e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.1, 2022
Research Paper , **UGC CARE Listed (Group -I) Journal**

Influence Of Various Natural Farming Modules On Available NPK, Viable Microbial Count And Economics Of Seed Production On African Marigold (*Tagetes Erecta* L.) Cv. 'Pusa Narangi Gainda'

Anjay Singh Bisht[1], BS Dilta[2], Manish Kumar Sharma[2], HS Baweja[3], BP Sharma[3] and Pardeep Kuma[5]

[1]School of Agricultural Studies, Quantum University, Roorkee, Uttarakhand, 247667

[2]Department of Seed Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, 173230, Himachal Pradesh, India

[3]Directorate of Horticulture and Food Processing, Almora, 243651, Uttarakhand, India

[4]Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, 173230, Himachal Pradesh, India

[5]Department of Soil Science and Water Management, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, 173230, Himachal Pradesh, India

Email for correspondence: anjaybisht250@gmail.com & anjay.agr@quantumeducation.in

---

ABSTRACT

A field study during 2018 and 2019 was conducted at the experimental farm of Department of Seed Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan. Different doses of Jeevamrit applied through drenching (25ml/m^2, 50ml/m^2, 75ml/m^2 and 100 ml/m^2) and as foliar sprays (5%, 10%, 15% & 20%) at 15 days interval, alternatively + Brahmastra @ 2.5 % and Neemastra @ 2.5 % at 7 days interval, alternatively along with RDF and untreated control as well as organic module based on *Trichoderma viride* comprised in the treatment modules. The trial used a Randomized Block Design (RBD) layout, with 19 treatments replicated three times. M_{18} had the highest available N, P, and K values (454.30 kg/ha, 87.54 kg/ha, and 434.74 kg/ha, respectively), which were statistically comparable to M_{16} natural farming modules. M_{16}, on the other hand, had the highest number of viable microbiological count of beneficial bacteria (119.17 105 cfu/g soil), fungus (17.33 103 cfu/g soil), and actinomycetes (14.00 102 cfu/g soil). Similarly, M_{16} had the highest benefit-to-cost ratio (3.69:1), which was closely followed by M_{12} treatment modules (3.63:1).So, the M_{16} modules. As a result, this M_{16} module is recommended to farmer for increasing the availability of nutrients and the maximum load of beneficial bacteria in the soil, which helps to improve the performance of African marigold cv. 'Pusa Narangi Gainda' in Himachal Pradesh's mid-hill conditions.

***Keywords*:** African marigold, available NPK, economics, viable microbial count, natural farming, RDF

INTRODUCTION

Marigold (*Tagetes spp*. L.) is an important commercial flower of family Asteraceae and is native to Central and South America especially Mexico. Marigold is grown commercially in India for the production of loose flowers which are mostly utilized for preparation of garlands, as well as for offerings in temples, churches, and other places of worship.They are used for decoration of landscapes as well as other places during festive occasions. The marigold is also planted for developing herbaceous borders as well as in the beds to provide colour and improve the aesthetic values of the landscapes.

The injudicious use of inorganic and chemical based fertilizers and pesticides as well has degraded the health and productivity potential of the soil. Consequently, the growth and flowering of various crops plants have been affected badly. Hence, use of natural farming systems based on Subhash Palekar Natural Farming concept may be some feasible and sustainable options to fight the unique challenges exacerbated by chemical fertiliser and pesticide-based farming systems under intensive cultivation of growth and flowering in marigold.

In the Subhash Palekar Natural Farming Systems, the requirements of essential nutrients and growth promoting substances as well as checking the incidences of various insect-pests and diseases are tackled by using different on farm produced products like Beejamrit, Jeevamrit, Neemastra, Brahmastra and Agniastra *etc.* These materials are created by combining several ingredients and fermenting dung and urine of *desi* cow, in small chunk and a tiny quantity of jaggery and pulse flour, a handful of undisturbed soil from the field bunds or forest area including the leaves and other parts of plants possessing medicinal and pesticidal principles. The above mentioned on farm produced products do not just ensure the supply of essential nutrients, but they also help in proliferation of beneficial bacteria, fungi and actinomycetes in the rhizosphere of the soil leading to maximization of soil biomass. So much so these products also act as the tonics to replenish the soil health and its fertility status by improving the structure and texture, besides improving the physico-chemical and biological properties of the solum. Hence, these products ultimately increases available nitrogen, phosphorus and potassium as well as huge load of microbial load (beneficial bacteria, fungi and actinomycetes) of various crops (Vasanthkumar, 2006).

