# NUTRIENT STATUS, YIELD AND PROFITABILITY OF FRENCH MARIGOLD AS INFLUENCED BY APPLICATION OF SPENT MUSHROOM COMPOST, BIOFERTILIZER AND MKP FOLIAR APPLICATION

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## ABSTRACT

An experiment was carried out in open field condition during 2018-19 to ascertain the effect of spent mushroom compost, biofertilizers and MKP foliar application on nutrient status, yield and profitability of French marigold. The experiment was laid out in Randomized Block Design (RBD) and comprised of twenty three treatments replicated thrice. The highest available soil nitrogen content (259.95 Kg/ha), available soil P (33.23 Kg/ha) and available soil potassium content (244.60 Kg/ha) was recorded with Control (100% RDF).Maximum total leaf nitrogen (1.367 %), leaf phosphorus (0.433 %) and leaf potassium content (1.88 %) was recorded with treatment 75% RDF + spent mushroom compost + biofertilizers + 1% foliar spray of MKP ($T_9$) whereas, the lowest total leaf nitrogen content (1.103 %), leaf phosphorus content (0.313 %) and total leaf K (1.33 %) was recorded with no fertilizer application (Farmers practice)**.** Plants treated with 75 % RDF + Biofertilizers + 1% foliar spray of MKP ($T_8$) recorded the highest benefit cost ratio (2.81:1) closely followed by benefit cost ratio of 2.54 in 100% RDF whereas lowest benefit cost ratio (0.36:1) was recorded in the treatment $T_{17}$ comprising 25 % RDF + Spent mushroom compost (1 kg/m$^2$).Highest chlorophyll content (48.89%) was recorded with $T_8$.



*Keywords: French marigold, INM, water soluble ferilizers, biofertilizers, spent mushroom compost, Foliar NPK, percent yield response*


## 1. INTRODUCTION

Marigold is one of the most popular and commercial loose flower crop of Jammu. Popularly known as the city of temples, Jammu region witnesses a huge demand of marigold flowers for garland making, offering in temples and other decorative purposes during various festive occasions. As result, the production of flowers in Jammu alone cannot meet the ever increasing demand and flowers worth lakhs need to be procured from neighboring states. Keeping in view the importance of crop and the present demand of quality flower, the investigations was carried out with the view to optimize a suitable Integrated Nutrient Management schedule for economic and profitable flower production of French marigold under Jammu subtropics. Excessive use of chemical fertilizers following hit and trial methods by the farmers now days results in poor health of the soil, nutrient imbalances and ultimately poor fertilizer use efficiency. Also small hold farmers do not have access to chemical fertilizer because of high price of fertilizers, poor distribution and other socio-economic factors involved. Therefore, modern nutrient management strategy aims towards the concept of sustainability and eco-friendliness. Urgent need of natural, low cost and eco-friendly sources of nutrient elements which not only fulfill the requirements of the crop but also sustain the health of the soil is the need of the hour.

## 2. MATERIAL AND METHODS

### Experimental Details:

A randomized block design was used to evaluate the effect of twenty three different nutritional treatments on flower yield, media physico-chemical properties and foliar nutrient content of French marigold. Treatments comprised of $T_1$ = Farmers practice (i.e. no fertilizer application); $T_2$ = Control (Recommended dose fertilizer 200 kg N, 100 kg $P_2O_5$ and 100 kg $K_2O$/ha);$T_3$ = 75 % RDF + Spent mushroom compost (1 kg/$m^2$);$T_4$ = 75 % RDF + Biofertilizers;$T_5$ = 75 % RDF + 1% foliar spray of MKP (00:52:34);$T_6$ = 75 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers; $T_7$ = 75 % RDF + Spent mushroom compost (1 kg/$m^2$) + 1% foliar spray of MKP (00:52:34);$T_8$ = 75 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_9$ = 75 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_{10}$= 50 % RDF + Spent mushroom compost (1 kg/$m^2$); $T_{11}$= 50 % RDF + Biofertilizers;$T_{12}$= 50 % RDF + 1% foliar spray of MKP (00:52:34);$T_{13}$= 50 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers; $T_{14}$= 50 % RDF + Spent mushroom compost (1 kg/$m^2$) + 1% foliar spray of MKP (00:52:34); $T_{15}$= 50 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_{16}$= 50 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_{17}$= 25 % RDF + Spent mushroom compost (1 kg/$m^2$);$T_{18}$= 25 % RDF + Biofertilizers; $T_{19}$= 25 % RDF + 1% foliar spray of MKP (00:52:34); $T_{20}$= 25 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers; $T_{21}$= 25 % RDF + Spent mushroom compost (1 kg/$m^2$) + 1% foliar spray of MKP (00:52:34); $T_{22}$= 25 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_{23}$= 25 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers + 1% foliar spray of MKP (00:52:34). )

