, Ballia. The pot experiment was conducted in the Department of Agricultural Chemistry and Soil Science, Faculty of Agriculture, Shri Murli Manohar Town P.G. College, Ballia (U.P.). The organic sources such as FYM (Farmyard manure), vermicompost, compost, poultry manure, dry leaf, culture and Inorganic chemical fertilizer and Sulphur (Saktiman sulphar) were collected from locally available market and from Department of Agriculture Chemistry and Soil Science and in Ballia city. Collected surface soil was processed and sieved to remove stone pieces, roots etc. then filled up 10 kg dry soil in each pot and applied required amount of manures and fertilizers as per treatment combination. Each pot was treated by nitrogen as urea, phosphorus as DAP, potassium as MOP, sulphur, FYM, Vermicompost, Compost, Poultry manure, Dry leaf, Culture were incorporated. The whole experiment was replicated in three. After transplanting of marigold seedling in pots were maintained 2 plants in each pot for experimentation. Types of soil was loam, weight of each pot soil was 10 kg, Marigold variety- Pusa Narangi Ganda (African marigold) during September, 2020 to June, 2021.

S. No.	Parameters	Content
1.	pH	7.12
2.	EC (dSm ⁻¹)	1.005
3.	Organic carbon (%)	0.719
4.	Available N (kg ha ⁻¹)	341.69
5.	Available P (kg ha ⁻¹)	9.23
6.	Available K (kg ha ⁻¹)	191.83
7.	Available S (mg kg ⁻¹)	15.99
8.	CaCO ₃ (%)	1.5
9.	Bulk density (Mgm ⁻³)	1.497
10.	Water holding capacity (%)	44.66

Table-1: Initial properties of experimental soil

The details of treatment as T₁-100% RDF+ S kg/ha (Control), T₂- FYM @ 20 t/ha + culture (*Azotobator*), T₃-FYM @ 40 t/ha, T₄- Vermicompost @ 20 t/ha + culture (*Azotobator*), T₅- Vermicompost @ 40 t/ha, T₆- Poultry manure @ 10 t/ha, T₇- Dry leaf @ 40 t/ha + culture (*Azotobator*), T₈- Compost @ 40 t/ha with three

replication under the RDF (Recommended dose of fertilizer as N:P:K:S -150:120:100:30 kg/ha), FYM (Farm Yard Manure). Moisture content in each pot was maintained by applied water as per requirement of plant.

Harvesting of flowers- Total 7 time flowers were picked. The first picking of flowers at full bloom flowering stage was done on 23th December, 2020 and last picking on 24th February, 2021 (at 42 DAT, 47 DAT, 52 DAT, 57 DAT, 82 DAT, 92 DAT and 104 DAT). The well developed and fully opened flowers were picked up with the help of scissor in the early morning.

Plant observation - In order to evaluate the effect of organic sources on growth, yield and quality of marigold as well as yield parameters were studied and particulars of which are given as plant height (cm) was measured at 90 days after transplanting (DAT) from base of plant to the top of main shoot

with the help of meter scale and averages height was calculated. Number of branches per plant was counted from the main stem was counted for plants in each pot at 90 days after transplanting and averages were calculated. Total number of flowers was counted at each picking on the plants in each pot. These numbers of flowers of each picking were added and averages computed. The diameter of fully opened flower was recorded in cm with the help of vernier calipers and averages were calculated. The mean weight of plants was taken just after harvest and averages were calculated. All the collected flowers were first air dried and then dried in to hot air oven, after that calculated an average. The flowers plucked from each of plant were weighed separately with help of digital balance at each harvesting till the final harvesting of flowers. All the noted values were summed up at the last and then the average flower yield per pot in grams was calculated. The collected soil sample from all treatment and replication were analyzed for soil pH, EC, Organic carbon, Calcium Carbonate (CaCO₃), Bulk density, water holding capacity, Available N, P, K, and S by applying standard method as described by different author's. The postharvest soil sample were done by the collected from each pot after harvesting of marigold at maturity. About 500 g of soil from each treatment and each replication were separately collected and processed. After air drying soil samples at the room temperature were, powdered and sieved through 2mm sieve and stored separately in polythene bag for physico-chemical analysis. Soil pH was determined by glass electrode pH meter (Model No. 335) by using 1:2.5 ratio of soil-water suspension method as described by Jackson (1973). Electrical conductivity of the supernatant liquid of the 1:2.5 ratio of soil-water suspension was determined by EC meter (Model No. 611 E) method as described by Jackson (1973). Soil organic carbon was determined by rapid titration method (Walkley and Black, 1934). Available nitrogen was determined by alkaline potassium permanganate method (Subbiah and Asija, 1956). Available phosphorus was estimated by using Olsen's *et al.* (1954) method. Ammonium acetate extractable method described by Muhr *et al.* (1965) was used for the determination of available potassium. Sulphur content of soil was determined by William and Steinberg (1959), rapid extraction method. Data from different observation was statistically analyses by methods sited by Gomez and Gomez (1987).

