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Research Article

Effect of Different Nutrient Sources on Growth, Flowering and Quality Attributes of French Marigold (*Tagetes patula* L.) cv. Pusa Arpita

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ABSTRACT

French marigold is one of the medicinal plants as well as flower crop, which was native to South America especially Mexico and belongs to the family Asteraceae or Compositae. The flowering plants also have different response to different rate of organic manures and inorganic fertilizers as well as bio fertilizers. Maximum stem height, diameter of stem, number of lateral branches, number of leaves, flowering attributes like; days taken to flowering, number of flowers, yield attributes like; flower yield per plant, and per hectare, quality parameters i.e. circumference of flower, number of florets per flower, spike length, and vase life of flower, were affected significantly by the application of ½ RDF + ½ PSB + ½ Vermicompost gave better as compared to other treatments. Application of bio-fertilizer significantly improved quality and quantity features in marigold, both inorganic and bio fertilizers have a significant effect on morphological traits. The use of organic manure and bio fertilizers along with the balanced use of chemical fertilizers is known for improving physico-chemical and biotic properties of soil, besides improving the efficiency of applied fertilizers. The role of bio-fertilizers containing symbiotic or non-symbiotic nitrogen-fixing bacteria in augmenting vegetative characters, yield attributes essential and chemical composition.

Keywords: *RDF, Phosphorus Solubilizing Bacteria, NPK, Vermicompost, FYM.*

INTRODUCTION

African marigold (*Tagetes erecta* Linn.) having approximately 33 species of genus Tegetes. It is hardy nature about 90-100 cm tall, erect and branched leaves are pinnately divided and leaflets are lanceolate and serrate. Flowers are single to fully double and its colour varies from lemon yellow to golden yellow or Orange and having large globular flowers of diameter 15 cm and above.

Regular irrigation, weeding and hoeing are required to obtain more of large flowers.

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Initial flower buds are disbudded to obtain bushy and compact growth. Flower heads are harvested when they have attained full size. Regular plucking of flowers increases the flower production. The flower yield is 8-12 tones/ha for French marigold and 11-18 t/ha for African marigold. Both the leaves and flower of marigold are equally important from medicinal point of view however, all parts of the plant contain essential oil in varying concentrations. The oil is commercially obtained by steam distillation for 3-4 hours, absorbing the distillate in petroleum ether or benzene. Prolonged distillation spoils the fragrance. Marigold yields 0.02-0.08% oil giving 8-15 kg oil/ha/year. African marigold flower oil is reddish yellow in colour, possessing characteristic marigold odour and polymerizing readily in air. Leaf and stem oils are greenish yellow in colour (Joy et al., 2001).

The roots of marigold are also known to suppress soil nematode population. The essential oil of marigold may be used in perfume industry. Since last few years in foreign countries, the powder of petals of orange colored varieties of marigold is being feed to poultry birds through feed, to obtain dark orange colored yolk in eggs. Few industries in India, particularly in Andhra Pradesh, Karnataka and Maharashtra are exporting the powder of orange colored marigold flowers. The eco-friendly nature of organic manures provide healthy environment as sustainability to horticulture. Profit from the cultivation of flowers by application of organic manures, the quality of flowers can be enhanced. Now a day's use of organic manures has played significant role in floriculture. Modern agriculture is based on the use of organic manures, which play a major role for producing the good quality and higher yield per unit area. There is need to seek alternative nutrient sources, which should be cheap and eco-friendly so that farmers may be able to reduce the investment made on fertilizer with maintaining good soil environmental conditions leading to ecological sustainable farming.

Organic manures like F.Y.M. and Vermicompost, are very popular among the farmers because of its eco-friendly nature and simply availability. These products are helpful in minimizing the environmental hazards and increase of soil fertility. For a sustainable agriculture system, it is imperative to utilize renewable inputs which can maximize the ecological benefits and minimize the environmental hazards. Chemical fertilizers have contributed significantly toward the pollution of water, air and soil. Therefore the current trend is to explore the possibility of supplementing chemical fertilizers with organic ones that are ecofriendly and cost-effective.

Using bio fertilizer and selection of the best microbial strains have vital role when integrating human society with vulnerable ecosystems. Bio fertilizers differ from chemical and organic fertilizers in that they do not directly supply any nutrients to crops and are cultures of special bacteria and fungi. It's containing living cells of different types of micro-organisms, which are capable of mobilizing nutritive elements from non-usable form to usable form through biological process. Now-a-days, different bio-fertilizers are available in the markets. Some microorganisms have positive effects on plant growth promotion, including the plant growth promoting rhizobacteria (PGPR) such as Azospirillum, Azotobacter, Pseudomonas fluorescens, and several gram positive Bacillus spp.