Marigold seedlings were transplanted in the experimental plots at a spacing of 40 cm x 40 cm thereby accommodating 21 seedlings per bed of 2.80 m × 1.20 m dimension. Biofertilizers viz. *Azotobacter chroococcum* and phosphorous solubilizing micro-organisms (*Bacillus polymyxa* +*Pseudomonas striata*) was applied as root dip of marigold seedlings into a slurry of 200 g of the inocula dissolved in one litre of 10 % sugar solution at the time of planting. Foliar spray of 1% MKP (Mono potassium phosphate; 00:52:34 water soluble fertilizer) was given twice during the experiment. First application was given at 30 days after transplanting and second application was given at 60 days after transplanting. One year old spent mushroom compost from which the crop of button mushroom has been harvested was procured from Mushroom Research and Training Centre, Division of Plant Pathology, SKUAST-Jammu. Spent mushroom compost before incorporation into the field was treated with 4% formalin and kept covered with polythene for 48 hours. After 48 hours the cover was removed and the spent mushroom compost was turned upside down frequently so as to release the fumes of formalin. Once the spent mushroom compost becomes free of formalin fumes, it was incorporated into the plots according to the treatment requirements. Standard intercultural operations were carried out in accordance with the recommended package of practices from time to time. No insect pest and disease incidence was observed during the experiment.

## Chemical analysis:

The soil samples were collected following the standard procedure after the termination of the experiment. Available N was determined by alkaline potassium permanganate method (Subbiah and Asija 1956), Phosphorous by Olsen method (Olsen et al. 1954) and Pottassium by Neutral ammonium acetate method (Merwin and Peach 1951). Organic carbon was determined by Chromic acid titration method (Walkley and Black method 1934). A basic study of the soil of the experimental field was conducted before starting the experiment The physio-chemical characteristics of soil taken revealed sandy loam textural class with Available N (232.54kg/ha), Available $P_2O_5$ (27.71kg/ha), Available $K_2O$ (225.81kg/ha), EC (0.35dS/m) and Organic carbon content of 0.38%. Leaf N analysis was determined by Micro Kjeldahl method (Jackson 1973), Potassium by flame-photometry and phosphorous was determined by Vanado-molybdate yellow colour method (Jackson 1973).

### Statistical analysis:

Data related to each parameter was recorded and statistically analyzed by applying the technique of analysis of variance using Randomized Block Design (Gomez and Gomez 1985). The level of significance for t-test was kept at 5% (P=0.05)

## 3. RESULTS AND DISCUSSION

### Flower yield and percent yield response

Findings revealed higher flower yield (0.50 kg) with the scheduled application of 75% RDF + spent mushroom compost + biofertilizers + 1% foliar spray of MKP ($T_9$) and lowest flower yield of 0.19kg) with farmers practice($T_1$). Highest percent yield response of 52.50 was recorded with farmers practice. The maximum increase in flower yield with the scheduled application of $T_9$ might be ascribed to improved fertilizer use efficiency through timely applications of N, P and K that had led to increased photosynthetic rate and in turn resulted in production of more flowering in comparison to other treatments. In addition foliar application through MKP also promoted better uptake of nutrients and hence resulted in higher utilization and translocation. Similar findings have been reported by Laishram *et al*. (2013) and Laishram *et al.* (2016) in chrysanthemum, Singh *et al*. (2013) and Singh *et al*. (2015) in carnation, Kumawat *et al.* (2017), Goutham *et al.* (2018) in marigold.

