The Pharma Innovation Journal 2022; 11(11): 2586-2592

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(11): 2586-2592

www.thepharmajournal.com
Received: 10-09-2022
Accepted: 13-10-2022

Ashwini A
Ph.D. Scholar, Department of Floriculture and Landscape Architecture, College of Horticulture, Bagalkot, Karnataka, India

Anand B Mastiholi
Professor of Agronomy and Head, Natural Farming Project, Regional Horticultural Research and Extension Centre, Dharwad, Karnataka, India

Pavankumar P
Assistant Professor of Floriculture and Landscape Architecture, COH, Bagalkot, Karnataka, India

Shirol AM
Associate Professor of Floriculture and Landscape Architecture, COH, Bagalkot, Karnataka, India

Nagaraja MS
Associate Professor and Head (Soil Science and Agricultural Chemistry), UAHS, Shivamogga, Karnataka, India

Suvarna Patil
Assistant Professor of Agri. Entomology, RHREC, Kumbapur, Dharwad, Karnataka, India

Corresponding Author:
Ashwini A
Ph.D. Scholar, Department of Floriculture and Landscape Architecture, College of Horticulture, Bagalkot, Karnataka, India

Effect of liquid jeevamrutha application on growth, yield and quality of marigold (*Tagetes erecta* L.) cv. Calcutta orange under Northern transition zone of Karnataka

Ashwini A, Anand B Mastiholi, Pavankumar P, Shirol AM, Nagaraja MS and Suvarna Patil

Abstract
A field experiment with application of liquid jeevamrutha in marigold cv. Calcutta Orange at different dosages and frequent intervals was carried out at Horticultural Research and Extension Centre, Kanabargi (Belagavi Dist.) (Under University of Horticultural Sciences, Bagalkot) during *rabi* season of 2019-20 and 2020-21. The objective is to study the performance of marigold under different dosages and frequency of application of jeevamrutha. In pooled data, application of liquid jeevamrutha @ 1000 litre per hectare with an interval of 15 days (D_3F_1) recorded significantly maximum growth and yield parameters like plant height (37.90 cm), plant spread (E-W and N-S direction) (23.80 and 24.47 cm), number of primary branches (9.22) and stem diameter (1.11 cm) at harvest stage. Flowering or yield parameters are days to first flowering (34.50), days to 50% flowering (45.07), flower diameter (3.42 cm), individual flower weight (3.92 g), number of flowers per plant (64.67), shelf life (4.40 days), flower yield (9.59 t/ha), fresh biomass (14.13 t/ha) and dry biomass (3.87 t/ha) was compared to other interaction treatments. In control (recommended package of practice) recorded significantly maximum plant height (39.40 cm), plant spread (E-W and N-S direction) (26.73 and 27.40 cm), number of primary branches (9.18) stem diameter (1.23) and leaf area per plant (179.63 cm^2) at harvest stage and maximum flower diameter (3.46 cm), individual flower weight (4.07 g), number of flowers per plant (69.83), flower yield (10.71 t/ha), fresh biomass (15.43 t/ha) and dry biomass (4.30 t/ha) were compared with other treatments.

Keywords: Jeevamrutha, dosage, frequency, growth, flowering and yield

Introduction
Marigold (*Tagetes erecta* L.) is one of the most important commercial flowers in the global floriculture industry. The marigold is an annual crop that grows up to a height of 80 to 120 cm with profuse branching habit and large-sized flowers of different colours (yellow and orange) belonging to the family asteraceae. Marigold stands next to the chrysanthemum among the traditional flower crops. The area under marigold cultivation is about 28, 825 hectares with the production of more than 2.0 million tons in India. Karnataka alone contributes 64, 025 tons of production from an area of 6725 hectares (Anon, 2020) [1]. It has gained popularity because of its wider adaptability to various soil and climatic conditions as well as its longer blooming period. Now a days, in modern agriculture, excessive use of synthetic inputs leads to soil and environmental degradation and also agro-ecological imbalances. The widespread use of chemicals, fertilizers and pesticides in modern farming practices resulted in pollution of soil and water bodies besides reduced input efficiency. Further, in future, we may face severe problems in fertilizer production as the reserves of raw materials of some fertilizers, especially phosphate, are becoming scarce. This makes the farming community to find out an alternate method which is eco-friendly, low cost, locally adoptable and enhance or maintain productivity sustainably. However, there is paucity of technical knowledge in adopting the ecofriendly and natural farming practices. Hence, this necessitated the need to ascertain whether the inorganic fertilizers can be substituted with natural farming inputs and practices (liquid jeevamrutha, ghanajeevamrutha and mulching) and organic farming inputs (FYM, poultry manures, neem-based products, biofertilizers, panchagavya, etc.) without compromising the yield are reported by Palekar (2006) [1].