Keeping above benefits points in view an investigation was carried out to find out the "Effect of different nutrient sources on growth, flowering and quality attributes of French marigold (Tagetes patula L.) cv. Pusa Arpita with the objectives:

To find out the effect of organic, inorganic and bio-fertilizer on growth, flower production and quality of French marigold.

MATERIALS AND METHODS

Site Description-

A field experiment was conducted at Horticultural Research Canter, Department of

Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut, Uttar Pradesh, India, during the year 2019-2020. The experiment was laid out in Randomized Block Design with eleven treatments and replicated thrice times. The marigold variety Pusa Arpita was procured from the, Division of Floriculture and Landscaping, Indian Agriculture Research Institute, Pusa, New Delhi was raised in nursery bed 3.0 X 1.0 meter and transplanted in plot 1.8 X 1.2 m at spacing 45 cm x 30 cm (row to row x plant to plant) during month of September, 2019. All agronomical practices in virtue were employed from time to time. The nursery beds were maintained systematically up to 45 days till the seedlings were ready for transplanting. Seedlings of marigold were transplanted in the main field, when they had 3-4 true leaf stage. During the transplanting soil was pressed firmly around the seedlings so that seedlings will not be disturbed by irrigation water immediately after transplanting.

Treatment details-

Different eleven treatments viz., T_1- Control, T_2- RDF@ 150:60:60 kg/ha (N:P:K), T_3- FYM @ 30t/ha, T_4- Vermicompost @10 q/ha, T_5- Azotobacter @700 ml/ha, T_6- PSB @ 500 ml/ha, T_7- ½ RDF + ½ FYM, T_8- ½ RDF + ½ Vermicompost, T_9- ½ RDF + ½ Azotobacter, T_{10}- ½ RDF + ½ PSB, T_{11}- ½ RDF + ½ PSB + ½ Vermicompost, were given to different plots. The biofertilizers namely Azotobacter @ 700 ml per hectare and Phosphorus Solubilizing Bacteria (PSB) @ 500 ml per hectare were applied through soil application near the root zone area of plant in the form of drenching, after calculating on the basis of per plot, according to the treatments at the time of transplanting. Vermicompost- 10 q/ha, FYM- 30t/h and NPK were applied according to treatments in soil one day before transplanting. Half dose of N and total dose of P_2O_5 and K_2O were applied as basal dose and second dose of remaining half N was applied 30 DAT and well mixed with the soil. Nitrogen was applied in the form of urea; whereas, phosphate and potash were applied in the form of SSP (Single Super Phosphate) and muriate of potash, respectively.

Observations recorded-

The observation regarding growth parameters viz., plant height, diameter of stem, number of branches, number of leaves were recorded 70 days after transplanting. Whereas flowering parameters, number of flower per plant, days taken to flowering were recorded at each harvesting interval and cumulative data was subjected to statistical analysis. Yield of flowers per plant, and per hectare and quality parameters i.e circumference of flower, spike length, florets per flower, and vase life of flowers, are recorded at time of final harvest.

Statistical analysis:

The recorded data were statistically analyzed (ANOVA analysis) using the software OPSTAT, (developed at O.P. Sheoran, Computer Section, CCS HAU, Hisar, India). Sources of variation were fertilizer treatments. Mean comparisons were performed using LSD test to determine whether the difference between the variables were significant at $P < 0.05$.

RESULTS AND DISCUSSION

Vegetative parameters-

It is revealed form the data presented in (Table 1) that treatment T_{10} - (½ RDF + ½ PSB + ½ Vermicompost) gave the maximum vegetative growth in case of plant height (50.55 cm), diameter of stem (14.90 mm) as well as number of primary branches per plant (18.33) and number of leaves per plant (110.46) during 70 days after transplanting. Bio-fertilizers inoculated plants may be ascribed to easy uptake of nutrients and simultaneous transport of growth promoting substances like cytokinin to the axillary buds, resulting in breakage of apical dominance. Ultimately, this has resulted in a better sink for faster mobilization of photosynthetic and early transformation of plant parts from vegetative to reproductive phase. In this way the bio-fertilizers helped in improving overall growth and yield of marigold. These results were in conformity with the findings of (Karuppaiah **&** Krishna 2005) in French marigold.