### Media physico-chemical properties:

The present study revealed that after termination of the experiment highest organic carbon content (0.78%), highest available soil nitrogen content (259.95 Kg/ha), available soil P (33.23 Kg/ha) and available soil potassium content (244.60 Kg/ha) was recorded with control (100% RDF).This might be ascribed to the high application rates which after meeting out the plant requirements have contributed to the buildup of the available N, P and K in the soil. The results are in conformity with the findings of Singh (1995) who observed an increase in the availability of P and K in the soil after harvest of the bean crop with higher application of P and K. Thakur (1996) also reported highest levels of NPK applied enhanced the status of the available nutrients in the soil after harvest in tomato. Bhan (2002) reported significant increase in the available N, P and K content in the soil after harvest of potato with the subsequent increase in the dose of N, P and K. Angadi (2014) recorded highest available NPK status in soil at harvest with the conjoint application of biofertilizers along with 50 % RDF in garland chrysanthemum (*Chrysanthemum coronarium* L.). Pandey *et al* (2018) reported maximum soil nutrient status in chrysanthemum with the conjoint application of 75% RDF +*Azotobacter*+ VAM +Vermicompost.Different integrated nutrient management treatments did not influence the soil electrical conductivity significantly over untreated control. However, the highest electrical conductivity (0.47 dS/m) was recorded with treatment $T_{17}$ (25 % RDF + Spent mushroom compost) and lowest electrical conductivity (0.35 dS/m) was recorded with treatment $T_{12}$ (50 % RDF + 1% foliar spray of MKP). Dalawai and Naik (2017) reported maximum available NPK in soil and total NPK content with conjoint application of *Azospirillum* + PSB + Vermicompost + 75 % RDF in carnation cv.Soto plants. Tiwari *et al* (2018) reported maximum available nitrogen in post-harvested soil with treatment 100% R.D of NPK (100 kg N, 75 kg P and 75 kg K) + R.D of Vermicompost to 25% N (17.85 q/ha).

## Foliar N, P and K content (%):

The findings revealed the maximum total leaf nitrogen (1.367 %), leaf phosphorus (0.433 %) and leaf potassium content (1.88 %) with treatment of 75% RDF + spent mushroom compost + biofertilizers + 1% foliar spray of MKP ($T_9$) whereas, the lowest total leaf nitrogen content (1.103 %), leaf phosphorus content (0.313 %) and total leaf K (1.33 %) was recorded with Farmers practice ($T_1$). Leaf analysis is the suitable diagnostic tool to analyse the status of nutrients in the plant. Positive relationships between leaf content of sufficient/deficient nutrients and yield of marigold have already been established. Leaf is the donor organ from which nutrients and other assimilates are translocated to various sinks to support various metabolic activities. The growth and flowering of a plant can therefore be considered as an index of the leaf nutrient status. The addition of organic amendments might have improved the physical conditions of soil, root network and more moisture retention which increased the absorption of water and nutrients and improved the leaf nutrient contents. These findings are in confirmity with the findings of Mengel and Kirkby (1987) and Pattanayak *et al.* (2001) who reported enhanced leaf P and K content by addition of organic manures in soil. Angadi (2014) also reported increased leaf nutrient contents with the conjoint application of biofertilizers along with 50% RDF in garland chrysanthemum (*Chrysanthemum coronarium* L.). Application of biofertilizers (*Azotobactor* and PSB) plus 50 % RDF + 10 t $ha^{-1}$ Vermicompost resulted in significantly higher uptake of mineral nutrients by chrysanthemum plants from soil (Mahadik *et al* .2017)

## Chlorophyll content (%)

The perusal of data given in Table 1 revealed that different nutritional treatments significantly influenced the chlorophyll content of French marigold. Maximum chlorophyll content (48.89 %) was recorded with 75 % RDF + Biofertilizers + 1% foliar spray of MKP ($T_8$) whereas minimum chlorophyll content (39.01 %) was recorded with the application of 25 % RDF + Spent mushroom compost.