Material and Methods

The present investigation on effect of liquid jeevamrutha on growth, yield and quality of marigold cv. Calcutta Orange was carried out at Horticultural Research and Extension Centre, Kanabargi (Belagavi Dist.) (Under University of Horticultural Sciences, Bagalkot) during *rabi* season of 2019-20 and 2020-21. The experiment was laid out in two Factorial Randomized Block Design with ten treatments (3×3+1) and three replications. Factor-A includes D_1: 500 litre/ha, D_2:750 litre/ha and D_3:1000 litre/ha, Factor-B includes F_1: Once in two weeks (15 days), F_2: Once in three weeks (21 days) and F_3: Once in four weeks (30 days) and these combinations were compared with control treatment *i*.e., RPP (N:P:K @ 225:60:60 kg/ha + FYM @ 20 t/ha). Ghanajeevamrutha was applied as basal application @1000 kg/ha during experimental plot preparation and ghanajeevamrutha was prepared by spreading 100 kg of desi cow dung on ground uniformly in the form of layer and added 2 kg powdered Jaggery, 2 kg pulse flour, required quantity of cow urine (for easy mixing) and handful of undisturbed farm soil and mixed properly. Thus made cow dung covered by jute bag for 48 hours and allowed for fermentation. Next spread on the floor and dried in the shade. Thus dried ghanajeevamrutha can be applied before planting. Liquid Jeevamrutha was prepared by mixing 10 kg desi cow dung, 10 litre cow urine, 2 kg local jaggery, 2 kg pulse flour and hand full of soil collected from farm. All these were put in 200 litre capacity plastic drum and mixed thoroughly and volume was made up to 200 litre. The mixture was stirred well in clock wise direction and kept in shade covered with wet jute bag. The solution was regularly stirred clockwise in the morning and in the evening continuously and it was used after 3-5 days of preparation during summer and 5-7 days of preparation in winter season for soil application near the plant roots. Jeevamrutha was applied as per the treatments and schedule regularly. In order to check the individual effect of liquid jeevamrutha and ghanajeevamrutha, combination treatments were compared with RPP, only jeevamrutha application and only ghanajeevamrutha application and the treatment details are furnished in table 1.

Table 1: Treatment details and combinations (D × F)

T_1	D_1F_1	Liquid jeevamrutha applied @ 500 l/ha once in two weeks (15 days)
T_2	D_1F_2	Liquid jeevamrutha applied @ 500 l/ha once in three weeks (21 days)
T_3	D_1F_3	Liquid jeevamrutha applied @ 500 l/ha once in four weeks (30 days)
T_4	D_2F_1	Liquid jeevamrutha applied @ 750 l/ha once in two weeks (15 days)
T_5	D_2F_2	Liquid jeevamrutha applied @ 750 l/ha once in three weeks (21 days)
T_6	D_2F_3	Liquid jeevamrutha applied @ 750 l/ha once in four weeks (30 days)
T_7	D_3F_1	Liquid jeevamrutha applied @ 1000 l/ha once in two weeks (15 days)
T_8	D_3F_2	Liquid jeevamrutha applied @ 1000 l/ha once in three weeks (21 days)
T_9	D_3F_3	Liquid jeevamrutha applied @ 1000 l/ha once in four weeks (30 days)
T_{10}	RPP	Control (Recommended package of practice) (RPP) (NPK @ 225:60:60 kg/ha + FYM @ 20 t/ha)

Note: Basal application of ghanajeevamrutha @1000 kg/ha, beejamrutha treatment, organic mulching, pests and disease management through natural means were common to all the treatments except T_{10}.