Results and discussion

Plant height (cm) – The use of organic manures of nutrients influences the plant height (Table.2). The greater plant height (21cm) was recorded with treatment T₁ which was significantly superior over T₂, T₃, T₄, T₅, T₆, T₇ and T₈. While plant height (18.66cm) was recorded in T₇ with application of dry leaf @ 40 t/ha + culture. The result revealed that use of 100% RDF of NPK and sulphur increased the plant height. It might be due to easily availability of high amount of nitrogen in soil to plants by chemical fertilizers as compared to organic sources (Naik, 2014).

Number of branches per plant- The use of organic manures for nutrients influences the number of branches (Table.2). The maximum number of branches per plant (8.83) was significantly recorded with treatment (T₁) which was superior over T₂, T₃, T₄, T₅, T₆, T₇ and T₈. The minimum number of branches per plant (5.33) was recorded in T₇ with application of dry leaf 40 t/ha with culture (*Azotobacter*). The result revealed that use of 100% RDF and sulphur increased the number of branches due to light soluble nature and easily solubility in soil as compared to organic sources (Zeljko *et al.*, 2013; Singh *et al.*, 2015).

Table - 2: Effect of different treatment on plant and yield parameters of marigold

Treatment	Average Plant height (cm)	Average number of branches per plant	Total no. of flower / pot	Average weight of flower/ pot	Average dry weight of flower/ pot	Average diameter of flower/ pot
T ₁	21	8.83	26.33	113.56	28.38	112.16
T ₂	19.83	8.16	20.66	96.33	24.08	92.5

T ₃	20.83	8.16	17.33	87.57	21.89	85.33
T ₄	20.66	7.33	13.66	78.27	19.56	75.7
T ₅	20.33	7	17	93.1	23.27	91.33
T ₆	18.91	6	19.33	89.24	22.80	90.66
T ₇	18.66	5.33	10	56.55	14.13	53.66
T ₈	20.16	6.83	17.66	93.1	23.27	90.5
C.D.(p = 0.05)	2.550	1.754	6.976	33.542	8.367	32.32

Table-3: Effect of different treatments on number of flowers for different stages of harvesting

Treatment	1 st harvest (43 DAT)	2 nd harvest (47 DAT)	3 rd harvest (52 DAT)	4 th harvest (57 DAT)	5 th harvest (82 DAT)	6 th harvest (92 DAT)	7 th harvest (104DAT)
T ₁	2.66	2.5	1.5	3.33	4.33	6.33	7.33
T ₂	2.5	1.66	1.5	2.66	3.33	5.33	5.66
T ₃	2.0	1.5	2.0	3.0	3.33	5.66	6.0
T ₄	2.0	2.0	1.66	2.5	3.0	3.33	4.0
T ₅	1.66	1.5	1.5	3.0	4.0	5.0	5.66
T ₆	1.5	1.33	1.0	2.0	3.0	5.0	5.66
T ₇	1.0	1.5	1.0	2.0	2.5	3.0	3.33
T ₈	1.33	2.0	1.5	2.5	3.0	4.0	6.33
C.D. (p = 0.05)	1.724	1.932	1.958	1.062	1.940	1.654	1.438

Table: 4- Effect of different treatments on weight of flower per pot in different stages of harvesting of marigold

