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RESEARCH ARTICLE

RESPONSE OF INTEGRATED NUTRIENT MANAGEMENT IN AFRICAN MARIGOLD

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ABSTRACT

Marigold is most popular and commercial loose flower cultivated in India and has great demand during the festive seasons. The experiment was conducted at Regional Research Station, Paiyur, Tamil Nadu Agricultural University to determine the effect of organic and inorganic fertilizers through Integrated Nutrient Management in African marigold Maxima yellow hybrid to get vigorous plant growth and maximum flower production of superior quality. Eight treatments were imposed viz., Control (T₁), 100% (RDF) recommended dose of fertilizer (T₂), 100% (RDF) + Farm Yard Manure (T₃), 100% (RDF) + Vermicompost (T₄), 100% RDF + FYM + ZnSO₄ (soil application) (T₅), 100% RDF + VC + ZnSO₄ (@ 25 kg/ha (soil application) (T₆), 100% RDF + FYM + ZnSO₄ (0.5% as foliar spray) (T₇), 100% RDF + VC + ZnSO₄ (0.5% as foliar spray) (T₈) were laid out in a randomized block design with three replication. The findings revealed that application of 100% RDF(200:150:150 kg/ha) +Vermicompost @ 5 t/ha + ZnSO₄ @ 25 kg/ha soil application performed better for growth and yield parameters viz., plant height (47.9 cm), number of branches per plant (19.2), plant spread (26 cm), days to first flowering (33 days), flower diameter (7.6 cm), duration of flowering (98.6 days), number of flowers per plant (52.6), individual flower weight (17.6 g), flower yield per plant (790.7g) and total yield (19.7 t/ha) with an yield increase of 69.8 per cent over the control was found to be superior than other treatments. The results revealed that NPK fertilization along with vermicompost and micronutrient zinc sulphate as soil application enhanced the growth, yield and produced good quality of marigold.

INTRODUCTION

Marigold (*Tagetes erecta* L.), an annual flower belongs to *Asteraceae* family is a potential commercial flower gaining popularity owing to its easy culture, wide adaptability and increasing demand (Asif, 2008). Marigold is also grown as an ornamental crop, suited for potted plant, bedding purpose, edging, herbaceous and shrubby border to provide color and fill the space. They are sold in the market as loose flowers in bulk or for making garlands. It is also one of the most important natural sources of xanthophylls used as natural food additive to brighten egg yolks and poultry skin. Moreover, it is also being used effectively to dye fabrics commercially, where its ethanol-based flower extracts produce different colors on fabrics. Marigold cultivars with orange color flowers have higher xanthophylls as compared with yellow (Deineka et al.1990). Among essential nutrients nitrogen, phosphorus and potassium are most essential for plant growth and flowering.

Proper combination of fertilizers plays a vital role in production of vigorous plants having maximum number of laterals, which have a positive impact on quality flower production and prolonged flowering period. Flowering can be increased by increasing the levels of NPK application (Anamika and Lavania, 1990). The continuous use of sole chemical fertilizers depletes the soil fertility and productivity. Hence, efficient and judicious use of chemical fertilizers along with organic manures is vital for obtaining more yield. Thus, Integrated Nutrient Management plays an important role in soil fertility and sustains crop production in long term effect with balanced use of chemical fertilizers and organic manures. The increase in cost of fertilizers has become imperative to imply the Integrated Nutrient Management practices in marigold with economic use of nutrients to obtain the targeted yield. Therefore, the specific objective of this study was to find out the effect of organic & inorganic manures along with micronutrients by reducing chemical fertilizers to maximize the flower production with superior quality in African marigold.