Results and Discussion

Growth parameters are important for proper growth and development of the plant which helps to increase the flower yield and plant biomass. Different dosage, frequency and interaction of liquid jeevamrutha influenced the growth parameters in marigold significantly. Pooled analysis of the two years data showed that, significantly higher plant height (26.39, 28.38 and 35.86 cm), plant spread (E-W) (9.12, 17.43 and 21.58 cm), plant spread (N-S) (8.34, 16.83 and 22.73 cm), number of primary branches (5.56, 6.82 and 7.94) and stem diameter (0.64, 0.79 and 1.02 cm) at 30, 60 and 90 DAT, respectively was recorded in D_3 (liquid jeevamrutha applied @ 1000 l/ha). Similarly, frequency of liquid jeevamrutha applied at 15 days interval (F_1) also recorded higher plant height (26.77, 28.83 and 35.98 cm), plant spread (E-W) (9.10, 17.56 and 22.00 cm), plant spread (N-S) (8.52, 17.22 and 22.99 cm), number of primary branches (5.59, 6.98 and 8.14) and stem diameter (0.69, 0.84 and 1.07 cm) at 30, 60 and 90 DAT, respectively. The interaction between dosage and frequency of liquid jeevamrutha applied @ 1000 l/ha at an interval of 15 days (D_3F_1) resulted in significantly higher plant height (28.13, 30.10 and 37.90 cm), plant spread (E-W) (10.47, 18.53 and 23.80 cm), plant spread (N-S) (9.70, 18.60 and 24.47 cm), number of primary branches (6.68, 8.10 and 9.22) and stem diameter (0.82, 0.87 and 1.11 cm) at 30, 60 and 90 DAT, respectively in pooled data was compared to other interaction treatments (Table 2).

Among different treatments, the plants treated with liquid jeevamrutha @ 1000 litre per hectare at 15 days interval (D_3F_1) was observed maximum values for all the vegetative parameters (Table 2). The higher growth parameters in the above treatment might be attributed to solubilisation of nutrients in soil and absorption of the same and further maintenance of good soil moisture level due to the application of jeevamrutha reported by Siddappa *et al.* (2016) [11]. Also higher doses of ghanajeevamrutha and liquid jeevamrutha stimulate the activities of micro organisms to release the nitrogen in a synchronous manner, which might have stirred the cellular activity. Further, the presence of growth promoting hormones *viz.*, IAA and GA_3 in jeevamrutha might have favored rapid cell division and multiplication contributing to increased growth parameters among the different levels of ghanajeevamrutha and liquid jeevamrutha which is in accordance with Sweta *et al.* (2017) [16] and Sreenivas *et al.* (2010) [15]. It is said to enhance microbial activity in soil and ultimately ensuring the availability and uptake of nutrients by the crop. These results are in consonance with findings of other authors (Gangadhar *et al.* 2020) [4] in field bean.

When interaction treatments are compared with recommended package of practice (RPP) it was revealed that significantly highest plant height (28.13, 30.27 & 39.40 cm), plant spread (E-W) (12.40, 21.73 & 26.73 cm), plant spread (N-S) (12.00, 21.87 & 27.40 cm), number of primary branches (7.10, 8.72 & 9.18) and stem diameter (0.82, 0.85 & 1.23 cm) at 30, 60 and 90 DAT in pooled data due to improved growth parameters in the present study might be due to the fact that FYM besides supplying N, P and K improves the soil

condition which enhances the source to sink relationship and also makes unavailable sources of elemental nitrogen, bound phosphates, micronutrients and decomposed plant residues into available form to facilitate the plants to absorb the nutrients (Table 2). These results are in agreement with findings of earlier scientist (Siddappa, 2015) [10].

Based on the pooled analysis of the two years data, it was observed that the dosage of liquid jeevamrutha applied @ 1000 litre per hectare (D_3) and frequency of its application at an interval of 15 days (F_1) took minimum of days (34.67 and 36.51 days, respectively) for first flowering. Further, interaction between dosage and frequency of liquid jeevamrutha (D_3F_2, D_3F_1 and D_3F_3 with 34.50, 34.58 and 34.94 days, respectively) also showed minimum days for first flowering. Similarly, significantly minimum number of days (45.29 days) was taken to 50%.

Table 2: Growth parameters in marigold cv. Calcutta Orange at different growth stages as influenced by dosage and frequency of liquid jeevamrutha