Treatment	1 st harvest (42 DAT)	2 nd harvest (47 DAT)	3 rd harvest (52 DAT)	4 th harvest (57 DAT)	5 th harvest (82 DAT)	6 th harvest (92 DAT)	7 th harvest (104 DAT)
T ₁	12.67	10.35	9.65	15.4	23.32	23.98	28.06
T ₂	11.18	10.56	9.14	11.56	21.86	23.43	22.46
T ₃	9.74	9.24	9.65	12.93	21.89	23.53	28
T ₄	8.41	9.2	11.52	13.67	18.93	20.79	21.59
T ₅	10.29	10.01	10.17	15.76	23.17	24.68	27.34
T ₆	9.63	7.19	9.65	11.63	17.62	19.33	25.82
T ₇	5.83	7.6	8.15	10.41	14.05	16.49	19.52
T ₈	8.13	9.4	10.91	12.93	18.93	23.86	26.32
C.D. (p = 0.05)	4.864	8.373	9.274	14.594	17.449	21.387	13.984

Yield attributes

Total number of flowers per pot -Data pertaining to total number of flower per pot presented in the – table.2 and table.3 indicated that total number of flowers collected from all stages of per pot was significantly influenced by the application of 100% RDF of NPK + sulphur T₁ which was significantly superior over T₂,T₃,T₄,T₅,T₆,T₇ and T₈. The minimum total number of flower (10) was recorded in treatment T₇ pot. Therefore, the increased use of 100% RDF of NPK and sulphur increased total number of flower as compared to so many organic sources might be due to easily availability and solubility of NPK chemical fertilizer (Umesh *et al.*, 2018).

Average fresh weight of flower per pot (g)- The cumulative data of average weight of flower is presented in table 2 and table.4 by the application of different organic sources has a significant effect on average weight of flower. The maximum average fresh weight of flower (113.56 g) was observed under the treatment T₁ 100% RDF of NPK + S. which was significantly superior over T₂, T₃, T₄, T₅, T₆,

T₇ and T₈. The minimum average weight of flower was in treatment T₇ (56.55g) pot. So, that the application of 100% RDF of NPK+ S increased average fresh weight of flower. It might be due to supply of easily soluble nutrient in chemical fertilizers (Jadhav *et al.*, 2014).

Average dry weight of flower per pot (g)- It is evident from table-2 that use of organic and inorganic sources of nutrient influences the average dry weight of flower. The maximum average dry weight of flower (28.38 g) was recorded with treatment T₁ which was significantly superior over T₂, T₃, T₄, T₅, T₆, T₇ and T₈. The minimum average dry weight of flower (14.13 g) was recorded in treatment T₇ pot. Results revealed that the use of 100% RDF of NPK + Sulphur increased the average dry weight of flower (Umashankar *et al.*, 2019).



Average diameter of flower (cm)- The average size of flower (cm) presented in the table- 2 indicate that it was significantly increased with the application of different organic manures. Maximum average size of flower (112.16 cm) was recorded with treatment T₁ which was significantly superior over T₂, T₃, T₄, T₅, T₆, T₇ and T₈. The minimum average size of flower was recorded in treatment T₇. Results revealed that increasing the use of 100% RDF of NPK and sulphur increased average size of flower (Guihong *et al.*, 2010).

Soil pH and E.C.- The effect of treatments on soil pH and EC in table.5 was significant but the highest pH value (7.65) was recorded in treatment T₁ with the application of 100 % RDF of NPK and sulphur. The lowest pH value (7.08) was recorded in treatment T₆. The results revealed that used of inorganic fertilizer increase the pH and used of organic fertilizers decrease the pH. The effect of treatments on soil EC was significant but the highest EC value (1.012) was recorded in treatment T₁. The lowest EC value (1.003) was recorded in treatment T₆. The results revealed that increasing the use of 100% RDF of NPK and sulphur increased the soil pH and EC (Singh *et al.*, 2023) and poultry manure resulted decreases value.

Organic carbon (%) content - The effect of different organic and inorganic sources of plant nutrient on content of organic carbon showed significantly variation among the treatment under study after in the harvest of crop (table-5).