MATERIALS AND METHODS

The experiment was conducted at Regional Research Station, Paiyur, Tamil Nadu Agricultural University in African marigold hybrid Maxima yellow. Treatments were laid out in a randomized block design consisting of eight treatments and replicated thrice. The seedlings were transplanted at 25 days after sowing at a spacing of 60cm x 45cm. The treatments viz., Control (T₁), 100% (RDF) Recommended Dose of Fertilizer (T₂), 100%(RDF) + (FYM) Farm Yard Manure (T₃), 100% (RDF) + (VC) Vermicompost (T₄), 100% RDF + FYM + ZnSO₄ (soil application) (T₅), 100% RDF + VC + ZnSO₄ (soil application) (T₆), 100% RDF + FYM + ZnSO₄ (0.5% as foliar spray) (T₇), 100% RDF + VC + ZnSO₄ (0.5% as foliar spray) (T₈). Recommended Dose of Fertilizer of 200:150:150 kg/ha of NPK i.e., N as Urea, P as Superphosphate & K as Muriate of Potash, Farm Yard Manure (FYM) @ 25 t/ha, Vermicompost (VC) @ 5t/ha, ZnSO₄ @ 25 kg/ha was applied as soil application and foliar spraying of ZnSO₄ @ 0.5% at 30 & 45 days after transplanting. Fertilizer with half dose of nitrogen and complete dose of phosphorus and potash were applied as basal dose at the time of transplanting, while the other half dose of nitrogen was applied 30 days after transplanting. The data on growth and yield parameters were statistically analysed.

RESULTS AND DISCUSSION

Effect of INM on growth parameters: The growth parameters viz., plant height, number of branches per plant and plant spread differed significantly among the treatments. Fertilization significantly improved the growth, yield, leaf nutritional status and flower xanthophylls contents of marigold. The results revealed that higher nitrogen and phosphorus application rates improved plant growth and yield. Higher nitrogen application rate proved more effective for increasing flower yield and quality along with reducing the crop duration by early flowering particularly when associated with higher phosphorus and constant potash application. These treatments helped the plants to produce more photosynthates, which were used by plants for producing higher flower yield of good quality along with early production (Anuradha et al., 1990; Belorkar et al., 1992).

A similar response was observed for fresh and dry weight of a flower, total flower yield per plant and blooming period with best results by higher nitrogen and phosphorus concentrations, which confirmed the positive effect of higher nitrogen and phosphorus application rate on reproductive growth of marigold (Chadaha et al., 1999; Khan et al. 2007). There is a linear gradual increase in the yield for all the treatments revealing that African marigold responds well to the application of recommended dose of fertilizers 200:150:150 kg/ha of NPK along with enhanced dose of vermicompost and zinc sulphate emphasizing the need to incorporate zinc sulphate in the zinc deficit soil. (Nagaich et al., 2003; Khan et al., 2007). The application of 100% RDF+Vermicompost @ 5 t/ha + ZnSO₄ @ 25 kg/ha as soil application recorded highest plant height (47.9 cm) and number of branches per plant (19.2). This might be due to the fact that nitrogen is an essential part of nucleic acid this plays vital role in promoting the plant growth. It is obvious that phosphorus is a constituent of chlorophyll and is involved in many physiological processes including cell division, development of meristematic tissue, photosynthesis, metabolism of carbohydrates, fats and proteins etc. Similar results had also been reported by Yadav et al. (2018); Prakash et al. (2002); Acharya and Dashora (2004). Maximum plant spread (26.0 cm) was also recorded with the application of 100% RDF+Vermicompost @ 5 t/ha+ ZnSO₄ @ 25 kg/ha (soil application) whereas lowest plant spread was recorded in control (23.2 cm). These findings are accordance with the Rao and Reddy (2006) in African marigold. The reason is availability of congenial growing conditions for growth of African marigold during summer season and subsequently the plants could put up more vegetative growth.

Effect of INM on flowering and yield parameters: The flowering parameters viz., days to first flowering (33 days) was found to be earlier and duration of flowering (98.6 days) with application of 100% RDF + Vermicompost @ 5 t/ ha + ZnSO₄ @ 25 kg/ha (soil application). This is in accordance with the findings of Bohra and Kumar (2014) reported that the treatment combination of NPK in combination with inorganic fertilizers and organic manure, the enhanced photosynthetic activity might have favoured an increased accumulation of dry matter and also efficient partitioning of photosynthates towards the sink. The finding was in accordance with the results of Yadav et al. (2018).