Treatments	Pooled data											
	Plant height (cm)			Plant spread (E-W direction) (cm)			Plant spread (N-S direction) (cm)			Stem diameter (cm)		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
Factor-A: Dosage of liquid jeevamrutha (D)												
D_1	24.73^{c}	26.78^{b}	32.19^{b}	7.52^{c}	14.81^{b}	19.59^{b}	7.00^{b}	14.44^{c}	20.21^{c}	0.57^{b}	0.76^{b}	0.94^{c}
D_2	25.51^{b}	27.49^{b}	34.76^{a}	8.33^{b}	16.61^{a}	20.87^{ab}	7.82^{a}	15.68^{b}	21.49^{b}	0.62^{a}	0.77^{b}	0.97^{b}
D_3	26.39^{a}	28.38^{a}	35.86^{a}	9.12^{a}	17.43^{a}	21.58^{a}	8.34^{a}	16.83^{a}	22.73^{a}	0.64^{a}	0.79^{a}	1.02^{a}
S.Em±	0.23	0.24	0.67	0.15	0.31	0.45	0.18	0.20	0.32	0.02	0.01	0.01
C.D. @ 5%	0.68	0.73	2.02	0.46	0.94	1.34	0.55	0.59	0.96	0.05	0.02	0.03
Factor-B: Frequency of liquid jeevamrutha (F)												
F_1	26.77^{a}	28.83^{a}	35.98^{a}	9.10^{a}	17.56^{a}	22.00^{a}	8.52^{a}	17.22^{a}	22.99^{a}	0.69^{a}	0.84^{a}	1.07^{a}
F_2	25.06^{b}	27.12^{b}	33.31^{b}	7.89^{b}	15.69^{b}	20.36^{b}	7.30^{b}	14.89^{b}	21.02^{b}	0.57^{b}	0.77^{b}	0.98^{b}
F_3	24.81^{b}	26.70^{b}	33.51^{b}	7.99^{b}	15.61^{b}	19.68^{b}	7.34^{b}	14.84^{b}	20.42^{b}	0.57^{b}	0.70^{c}	0.89^{c}
S.Em±	0.23	0.24	0.67	0.15	0.31	0.45	0.18	0.20	0.32	0.02	0.01	0.01
C.D. @ 5%	0.68	0.73	2.02	0.46	0.94	1.34	0.55	0.59	0.96	0.05	0.02	0.03
Interaction (D×F)												
T_1: D_1F_1	26.93^{b}	28.78^{b}	35.17^{abc}	8.70^{bc}	17.30^{ab}	21.60^{abc}	8.10^{bc}	17.00^{bc}	23.03^{abc}	0.64^{b}	0.83^{b}	1.03^{b}
T_2: D_1F_2	24.97^{de}	27.07^{cde}	32.30^{cd}	7.30^{ef}	14.70^{d}	19.80^{c}	6.80^{ef}	14.80^{e}	21.27^{d}	0.60^{b}	0.77^{c}	0.94^{cd}
T_3: D_1F_3	22.30^{f}	24.49^{f}	29.10^{d}	6.57^{f}	12.43^{e}	17.37^{d}	6.10^{f}	11.53^{g}	16.33^{f}	0.46^{c}	0.68^{e}	0.86^{e}
T_4: D_2F_1	27.47^{ab}	28.87^{ab}	37.20^{ab}	9.23^{b}	18.00^{ab}	22.30^{ab}	8.80^{ab}	17.67^{ab}	23.67^{ab}	0.61^{a}	0.83^{b}	1.07^{ab}
T_5: D_2F_2	25.23^{cd}	27.60^{bcd}	34.87^{abc}	8.13^{cd}	16.83^{b}	20.60^{bc}	7.77^{cd}	16.07^{cd}	21.47^{cd}	0.48^{b}	0.76^{c}	0.96^{c}
T_6: D_2F_3	23.83^{e}	26.00^{e}	32.20^{cd}	7.63^{de}	15.00^{cd}	19.70^{c}	6.90^{def}	13.30^{f}	19.33^{e}	0.78^{c}	0.71^{d}	0.89^{de}
T_7: D_3F_1	28.13^{a}	30.10^{a}	37.90^{a}	10.47^{a}	18.53^{a}	23.80^{a}	9.70^{a}	18.60^{a}	24.47^{a}	0.82^{a}	0.87^{a}	1.11^{a}
T_8: D_3F_2	26.37^{bc}	28.30^{bc}	35.43^{abc}	8.73^{bc}	17.37^{ab}	21.57^{abc}	8.20^{bc}	16.57^{c}	22.47^{bcd}	0.64^{b}	0.78^{c}	1.04^{b}
T_9: D_3F_3	24.67^{de}	26.73^{de}	34.23^{bc}	8.17^{cd}	16.40^{bc}	19.37^{cd}	7.13^{de}	15.33^{de}	21.27^{d}	0.47^{c}	0.72^{d}	0.91^{cde}
S.Em±	0.39	0.42	1.16	0.27	0.54	0.78	0.32	0.34	0.56	0.03	0.01	0.02
C.D. @ 5%	1.18	1.27	3.49	0.80	1.63	2.33	0.96	1.02	1.67	0.08	0.02	0.05
T_{10}: RPP	28.13	30.27	39.40	12.40	21.73	26.73	12.00	21.87	27.40	0.82	0.85	1.23
S.Em±	0.40	0.64	1.28	0.46	1.09	1.31	0.51	0.96	1.19	0.03	0.01	0.02
C.D. @ 5%	1.19	1.91	3.82	1.36	3.24	3.90	1.53	2.84	3.53	0.08	0.02	0.05