The climatic conditions in Himachal Pradesh's mid-hill region are ideal for growing for flowering plants. So, higher availability of NPK and huge load of viable microbes after harvesting in marigold are major components for good quality marigold seed production. So, keeping in view the above facts, the growing of different flower crops including marigold employing Subhash Palekar Natural Farming Systems offers some feasible alternatives to chemical fertiliser and pesticide-based farming systems under intensive cultivation systems with improving the soil health and its productivity.

MATERIALS AND METHODS

The present investigation was conducted at the Khaltoo experimental farm of the Department of Seed Science and Technology, Dr Yashwant Singh Parmar University of

e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.1, 2022
Research Paper , UGC CARE Listed (Group -I) Journal

Horticulture and Forestry, Nauni, Solan (HP) during 2018 and 2019 for two successive years. The field experiment comprising 19 treatment modules was laid out in Randomized Block Design having three replications. The cultivar used was 'Pusa Narangi Gainda'. The plot size was 2.40 × 1.80 m and spacing between row to row and plant to plant was kept at 60 × 60 cm a part. The details of the experiment were as under:

Details of treatment modules:

Module-1 (M_1)	Drenching with Jeevamrit @ 25 ml/m^2 + Foliar application of Jeevamrit @ 5 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-2 (M_2)	Drenching with Jeevamrit @ 25 ml/m^2 + Foliar application of Jeevamrit @ 10 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-3 (M_3)	Drenching with Jeevamrit @ 25 ml/m^2 + Foliar application of Jeevamrit @ 15 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-4 (M_4)	Drenching with Jeevamrit @ 25 ml/m^2 + Foliar application of Jeevamrit @ 20 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-5 (M_5)	Drenching with Jeevamrit @ 50 ml/m^2 + Foliar application of Jeevamrit @ 5 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-6 (M_6)	Drenching with Jeevamrit @ 50 ml/m^2 + Foliar application of Jeevamrit @ 10 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-7 (M_7)	Drenching with Jeevamrit @ 50 ml/m^2 + Foliar application of Jeevamrit @ 15 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-8 (M_8)	Drenching with Jeevamrit @ 50 ml/m^2 + Foliar application of Jeevamrit @ 20 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-9 (M_9)	Drenching with Jeevamrit @ 75 ml/m^2 + Foliar application of Jeevamrit @ 5 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-10 (M_{10})	Drenching with Jeevamrit @ 75 ml/m^2 + Foliar application of Jeevamrit @ 10 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-11 (M_{11})	Drenching with Jeevamrit @ 75 ml/m^2 + Foliar application of Jeevamrit @ 15 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-12 (M_{12})	Drenching with Jeevamrit @ 75 ml/m^2 + Foliar application of Jeevamrit @ 20 % at 15 days interval, alternatively + Neemastra @ 2.5 % and

	Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-13 (M_{13})	Drenching with Jeevamrit @ 100 ml/m^2 + Foliar application of Jeevamrit @ 5 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-14 (M_{14})	Drenching with Jeevamrit @ 100 ml/m^2 + Foliar application of Jeevamrit @ 10 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-15 (M_{15})	Drenching with Jeevamrit @ 100 ml/m^2 + Foliar application of Jeevamrit @ 15 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-16 (M_{16})	Drenching with Jeevamrit @ 100 ml/m^2 + Foliar application of Jeevamrit @ 20 % at 15 days interval, alternatively + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively
Module-17 (M_{17})	Soil treatment with *Trichoderma* spp. @ 1 kg/q FYM + Foliar application of Neem seed kernel extract and Garlic extract @ 5% each at 15 days interval, respectively
Module-18 (M_{18})	RDF (100% NPK) + FYM @ 5 kg/m^2
Module-19 (M_{19})	Untreated control

*Sprays of Chlorpyriphos (50 EC) @ 1 ml/l and Imidacloprid (17.8 SL) @ 0.5 ml/l at 15 days intervals, alternatively as well as Diathane M-45 @ 2.0 g/l and Bavistin @ 1 g/l at 15 days intervals, alternatively was practiced only in the treatment module M_{18}.