## Cost benefit ratio

While evaluating the cost of production for different treatments it was observed that the plants treated with 75 % RDF + Biofertilizers + 1% foliar spray of MKP ($T_8$) recorded the highest benefit cost ratio (2.81:1) closely followed by benefit cost ratio of 2.54 in 100% RDF whereas lowest benefit cost ratio (0.36:1) was recorded in the treatment $T_{17}$ comprising 25 % RDF + Spent mushroom compost (1 $kg/m^2$).The variation in net returns and cost: benefit ratio might be due to the difference in yield, price of flowers and other inputs like spent mushroom compost, biofertilizers and MKP. Jadhav *et al.* (2014) reported the maximum benefit cost ratio with the application of 75% RDN + *Azotobacter* in marigold cv. Pusa Basanti Gainda. Rao(2015) reported maximum B: C ratio with conjoint application of 75% RDF and biofertilizers in tuberose. Sharma *et al.* (2017) reported highest B: C ratio with application of *Azospirilium*+ PSB+ 5 % cow urine + 50 % recommended dose of N through vermicompost +50 % recommended dose of NPK in African .Similar findings have also been reported by Laishram *et al* (2016) in chrysanthemum and Singh *et al* (2016) in carnation.

**Table 1: Effect of conjoint application of spent mushroom compost, biofertilizer and MKP foliar application on soil and foliar nutrient status, yield and profitability of French marigold**

| Treatments | Flower yield/plant (g) | Percent yield response | Available N (Kg/ha) | Available P (Kg/ha) | Available K (Kg/ha) | Total leaf N (%) | Total leaf P (%) | Total leaf K (%) | Chlorophyll content (%) | Electrical conductivity (dS/m) | Organic carbon (%) | B:C Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 0.19 | 52.50 | 231.80 | 26.89 | 236.50 | 1.103 | 0.313 | 1.33 | 44.89 | 0.41 | 0.58 | 0.70 |
| $T_2$ | 0.40 | 0.00 | 259.95 | 33.23 | 244.60 | 1.310 | 0.380 | 1.66 | 47.60 | 0.36 | 0.78 | 2.54 |
| $T_3$ | 0.34 | 15.00 | 247.87 | 30.15 | 242.93 | 1.277 | 0.347 | 1.50 | 45.95 | 0.41 | 0.67 | 1.77 |
| $T_4$ | 0.35 | 12.50 | 249.85 | 30.20 | 243.21 | 1.213 | 0.347 | 1.52 | 44.81 | 0.42 | 0.67 | 1.19 |
| $T_5$ | 0.36 | 10.00 | 251.22 | 30.51 | 243.49 | 1.257 | 0.367 | 1.58 | 47.19 | 0.44 | 0.68 | 1.98 |
| $T_6$ | 0.27 | 32.50 | 254.60 | 30.53 | 243.61 | 1.337 | 0.377 | 1.66 | 46.68 | 0.38 | 0.72 | 0.68 |
| $T_7$ | 0.36 | 10.00 | 255.50 | 30.55 | 243.63 | 1.330 | 0.380 | 1.69 | 47.14 | 0.35 | 0.73 | 1.25 |
| $T_8$ | 0.46 | -15.00 | 256.62 | 30.72 | 243.88 | 1.323 | 0.410 | 1.76 | 48.89 | 0.43 | 0.74 | 2.81 |
| $T_9$ | 0.50 | -25.00 | 257.17 | 30.86 | 243.94 | 1.367 | 0.433 | 1.88 | 45.13 | 0.35 | 0.75 | 2.11 |
| $T_{10}$ | 0.29 | 27.50 | 238.32 | 29.19 | 241.58 | 1.283 | 0.330 | 1.40 | 42.14 | 0.42 | 0.66 | 0.84 |
| $T_{11}$ | 0.30 | 25.00 | 238.74 | 29.36 | 241.61 | 1.253 | 0.337 | 1.48 | 42.18 | 0.44 | 0.66 | 1.55 |
| $T_{12}$ | 0.27 | 32.50 | 239.82 | 29.55 | 241.88 | 1.247 | 0.343 | 1.50 | 41.31 | 0.35 | 0.67 | 1.30 |
| $T_{13}$ | 0.25 | 37.50 | 243.86 | 29.56 | 242.18 | 1.220 | 0.350 | 1.55 | 44.26 | 0.39 | 0.67 | 0.58 |
| $T_{14}$ | 0.31 | 22.50 | 244.36 | 29.63 | 242.57 | 1.157 | 0.360 | 1.55 | 41.59 | 0.45 | 0.68 | 0.97 |
| $T_{15}$ | 0.36 | 10.00 | 247.09 | 29.70 | 242.88 | 1.253 | 0.363 | 1.55 | 42.84 | 0.45 | 0.70 | 2.05 |
| $T_{16}$ | 0.34 | 15.00 | 247.55 | 29.85 | 242.91 | 1.223 | 0.363 | 1.57 | 43.27 | 0.36 | 0.71 | 1.15 |
| $T_{17}$ | 0.21 | 47.50 | 233.93 | 28.19 | 240.61 | 1.147 | 0.323 | 1.36 | 39.01 | 0.47 | 0.61 | 0.36 |
| $T_{18}$ | 0.22 | 45.00 | 235.34 | 28.36 | 240.85 | 1.180 | 0.327 | 1.38 | 42.90 | 0.47 | 0.63 | 0.91 |
| $T_{19}$ | 0.27 | 32.50 | 236.03 | 28.65 | 241.06 | 1.137 | 0.327 | 1.38 | 39.52 | 0.39 | 0.64 | 1.35 |
| $T_{20}$ | 0.31 | 22.50 | 236.31 | 28.82 | 241.17 | 1.177 | 0.330 | 1.39 | 42.44 | 0.45 | 0.64 | 1.00 |
| $T_{21}$ | 0.33 | 17.50 | 236.76 | 28.83 | 241.54 | 1.120 | 0.333 | 1.41 | 41.70 | 0.46 | 0.65 | 1.13 |
| $T_{22}$ | 0.33 | 17.50 | 237.01 | 29.10 | 241.54 | 1.220 | 0.337 | 1.46 | 40.86 | 0.40 | 0.65 | 1.86 |
| $T_{23}$ | 0.31 | 22.50 | 238.10 | 29.17 | 241.58 | 1.160 | 0.337 | 1.46 | 41.93 | 0.41 | 0.65 | 1.00 |
| SE $\pm$ (m) | 0.04 | - | 2.32 | 0.89 | 1.17 | 0.032 | 0.019 | 0.009 | 2.67 | 0.05 | 0.03 | - |
| CV | 20.35 | - | 1.64 | 5.19 | 0.84 | 4.531 | 9.310 | 1.047 | 7.47 | 19.58 | 8.36 | - |
| $CD_{0.05}$ | 0.11 | - | 6.63 | 2.55 | 3.36 | 0.092 | 0.054 | 0.026 | 5.390 | N.S | 0.09 | - |