Note: D_1- Liquid jeevamrutha @ 500 l/ha D_2- Liquid jeevamrutha @ 750 l/ha D_3- Liquid jeevamrutha @ 1000 l/ha
F_1- Once in 15 days F_2- Once in 21 days F_3- Once in 30 days
RPP- Recommended package of practice (NPK @ 225:60:60 kg/ha + FYM @ 20 t/ha)

Table 3: Days to first flowering, days to 50 percent flowering and duration of marigold cv. Calcutta Orange as influenced by dosage and frequency of liquid jeevamrutha

Treatments	Days to 1st flowering			Days to 50% flowering			Duration of flowering		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor-A: Dosage of liquid jeevamrutha (D)									
D_1	38.52^{a}	39.40^{a}	38.96^{a}	46.68^{a}	48.07^{a}	47.37^{a}	69.89^{a}	70.34^{a}	70.11^{a}
D_2	35.66^{b}	37.13^{b}	36.40^{b}	45.56^{b}	46.38^{b}	45.97^{b}	66.82^{b}	67.98^{b}	67.40^{b}
D_3	34.50^{c}	34.84^{c}	34.67^{c}	45.09^{c}	45.49^{c}	45.29^{c}	61.51^{c}	61.35^{c}	61.43^{c}
S.Em±	0.16	0.10	0.09	0.12	0.07	0.07	0.15	0.14	0.09
C.D. @ 5%	0.48	0.30	0.26	0.37	0.21	0.22	0.44	0.42	0.28
Factor-B: Frequency of liquid jeevamrutha (F)									
F_1	36.16^{ab}	36.87^{b}	36.51^{b}	45.44^{b}	46.16^{c}	45.80^{c}	65.43^{c}	66.01^{b}	65.72^{c}
F_2	35.91^{b}	37.04^{b}	36.48^{b}	45.81^{ab}	46.73^{b}	46.27^{b}	65.95^{b}	66.17^{ab}	66.06^{b}
F_3	36.61^{a}	37.47^{a}	37.04^{a}	46.09^{a}	47.04^{a}	46.57^{a}	66.84^{a}	67.49^{a}	67.16^{a}
S.Em±	0.16	0.10	0.09	0.12	0.07	0.07	0.15	0.14	0.09
C.D. @ 5%	0.48	0.30	0.26	0.37	0.21	0.22	0.44	0.42	0.28
Interaction (D×F)									
T_1: D_1F_1	38.09^{a}	39.27^{a}	38.68^{b}	46.10^{b}	47.40^{c}	46.75^{b}	68.97^{b}	69.99^{b}	69.48^{c}
T_2: D_1F_2	38.55^{a}	39.47^{a}	39.01^{ab}	46.81^{a}	48.20^{b}	47.50^{a}	70.33^{a}	70.03^{b}	70.18^{b}
T_3: D_1F_3	38.91^{a}	39.47^{a}	39.19^{a}	47.14^{a}	48.60^{a}	47.87^{a}	70.37^{a}	70.99^{a}	70.68^{a}
T_4: D_2F_1	35.89^{b}	36.67^{c}	36.28^{d}	45.27^{c}	45.87^{e}	45.57^{d}	66.08^{c}	66.83^{c}	66.45^{d}