RESULTS AND DISCUSSION

A. Effect of different treatment modules on available NPK of soil after harvesting (kg/ha)

According to the results in Table-1, the application of different modules had a considerable impact on the available NPK content in the soil during both years. The maximum available N, P, and K levels were found to be (454.30 kg/ha, 87.54 kg/ha, and 434.74 kg/ha, respectively) in M_{18} i.e. RDF (100% NPK) + FYM @ 5 kg/m^2 and were statistically comparable with the natural farming modules M_{16} (450.20 kg/ha, 85.92 kg/ha and 432.74 kg/ha NPK). However, lowest availability of N, P and K content (297.50 kg/ha, 62.05 kg/ha & 257.14 kg/ha, respectively) was recorded in M_{19}.

The application of NPK according to the recommendations, which has supplied the soil with a balanced amount of these nutrients, can be attributed to the increase in available soil nitrogen, phosphorus, and potassium content of the soil receiving M_{18}. These findings in marigold are consistent with Kumar *et al*. (2010), Pal and Ghosh (2010), Rajput (2015), and Sharma (2018). However, increased availability of NPK content in the soil augmented with the natural farming module M_{16}, which could be as a result of faster mineralization carried out by increased microbial activity by applying Jeevamrit, ensuring requisite supply of NPK as

Jeevamrit is a rich source of plant nutrients besides paving a way for multiplication of beneficial microbes responsible for rapid mineralization and decomposition of organic matter in the soil including conversion of nutrients from non available forms into available forms. As a result, additional NPK contents were recorded. Higher accessible NPK content in the soil was also seen in the research conducted in finger millet by Shivakumar (1999) and George (2012) in gerbera as well as Rathore (2018) in egg plant after treatment modules containing different combinations of drenching and foliar spray with Jeevamrit.

B. After harvesting, the number of viable microbes in the soil (cfu/g)

The observation and comparison of data in Table-2 demonstrated a considerable impact of different treatment combinations on the population of beneficial bacteria, fungus, and actinomycetes in the soil during both research years. The treatment module M_{16} comprising drenching of Jeevamrit (100 ml/m^2) + spraying of Jeevamrit (20 %) at 15 days interval + Neemastra (2.5 %) and Brahmastra (2.5 %) at 7 days intervals recorded beneficial bacteria (119.17 105 cfu/g soil), fungus (17.33 103 cfu/g soil), and actinomycetes (14.00 102 cfu/g soil) all had significantly higher maximum loads of viable microbial count. Whereas, M_{18}, i.e. RDF (100 percent NPK) + FYM @ 5 kg/m2, the minimum count of viable and beneficial bacteria (89.83 105 cfu/g soil), fungus (10.83 103 cfu/g soil), and actinomycetes (7.50 102 cfu/g soil) was recorded.

The significant increase in beneficial bacteria, fungi, and actinomycetes in the Jeevamrit-based natural farming module M_{16} could be due to Jeevamrit's unique ability to create a favourable environment for the proliferation of microorganisms, particularly beneficial bacteria, fungi, and actinomycetes, by increasing organic carbon content in the soil. Jeevamrit may have ensured the provision of plant nutrients (macro and mico), some vitamins, vital amino acids, and other growth regulating chemicals of organic origin by multiplying helpful bacteria in the rhizosphere by its application. These findings are very similar to those of the research work completed by Siddappa (2015) in field bean, Shwetha *et al.* (2009) in soybean-wheat cropping system, Biradar *et al.* (2017) in French bean as well as Gore and Sreenivasa (2011) in maize. Jeevamrit nourishes the soil by introducing a large number of helpful microorganisms (Aulakh *et al.*, 2013). It has also been declared that there has been a significant rise in the viable microbial population in the soil by Pamya (2018) and George (2012) when they cultivated gerbera with Jeevamrit-based treatment combinations. Similarly, Kaur (2019) noticed that sprayed Jeevamrit @ 20% in wheat at 2-week intervals, the viable microbial count increased considerably.