Table 1: Effect of different nutrient sources on growth and floral attributes in French marigold

Treatments	Plant height (cm) at 70 DAT	Diameter of stem (mm) at 70 DAT	Number of primary branches at 70 DAT	Number of leaves per plant at 70 DAT	Days taken to first flowering	Number of flower per plants
Control	35.14	8.19	12.41	45.61	59.70	14.69
RDF-150:60:60 kg/ha N:P:K	38.79	9.68	14.23	69.07	57.53	24.58
FYM @ 30 t/ha	41.94	9.76	14.46	83.47	54.40	22.76
Vermicompost @ 10Q/ha	42.65	10.77	15.51	93.37	51.40	25.79
Azotobacter @ 700 ml/ha	42.45	10.83	15.52	102.37	50.32	32.72
PSB @ 500 ml/ha	44.40	11.81	16.53	97.63	48.62	31.63
½ RDF + ½ FYM	45.61	11.98	16.37	104.54	47.43	29.62
½ RDF + ½ Vermicompost	46.45	12.91	16.42	105.98	46.72	31.65
½ RDF + ½ Azotobacter	48.39	12.87	17.39	109.10	43.76	32.62
½ RDF + ½ PSB	49.53	12.80	17.17	96.44	43.76	35.56
½ RDF + ½ PSB + ½ Vermicompost	50.55	14.90	18.33	110.46	41.39	38.56
S.E.(m)±	0.54	0.48	0.46	0.40	0.62	0.52
C. D. at 5%	1.61	1.44	1.38	1.20	1.85	1.56

Flowering and yield parameters-

The experiment results predicted in (table 1 and 2), days taken to flowering, and number of flowers per plant significantly influenced due to various nutrient sources. Significantly minimum days taken to flowering (41.39 days), number of flower (38.56), flower yield per plant (133.58 g) as well as per ha (402.09 q/h) were recorded with application ½ RDF + ½ PSB + ½ Vermicompost. This might be due to INM are promote vegetative growth, which associated with diversion of more photosynthesis form source (canopy) to sink (flowers) (Airadevi, 2014), responsible for early transformation form vegetative to reproductive phase (Rathi et al., 2005).

Table 2: Effect of different nutrient sources on flower production and quality in French marigold

Treatments	Yield of flowers per plant (g)	Yield of flower per ha (q)	Circumference of flower (cm)	Number of florets per flower	Length of flower stalk (cm)	Vase life (days)
Control	80.59	151.41	9.92	56.88	3.40	3.60
RDF-150:60:60 kg/ha N:P:K	86.42	208.35	12.21	78.69	4.51	4.80
FYM @ 30 t/ha	94.30	292.47	13.48	89.15	4.83	5.81
Vermicompost @ 10Q/ha	108.59	181.32	14.83	97.52	4.55	5.84
Azotobacter @ 700 ml/ha	115.05	248.28	15.34	109.50	4.66	6.33
PSB @ 500 ml/ha	116.79	222.48	15.62	112.72	4.09	5.80
½ RDF + ½ FYM	108.50	327.87	15.98	124.68	4.45	5.74
½ RDF + ½ Vermicompost	127.60	340.61	18.84	126.65	5.53	6.44
½ RDF + ½ Azotobacter	120.54	352.76	18.47	121.42	5.41	6.54
½ RDF + ½ PSB	128.22	385.41	20.73	122.46	5.30	6.82
½ RDF + ½ PSB + ½ Vermicompost	133.58	402.09	22.51	136.55	6.44	7.47
S.E.(m)±	0.49	0.57	0.39	0.49	0.49	0.34
C. D. at 5%	1.47	1.71	1.16	1.46	1.45	1.03

Quality parameters-

The results noted in (table 2) that all quality parameters showed statically significant. Maximum circumference of flower (22.51 cm), number of florets per flower (136.55), length of flower stalk (6.44 cm), and Vase life of flower (7.47 days) found in treatment ½ RDF + ½ PSB + ½ Vermicompost. This might be due to PSB in combination with Vermicompost is found to be in valued in

initiation of flower primordial formation leading to increase number of florets circumference of flower in marigold (Verma et al., 2011). Restrict respiration due to in availability action of these nutrient sources might here increase the vase life.

CONCLUSION

It was concluded from the present study that the role of different treatments of organic, inorganic and bio-fertilizers of vital importance for vegetative characters, flower production and quality of French marigold. The application of ½ RDF + ½ PSB + ½ Vermicompost finally increased flower productivity and flower yield in Pusa Arpita.

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