T_5: D_2F_2	34.77^{c}	37.07^{c}	35.92^{d}	45.51^{bc}	46.53^{d}	46.02^{c}	65.96^{c}	67.23^{c}	66.59^{d}
T_6: D_2F_3	36.31^{b}	37.67^{b}	36.99^{c}	45.91^{b}	46.73^{d}	46.32^{c}	68.41^{b}	69.88^{b}	69.15^{c}
T_7: D_3F_1	34.48^{c}	34.67^{e}	34.58^{e}	44.94^{c}	45.20^{g}	45.07^{e}	61.23^{d}	61.21^{d}	61.22^{e}
T_8: D_3F_2	34.40^{c}	34.60^{e}	34.50^{e}	45.12^{c}	45.47^{fg}	45.29^{de}	61.57^{d}	61.24^{d}	61.41^{e}
T_9: D_3F_3	34.61^{c}	35.27^{d}	34.94^{e}	45.22^{c}	45.80^{ef}	45.51^{d}	61.74^{d}	61.60^{d}	61.67^{e}
S.Em±	0.28	0.17	0.15	0.21	0.12	0.12	0.26	0.24	0.16
C.D. @ 5%	0.83	0.51	0.44	0.64	0.37	0.37	0.77	0.73	0.48
T_{10}: RPP	34.80	35.33	35.10	45.10	45.93	45.52	68.94	69.80	69.37
S.Em±	0.29	0.17	0.15	0.20	0.12	0.12	0.24	0.27	0.17
C.D. @ 5%	0.86	0.49	0.45	0.60	0.35	0.35	0.72	0.81	0.50

Note: D_1- Liquid jeevamrutha @ 500 l/ha D_2- Liquid jeevamrutha @ 750 l/ha D_3- Liquid jeevamrutha @ 1000 l/ha
F_1- Once in 15 days F_2- Once in 21 days F_3- Once in 30 days
RPP- Recommended package of practice (NPK @ 225:60:60 kg/ha + FYM @ 20 t/ha)

Flowering in D_3 (liquid jeevamrutha applied @ 1000 l/ha), F_1 (frequency of liquid jeevamrutha at 15 days interval) (45.80 days) and D_3F_1 (liquid jeevamrutha applied @ 1000 l/ha at an interval of 15 days) (45.07 days) in pooled data (Table 3). The earliness in flowering might be due to the higher net assimilation rate on account of better growth leading to the production of endogenous metabolites earlier in optimum level enabling early flowering as reported by Singh and Varu (2013) in papaya.

Duration of flowering differed significantly due to dosage, frequency and interaction treatments of liquid jeevamrutha during both the years and in pooled data. The dosage of liquid jeevamrutha applied @ 500 litre per hectare (D_1) (70.11 days), frequency of liquid jeevamrutha at 30 days interval) (F_3) (67.16 days) and their interaction treatment of liquid jeevamrutha @ 500 litre per hectare at 30 days interval (D_1F_3) (70.68 days) in pooled data showed maximum duration of flowering in marigold crop (Table 3). This might be due to maximum number of days taken for all the reproductive parameters. The low leaf emission rate and slow mineralization of the organic manures might be the reasons for more duration of flowering (Maheshbabu *et al*. 2008) [7].

The dosage and frequency of liquid jeevamrutha also influenced the flower diameter (cm) and individual flower weight (g) significantly. The dosage D_3 (liquid jeevamrutha applied @ 1000 l/ha) (3.31 cm and 3.71 g), frequency F_1 (frequency of liquid jeevamrutha at 15 days interval) (3.32 cm and 3.76 g) and their interaction D_3F_1 (liquid jeevamrutha applied @ 1000 l/ha at an interval of 15 days) (3.42 cm and 3.92 g) produced significantly maximum flower diameter and individual flower weight than other levels and frequencies of liquid jeevamrutha application (Table 4). This might be due to direct response of crop to organic manures which may promote cell proliferation efficiently. Cell division and cell enlargement are accelerated by ample supply of nitrogen which initiates meristematic activity in crop (Chaupoo and Kumar, 2020) [3].

When RPP (recommended package of practice) was compared with other interaction treatments, it was found that significantly maximum flower diameter and individual flower weight recorded in RPP (3.46 cm and 4.07 g) than rest of the interaction treatments (Table 4). The beneficial effect of nitrogen and phosphorus nutrient on flower size and weight of flower might be due to the fact that nitrogen increases the protein synthesis, thus promote the development of floral primordial and phosphorus was found involved in the formation of floral primodial, resulting in more number of flowers (Singh *et al.*, 2015) [13].

Shelf life of flower is an important parameter which decides the durability of loose flowers. In the present investigation jeevamrutha application @ 1000 litre per hectare once in 15 days led to higher shelf life of marigold flower than other levels and frequencies of application in 2020-21 and pooled data (Table 4). The higher shelf life in flowers might be due to application of organic manures which influenced flower longevity due to the increased nutrient uptake by plant and greater development of water conducting tissues (Singh *et al*, 2015) [14].