C. Seed Production Economics

The cost of seed production on African marigold cv. 'Pusa Narangi Gainda' for various treatment modules showed in Table 3. In terms of the impact of several treatment modules on estimated gross income, the maximum gross income of Rs. 1965555.56/ha was recorded in M_{18} i.e. RDF (100% NPK) + FYM @ 5 kg/m^2 and was closely followed in M_{16} (Rs. 1948666.67/ha). However, in the untreated control (M_{19}) minimum gross income of Rs.

1060000.00/ha was reported. Similarly, the net returns per hectare were also calculated maximum (Rs. 1420012.58) in M_{16} and followed by M_{12} (Rs. 1385012.58) and M_{15} (Rs. 1355498.69). On the other hand, M_{19} had the lowest net returns (Rs. 567150.91/ha). The results in Table-3 also showed that M_{16} had the highest benefit:cost ratio of 3.69:1, followed by M_{12} (3.63:1) and M_{15} (3.63:1). (3.57:1). When compared to natural farming modules M16, M12, and M15, the value for benefit: cost ratio in M18 was evaluated to be 2.84:1, which is quite low. On the other hand, (M_{19}) reported the lowest benefit-to-cost ratio (2.15:1) i.e. untreated control. The treatment modules M_{17} and M_{18} showed higher total expenditure and gross income estimates for seed production of African marigold on a per hectare basis, which could be attributable to greater input costs in these treatments, resulting in higher costs despite achieving maximum gross income. However, the net returns as well as benefit:cost ratios were found to be highest in natural farming modules M_{16} and M_{15}, which could be due to lower spending to be justified by the inputs needed for treatment augmentation. As a result, natural farming modules are extremely cost-effective, as they provide better net returns per unit area and a higher benefit-to-cost ratio.

Sharma *et al*. (2016) conducted an economic analysis of various treatments for cultivating African marigolds and found the following to be the most beneficial: cost-benefit analysis when marigolds were grown with the help of a treatment consortia containing PSB, *Azospirillum*, vermicompost (equivalent to 50 % RDN), NPK fertilizers (equivalent to 50 % RDF) and Cow Urine (5 %). Similarly, when aerobic rice was grown with the combined application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF + FYM, along with the foliar application of Jeevamrut @ 500 l/ha at the time of planting, 30, and 60 days after planting, and spraying cow urine @ 10% at panicle emergence and flowering stages, Sahare and Mahapatra (2015) found the highest net returns and benefit:cost ratio.

CONCLUSION

From the present investigation, it may be concluded that the treatment module M_{18} (i.e. Drenching with Jeevamrit @ 100 ml/m2 + foliar application of Jeevamrit @ 20% at 15 day intervals + Neemastra @ 2.5 percent and Brahmastra @ 2.5 percent at 7 day intervals, alternation) improved NPK availability in African marigold significantly over untreated control but exhibited statistically similar results to the natural farming module M_{16} (i.e. Drenching with Jeevamrit @ 100 ml/m^2 + foliar application of Jeevamrit @ 20 % at 15 days interval + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively). However, the treatment module M_{16} (i.e. Drenching with Jeevamrit @ 100 ml/m^2 + foliar application of Jeevamrit @ 20 % at 15 days interval + Neemastra @ 2.5 % and Brahmastra @ 2.5 % at 7 days intervals, alternatively) also showed a massive load of live microorganisms, as well as the highest benefit:cost ratio over RDF. As a result, this module is recommended for increasing the availability of nutrients and the maximum load of beneficial bacteria in the soil, which helps to improve the performance of African marigold cv. 'Pusa Narangi Gainda' in Himachal Pradesh's mid-hill conditions.