Table-5: Effect of different organic manures on soil properties of post harvested soil samples

Treatment	pH	EC (dSm ⁻¹)	Organic carbon (%)	Available Nutrients in soil				Calcium carbonate (%)
				N (kg/ha)	P (kg/ha)	K (kg/ha)	Sulphur (kg/ ha)	
T ₁	7.65	1.012	0.521	333.61	10.41	193.91	21.22	1.45
T ₂	7.59	1.010	0.729	314.31	10.13	176.92	19.33	1.55

T ₃	7.62	1.009	0.730	332.85	8.99	177.43	19.51	1.61
T ₄	7.24	1.009	0.713	327.35	9.79	176.51	18.99	1.72
T ₅	7.38	1.008	0.726	333.61	9.84	178.31	19.18	1.65
T ₆	7.08	1.003	0.682	350.40	11.09	167.68	18.29	1.49
T ₇	7.19	1.007	0.637	310.64	7.67	158.38	15.71	1.44
T ₈	7.19	1.008	0.722	329.00	9.43	174.50	19.24	1.62
C.D. (p = 0.05)	N.S.	0.428	0.021	16.118	0.291	6.377	0.158	0.316

The highest organic carbon (0.730 %) was recorded in treatment T₃ with application of FYM @ 40 t/ha which was significantly superior over the all treatment. The lowest organic carbon (0.637 %) was recorded in treatment T₁. Result recorded that used of organic fertilizer increase the organic carbon content in post-harvest soil might be due to manurial value of poultry manure.

Available nitrogen (kg/ha)-The soil available nitrogen content showed variation among the treatment under study after the harvest of marigold (table-5) revealed that differences in the soil available nitrogen after harvest of marigold due to application of different treatment combination. Higher soil available nitrogen (350.40 kg/ha) was recorded with treatment T₆ application of poultry manure @ 10 t/ha might be due to mineralization effect. The lowest available nitrogen (310.64 kg/ ha) was observed in treatment T₇. The result revealed that used of inorganic fertilizer increase the available nitrogen in soil (Dahiya *et al*,1998) as well as poultry manure also.

Available phosphorus (kg/ha)-The effect of treatment on available phosphorus (table.5) was significant. Higher soil available phosphorus (11.09 kg/ha) was recorded in treatment T₆ whereas, lower soil available phosphorus (7.67 kg/ha) was observed in treatment T₇. The result revealed that used of inorganic fertilizer increase the available phosphorus in soil at par with the application of @10 t/ha poultry manure might be due to mineralization effect.

Available potassium (kg/ha)-The influence of different organic and inorganic sources levels were significantly showed variation in treatment combination. Available potassium status in soil varied due to various organic and inorganic fertilizer and manure. Higher soil available potassium (193.91 kg/ha) was recorded in treatment T₁ whereas, lower soil available potassium (158.38 kg/ha) was observed in treatment T₇. The result revealed that used of inorganic fertilizer increase the available potassium in soil (Sumangala *et al.*, 2018) but at par value of poultry manure were also observed.

Available sulphur (kg/ha)- Influence of different organic and inorganic sources and levels were significantly showed variation due to treatment combination (table-5). Available potassium status in soil varied due to various organic and inorganic fertilizer and manure. Higher soil available sulphur (21.22 kg/ha) was recorded in treatment T₁ whereas, lower soil available potassium (15.71 kg/ha) was observed in treatment T₇ (Chandra *et al.*, 2018) might be slight decomposition and mineralization.

Calcium carbonate (%)-use of organic sources of plant nutrient influence the content CaCO₃ (table. 5). The effect of different organic and chemical fertilizer treatment on calcium carbonate was significant. The highest calcium carbonate (1.72%) was recorded in treatment T₄ while the value was (1.44 %) observed in treatment T₇.

Conclusion

Application of different organic sources of nutrients and RDF with S had positive effects on the growth, floral and yield parameters of marigold. The use of sulphure @ 30 kg/ha with 100% RDF of NPK (150: 120: 100 kg/ha) showed better effect on the growth, floral and yield parameters of marigold. Soil fertility was favorably influence by the different combination of organic manures and inorganic fertilizer (RDF+ S) in terms of increments in status of soil pH, EC, soil organic carbon,

buildup of available N, P, K, S and calcium carbonate (CaCO₃). Therefore, application of @10 t/ha poultry manure also found to change in properties of soil and marigold which are beneficial to adopt best nutrient management strategies for soil health sustainability and improved productivity.

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