$T_1$ = Farmers practice (no fertilizer); $T_2$ = Control (Recommended dose of fertilizer (200 kg N, 100 kg $P_2O_5$ and 100 kg $K_2O$/ha);$T_3$ = 75 % RDF + Spent mushroom compost (1 kg/$m^2$);$T_4$ = 75 % RDF + Biofertilizers;$T_5$ = 75 % RDF + 1% foliar spray of MKP (00:52:34);$T_6$ = 75 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers; $T_7$ = 75 % RDF + Spent mushroom compost (1 kg/$m^2$) + 1% foliar spray of MKP (00:52:34);$T_8$ = 75 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_9$ = 75 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_{10}$= 50 % RDF + Spent mushroom compost (1 kg/$m^2$); $T_{11}$= 50 % RDF + Biofertilizers;$T_{12}$= 50 % RDF + 1% foliar spray of MKP (00:52:34);$T_{13}$= 50 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers; $T_{14}$= 50 % RDF + Spent mushroom compost (1 kg/$m^2$) + 1% foliar spray of MKP (00:52:34); $T_{15}$= 50 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_{16}$= 50 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_{17}$= 25 % RDF + Spent mushroom compost (1 kg/$m^2$);$T_{18}$= 25 % RDF + Biofertilizers; $T_{19}$= 25 % RDF + 1% foliar spray of MKP (00:52:34); $T_{20}$= 25 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers; $T_{21}$= 25 % RDF + Spent mushroom compost (1 kg/$m^2$) + 1% foliar spray of MKP (00:52:34); $T_{22}$= 25 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34); $T_{23}$= 25 % RDF + Spent mushroom compost (1 kg/$m^2$) + Biofertilizers + 1% foliar spray of MKP (00:52:34).

## 4. CONCLUSION

75 % RDF + Biofertilizers + 1% foliar spray of MKP recorded the highest benefit cost ratio (2.81:1) closely followed by benefit cost ratio of 2.54 in 100% RDF.

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