REFERENCES

Aulakh CS, Singh H, Walia SS, Phutela RP and Singh G. 2013. Evaluation of microbial culture (Jeevamrutha) preparation and its effect on productivity of field crops. *Indian Journal of Agronomy* **58**: 182-186.

Biradar N, Murali K, Devakumar N and Lavanya G. 2017. Influence of organic liquid formulations on soil beneficial microbial population of organic frenchbean (*Phaseolus vulgaris* L.). In: *Proceedings of Scientific Track "Innovative Research for Organic Agriculture 3.0",* held at New Delhi, 9-11 November 2017. 19th Organic World Congress. pp. 467-471.

George E. 2012. *Effect of integrated nutrient management on growth, flower yield and post harvest quality of gerbera* **(***gerbera jamesonii Bolus.) cv.* '*Galileo Red*' *under poly house condition*. Ph.D. Thesis. Department of Horticulture, University of Agricultural Sciences GKVK, Bangalore, India. 170p.

Gore NS and Sreenivasa MN. 2011. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* Mill.) in the sterilized soil. *Karnataka Journal of Agricultural Sciences* **24**: 153-157.

Kaur K. 2019. Eco-*friendly management of pea root rot caused by Fusarium solani f. sp. pisi.* M.Sc. Thesis. Department of Plant Pathology, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India. 56p.

Kumar P, Kumar J, Umrao VK and Rajbeer. 2010. Effects of nitrogen and iron on growth and flowering parameters in African marigold (*Tagetes erecta* L.) cv. 'Pusa Narangi Gainda'. *Annals of Horticulture* **3**: 118-119.

Pal P and Ghosh P. 2010. Effect of different sources and levels of potassium on growth, flowering and yield of African marigold (*Tagetes erecta* L.) cv. 'Siracole'. *Indian Journal of Natural Products and Resources* **1**: 371-375.

Pamya L. 2018. *Effect of organic fertilizers in conjunction with chemical fertilizers on the growth and flowering of gerbera (Gerbera jamesonii Bolus Ex. Hook)*. M.Sc. Thesis. Department of Floriculture and Landscape Architecture, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, India. 106p.

Rajput AS. 2015. Effect *of Nitrogen and Phosphorus on Growth and Flowering of French Marigold (Tagetes patula L.) cv. 'Pusa Arpita' under Malwa Region of Madhya Pradesh.* M.Sc. Thesis. Department of Floriculture and Landscape Architecture, Rajmata Vijayaraje Scindia Krishi Vidyalaya, Gwalior. 76p.

Sahare D and Mahapatra A. 2015. Effect of organic manures and liquid organic manures on growth, yield and economics of aerobic rice cultivation. *International Journal of Agricultural Sciences* **11**: 183-188.

Sharma G, Sahu NP and Shukla N. 2016. Effect of bio-organic and inorganic nutrient sources on growth and flower production of african marigold. *Horticulturae* **3**: 1-5.

Rathore G. 2018. *Effect of organic management practices on yield and quality of brinjal* (*Solanum melongena* L.). M.Sc. Thesis. Department of Soil Science and Water Management, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, India. 65p.

Sharma G. 2018. *Effect of NPK on growth and yield of African marigold (Tagetes erecta L.) cv. Pusa Narangi Gainda.* M.Sc. Thesis. Department of Soil Science and Water Management, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, India. 98p.

Shivakumar. 1999. *Effect of Farmyard manure, urban compost and NPK fertilizers on growth and yield of fingermillet*. M.Sc. Thesis. Department of Agronomy, University of Agricultural Sciences, Bangalore, India. 92p.

Shwetha BN, Babalad HB and Jagadeesh KS. 2009. Effect of organics and fermented organics on biological activity of soil in soybean. *Journal of Ecobiology* **25**: 201-207.

Siddappa. 2015. *Use of jeevamrutha and farm yard manure on growth and yield of field bean (Lablab purpureus var. Lignosus).* M.Sc. Thesis. University of Agricultural Sciences, Dharwad. 84p.

Vasanthakumar HA. 2006. Jeevamrut slurry preparation. *Siri Samruddhi.* pp4-5.