Table 1. Mean Performance of growth and flowering parameters in African marigold (*Tagetes erecta* L.) Maxima yellow hybrid

Treatments	Plant height (cm)	Number of branches per plant	Plant spread (cm)	Days to first flowering (days)	Flower diameter (cm)	Duration of flowering (days)
T ₁ - Control	38.8	12.5	23.2	44	5.9	76.4
T ₂ -100% (RDF) Recommended Dose of Fertilizer	41.3	13.3	23.3	39	6.4	76.9
T ₃ - 100%(RDF) + (FYM) FarmYardManure	42.7	15.5	25.0	37	6.7	90.4
T ₄ -100% (RDF) + (VC) Vermicompost	43.2	16.1	24.0	38	6.8	91.5
T ₅ -100% RDF + FYM + ZnSO ₄ (soil application)	43.7	16.8	24.6	35	7.0	93.0
T ₆ -100% RDF + VC + ZnSO ₄ (soil application)	47.9	19.2	26.0	33	7.6	98.6
T ₇ -100% RDF + FYM + ZnSO ₄ (0.5% as foliar spray)	42.4	14.8	23.3	38	6.4	88.7
T ₈ - 100% RDF + VC + ZnSO ₄ (0.5% as foliar spray)	41.2	12.9	23.4	38	6.9	89.8
SEd	1.15	0.78	1.80	0.73	0.14	1.11
CD(0.05)	2.42	1.64	3.78	1.54	0.3	2.3

Table 2. Mean Performance of yield parameters in African marigold (*Tagetes erecta* L.) Maxima yellow hybrid

Treatments	Number of flowers per plant	Individual flower weight(g)	Flower yield per plant (g)	Total yield (t/ha)	Per cent yield increase over control
T ₁ - Control	39.7	11.9	545.5	11.6	-
T ₂ -100% (RDF) Recommended Dose of Fertilizer	40.0	12.6	558.0	13.8	18.9
T ₃ - 100%(RDF) + (FYM) FarmYardManure	42.5	15.3	620.0	14.4	24.1
T ₄ -100% (RDF) + (VC) Vermicompost	41.9	14.1	720.0	14.4	24.1
T ₅ -100% RDF + FYM + ZnSO ₄ (soil application)	48.2	15.8	727.5	17.2	48.3
T ₆ -100% RDF + VC + ZnSO ₄ (soil application)	52.6	17.6	790.7	19.7	69.8
T ₇ -100% RDF + FYM + ZnSO ₄ (0.5% as foliar spray)	40.1	14.5	590.0	14.6	25.9
T ₈ - 100% RDF + VC + ZnSO ₄ (0.5% as foliar spray)	41.9	12.2	592.7	16.1	38.8
SEd	0.99	0.89	6.53	0.53	
CD(0.05)	2.03	1.83	13.44	1.08	

The treatment 100% RDF+Vermicompost @ 5 t/ha+ ZnSO₄ @ 25 kg/ha (soil application) also recorded the greater flower diameter (7.6 cm) and lesser flower diameter (5.9 cm) in control. The increase in diameter might be due to the fact that the balanced application of fertilizers resulted in increased carbohydrate assimilation leading to increased vegetative growth. These carbohydrates when translocated to reproductive organs underwent hydrolysis and got converted into the reducing sugars which ultimately helped in increasing bud size (Naik, 2014; Yadav *et al.*, 2018). Yield attributes like number of flowers per plant (52.6), individual flower weight (17.6 g), flower yield per plant (790.7 g) and yield (19.7 t/ha) significantly among the different treatments and was found to be higher in the treatment of 100% RDF + Vermicompost @ 5 t/ha + ZnSO₄ @ 25 kg/ha (soil application). This might be due to the higher amount of nutrients are made available to the plants might have increased the yield attributing components which is in accordance with the findings of Rao and Reddy (2006) and Pushkar *et al.* (2008) in marigold.

CONCLUSION

The experiment results revealed that African marigold Maxima yellow hybrid responded well and was found promising with the application of 100% Recommended Dose of Fertilizers (200:150:150 kg/ha), Vermicompost @ 5 t/ha along with ZnSO₄ @ 25 kg/ha as soil application. The yield increase over the control was found to be 69.8 higher in this treatment.

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