Table 4: Flower diameter (cm), flower weight (g), number of flowers per plant and shelf life (days) of marigold cv. Calcutta Orange as influenced by dosage and frequency of liquid jeevamrutha

Treatments	Flower diameter (cm)			Flower weight (g)			No. of flowers/plant			Shelf life (Days)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor-A: Dosage of liquid jeevamrutha (D)												
D_1	3.24^{b}	3.09^{b}	3.17^{b}	3.37^{b}	3.62^{b}	3.49^{b}	54.22^{c}	53.56^{c}	53.89^{c}	4.26	3.71^{b}	3.98^{b}
D_2	3.32^{ab}	3.21^{a}	3.27^{a}	3.46^{ab}	3.64^{b}	3.55^{b}	57.00^{b}	57.78^{b}	57.39^{b}	4.19	3.80^{b}	3.99^{b}
D_3	3.35^{a}	3.27^{a}	3.31^{a}	3.52^{a}	3.89^{a}	3.71^{a}	62.00^{a}	60.00^{a}	61.00^{a}	4.26	3.93^{a}	4.10^{a}
S.Em±	0.03	0.03	0.02	0.04	0.03	0.02	0.56	0.40	0.40	0.04	0.04	0.02
C.D. @ 5%	0.10	0.08	0.06	0.11	0.10	0.07	1.68	1.20	1.20	NS	0.12	0.07
Factor-B: Frequency of liquid jeevamrutha (F)												
F_1	3.38^{a}	3.26^{a}	3.32^{a}	3.62^{a}	3.89^{a}	3.76^{a}	61.11^{a}	58.44^{a}	59.78^{a}	4.37^{a}	4.29^{a}	4.33^{a}
F_2	3.27^{b}	3.17^{b}	3.22^{b}	3.40^{b}	3.68^{b}	3.54^{b}	57.56^{b}	57.11^{b}	57.33^{b}	4.19^{b}	3.69^{b}	3.94^{b}
F_3	3.26^{b}	3.15^{b}	3.20^{b}	3.32^{b}	3.59^{b}	3.46^{c}	54.56^{c}	55.78^{c}	55.17^{c}	4.14^{b}	3.47^{c}	3.81^{c}
S.Em±	0.03	0.03	0.02	0.04	0.03	0.02	0.56	0.40	0.40	0.04	0.04	0.02
C.D. @ 5%	0.10	0.08	0.06	0.11	0.10	0.07	1.68	1.20	1.20	0.11	0.12	0.07
Interaction (D×F)												
T_1: D_1F_1	3.33^{ab}	3.23^{a-d}	3.28^{bc}	3.53^{abc}	3.73^{bc}	3.63^{bc}	55.33^{c}	54.67^{de}	55.00^{cde}	4.30^{ab}	4.20^{a}	4.25^{b}
T_2: D_1F_2	3.22^{b}	3.08^{ef}	3.15^{de}	3.33^{de}	3.60^{cd}	3.47^{def}	54.00^{c}	53.33^{e}	53.67^{de}	4.27^{ab}	3.53^{cd}	3.90^{d}
T_3: D_1F_3	3.17^{b}	2.97^{f}	3.07^{e}	3.23^{e}	3.53^{d}	3.38^{f}	53.33^{c}	52.67^{e}	53.00^{e}	4.20^{bc}	3.40^{d}	3.80^{e}
T_4: D_2F_1	3.43^{a}	3.31^{ab}	3.37^{ab}	3.63^{ab}	3.80^{b}	3.72^{b}	60.67^{b}	58.67^{bc}	59.67^{b}	4.40^{a}	4.27^{a}	4.33^{ab}