Treatment Code	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)

Table 1: Effect of different treatment on available nitrogen, phosphorus and potassium in the soil (kg/ha) after harvesting

	2018 (Y_1)	2019 (Y_2)	Pooled	2018 (Y_1)	2019 (Y_2)	Pooled	2018 (Y_1)	2019 (Y_2)	Pooled
M_1	304.21	307.71	**305.96**	66.06	67.31	**66.69**	258.01	263.77	**260.89**
M_2	311.26	314.76	**313.01**	68.34	69.59	**68.97**	267.98	273.39	**270.69**
M_3	322.71	326.21	**324.46**	68.56	69.81	**69.19**	274.37	278.71	**276.54**
M_4	325.69	329.19	**327.44**	69.68	70.93	**70.30**	282.86	284.84	**283.85**
M_5	347.46	350.96	**349.21**	70.18	71.43	**70.81**	293.61	298.51	**296.06**
M_6	349.46	352.96	**351.21**	70.91	72.16	**71.54**	299.06	301.66	**300.36**
M_7	358.06	361.56	**359.81**	71.94	73.19	**72.56**	327.62	327.88	**327.75**
M_8	360.06	363.56	**361.81**	74.84	76.09	**75.47**	334.72	336.62	**335.67**
M_9	362.73	366.23	**364.48**	75.93	77.18	**76.56**	340.89	340.46	**340.68**
M_{10}	363.99	367.49	**365.74**	76.13	77.38	**76.76**	345.53	346.30	**345.91**
M_{11}	368.79	373.29	**371.04**	77.81	79.31	**78.56**	348.48	349.82	**349.15**
M_{12}	378.98	383.48	**381.23**	78.30	79.80	**79.05**	356.97	358.09	**357.53**
M_{13}	399.88	404.38	**402.13**	79.58	81.08	**80.33**	363.19	363.22	**363.21**
M_{14}	412.24	418.74	**415.49**	80.15	81.65	**80.90**	367.47	368.27	**367.87**
M_{15}	433.18	438.82	**436.00**	81.33	82.83	**82.08**	390.73	390.11	**390.42**
M_{16}	447.78	452.62	**450.20**	85.17	86.67	**85.92**	430.33	435.15	**432.74**
M_{17}	421.65	426.15	**423.90**	83.31	84.81	**84.06**	392.73	392.11	**392.42**
M_{18}	452.05	456.55	**454.30**	86.79	88.29	**87.54**	432.33	437.15	**434.74**
M_{19}	295.25	299.75	**297.50**	61.80	62.30	**62.05**	256.01	258.26	**257.14**
Mean	**369.23**	**373.39**	**371.31**	**75.10**	**76.41**	**75.75**	**334.89**	**337.07**	**335.98**
$CD_{0.05}$	12.00	12.00		2.79	2.94		11.60	7.07	
	M		8.34	**M**		1.99	**M**		6.68
	Y		2.71	**Y**		0.64	**Y**		2.17
	M × Y		NS	**M × Y**		NS	**M × Y**		NS

e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.1, 2022
  UGC CARE Listed (Group -I) Journal

Table 2: Effect of different treatment modules on viable microbial count in the soil (cfu/g) after harvesting

Treatment Code	Bacteria (10^5) (cfu/g)			Fungi (10^3) (cfu/g)			Actinomycetes (10^2) (cfu/g)		
	2018 (Y_1)	2019 (Y_2)	Pooled	2018 (Y_1)	2019 (Y_2)	Pooled	2018 (Y_1)	2019 (Y_2)	Pooled
M_1	92.33	93.67	**93.00**	11.00	12.33	**11.67**	8.00	8.67	**8.33**
M_2	93.00	94.00	**93.50**	12.00	13.33	**12.67**	9.00	9.67	**9.33**
M_3	97.67	98.67	**98.17**	12.67	14.00	**13.33**	9.67	10.33	**10.00**
M_4	98.67	97.33	**98.00**	12.67	14.00	**13.33**	9.67	10.33	**10.00**
M_5	97.33	98.33	**97.83**	13.33	14.67	**14.00**	10.33	11.00	**10.67**
M_6	101.33	102.33	**101.83**	13.33	14.67	**14.00**	10.33	11.00	**10.67**
M_7	105.67	106.67	**106.17**	12.33	13.67	**13.00**	9.33	10.00	**9.67**
M_8	109.00	110.00	**109.50**	13.00	14.33	**13.67**	10.00	10.67	**10.33**
M_9	111.00	112.00	**111.50**	14.33	15.67	**15.00**	11.33	12.00	**11.67**
M_{10}	110.67	111.67	**111.17**	14.67	16.00	**15.33**	11.67	12.33	**12.00**
M_{11}	113.00	113.67	**113.33**	15.00	16.33	**15.67**	12.00	12.67	**12.33**
M_{12}	115.00	116.00	**115.50**	15.33	16.67	**16.00**	12.33	13.00	**12.67**
M_{13}	113.33	114.33	**113.83**	15.00	16.33	**15.67**	12.00	12.67	**12.33**
M_{14}	115.00	116.00	**115.50**	15.33	16.33	**15.83**	11.33	12.00	**11.67**
M_{15}	117.33	118.33	**117.83**	16.00	17.33	**16.67**	12.67	13.67	**13.17**
M_{16}	118.67	119.67	**119.17**	16.67	18.00	**17.33**	13.67	14.33	**14.00**
M_{17}	117.00	118.00	**117.50**	15.67	17.00	**16.33**	12.33	13.33	**12.83**
M_{18}	89.00	90.67	**89.83**	10.00	11.67	**10.83**	7.33	7.67	**7.50**
M_{19}	90.67	91.33	**91.00**	10.33	12.00	**11.17**	7.67	8.00	**7.83**
Mean	**105.56**	**106.46**	**106.01**	**13.61**	**14.96**	**14.29**	**10.56**	**11.23**	**10.89**
$CD_{0.05}$	1.34	1.96		1.33	2.05		1.38	1.31	
	M		1.17	**M**		1.20	**M**		0.94
	Y		0.38	**Y**		0.39	**Y**		0.30

	M × Y	NS	**M × Y**	NS	**M × Y**	NS

Table 3: Effect of different treatment modules on economics of seed production of African marigold per hectare

Treatment code	Seed yield (kg/ha) (Pooled)	Total cost of seed production/ha (Rs.)	*Gross returns/ha (Rs.)	Net returns/ha (Rs.)	B:C ratio
M_1	199.37	518529.09	1196222.22	677693.13	**2.31:1**
M_2	204.41	518904.09	1226444.44	707540.36	**2.36:1**
M_3	208.85	519279.09	1253111.11	733832.02	**2.41:1**
M_4	223.89	519654.09	1343333.33	823679.24	**2.59:1**
M_5	217.41	521529.09	1304444.44	782915.36	**2.50:1**
M_6	226.33	521904.09	1358000.00	836095.91	**2.60:1**
M_7	226.78	522279.09	1360666.67	838387.58	**2.61:1**
M_8	252.56	522654.09	1515333.33	992679.24	**2.90:1**
M_9	242.70	524529.09	1456222.22	931693.13	**2.78:1**
M_{10}	266.04	524904.09	1596222.22	1071318.13	**3.04:1**
M_{11}	278.81	525279.09	1672888.89	1147609.80	**3.18:1**
M_{12}	318.44	525654.09	1910666.67	1385012.58	**3.63:1**
M_{13}	287.56	527529.09	1725333.33	1197804.24	**3.27:1**
M_{14}	300.48	527904.09	1802888.89	1274984.80	**3.42:1**
M_{15}	313.96	528279.09	1883777.78	1355498.69	**3.57:1**
M_{16}	324.78	528654.09	1948666.67	1420012.58	**3.69:1**
M_{17}	310.85	716484.09	1865111.11	1148627.02	**2.60:1**
M_{18}	327.59	691320.39	1965555.56	1274235.17	**2.84:1**
M_{19}	176.67	492849.09	1060000.00	567150.91	**2.15:1**

***The gross returns were worked out on the basis of sell price of African marigold seeds @6000/- per kg (i.e. University rate)**