T_5: D_2F_2	3.34^{ab}	3.18^{b-e}	3.26^{bcd}	3.40^{cde}	3.63^{bcd}	3.52^{de}	56.00^{c}	58.00^{bc}	57.00^{c}	4.12^{bc}	3.67^{bc}	3.89^{d}
T_6: D_2F_3	3.20^{b}	3.13^{de}	3.17^{de}	3.33^{de}	3.50^{d}	3.42^{ef}	54.33^{c}	56.67^{cd}	55.50^{cd}	4.04^{c}	3.47^{cd}	3.75^{e}
T_7: D_3F_1	3.47^{a}	3.37^{a}	3.42^{a}	3.70^{a}	4.13^{a}	3.92^{a}	67.33^{a}	62.00^{a}	64.67^{a}	4.40^{a}	4.40^{a}	4.40^{a}
T_8: D_3F_2	3.40^{a}	3.29^{abc}	3.35^{ab}	3.47^{bcd}	3.80^{b}	3.63^{bc}	62.67^{b}	60.00^{ab}	61.33^{b}	4.20^{bc}	3.87^{b}	4.03^{c}
T_9: D_3F_3	3.18^{b}	3.16^{cde}	3.17^{cde}	3.40^{cde}	3.73^{bc}	3.57^{cd}	56.00^{c}	58.00^{bc}	57.00^{c}	4.18^{bc}	3.53^{cd}	3.86^{de}
S.Em±	0.06	0.05	0.04	0.06	0.06	0.04	0.97	0.69	0.69	0.06	0.07	0.04
C.D. @ 5%	0.17	0.14	0.11	0.19	0.17	0.12	2.90	2.08	2.07	0.19	0.21	0.13
T_{10}: RPP	3.49	3.43	3.46	3.80	4.33	4.07	69.33	70.33	69.83	4.17	4.13	4.15
S.Em±	0.06	0.05	0.04	0.06	0.06	0.04	0.96	0.70	0.71	0.07	0.08	0.05
C.D. @ 5%	0.17	0.15	0.12	0.18	0.18	0.12	2.86	2.09	2.10	0.20	0.23	0.16

Note: D_1- Liquid jeevamrutha @ 500 l/ha D_2- Liquid jeevamrutha @ 750 l/ha D_3- Liquid jeevamrutha @ 1000 l/ha
F_1- Once in 15 days F_2- Once in 21 days F_3- Once in 30 days
RPP- Recommended package of practice (NPK @ 225:60:60 kg/ha + FYM @ 20 t/ha)

Table 5: Yield in marigold cv. Calcutta Orange as influenced by dosage and frequency of liquid jeevamrutha

Treatments	Flower yield (g/plant)			Flower yield (kg/plot)			Flower yield (t/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor-A: Dosage of liquid jeevamrutha (D)									
D_1	182.56^{c}	194.11^{c}	188.33^{c}	13.00^{c}	13.05^{c}	13.02^{c}	6.68^{c}	6.71^{c}	6.70^{c}
D_2	197.44^{b}	210.56^{b}	204.00^{b}	13.84^{b}	14.37^{b}	14.10^{b}	7.12^{b}	7.40^{b}	7.26^{b}
D_3	219.00^{a}	233.78^{a}	226.39^{a}	17.02^{a}	17.75^{a}	17.39^{a}	8.76^{a}	9.13^{a}	8.94^{a}
S.Em±	1.83	1.54	1.39	0.16	0.13	0.11	0.08	0.06	0.05
C.D. @ 5%	5.48	4.62	4.16	0.49	0.37	0.32	0.25	0.19	0.16
Factor-B: Frequency of liquid jeevamrutha (F)									
F_1	221.78^{a}	227.89^{a}	224.83^{a}	15.09^{a}	15.34^{a}	15.22^{a}	7.76^{a}	7.90^{a}	7.83^{a}
F_2	195.89^{b}	210.33^{b}	203.11^{b}	14.62^{ab}	15.01^{ab}	14.82^{b}	7.52^{ab}	7.72^{ab}	7.62^{b}
F_3	181.33^{c}	200.22^{c}	190.78^{c}	14.14^{b}	14.82^{b}	14.48^{c}	7.27^{b}	7.62^{b}	7.45^{c}
S.Em±	1.83	1.54	1.39	0.16	0.13	0.11	0.08	0.06	0.05
C.D. @ 5%	5.48	4.62	4.16	0.49	0.37	0.32	0.25	0.19	0.16
Interaction (D×F)									
T_1: D_1F_1	195.33^{c}	204.33^{ef}	199.83^{c}	13.36^{c}	13.50^{cd}	13.43^{cd}	6.87^{c}	6.95^{cd}	6.91^{cd}
T_2: D_1F_2	180.00^{e}	192.00^{gh}	186.00^{de}	12.99^{c}	13.00^{de}	12.99^{de}	6.68 ^{c}	6.69^{de}	6.68^{de}
T_3: D_1F_3	172.33^{e}	186.00^{h}	179.17^{e}	12.64^{c}	12.65^{e}	12.65^{e}	6.50 ^{c}	6.51^{e}	6.50^{e}
T_4: D_2F_1	220.67^{b}	223.00^{bc}	221.83^{b}	15.04^{b}	15.74^{b}	15.39^{b}	7.74^{b}	8.09^{b}	7.91^{b}
T_5: D_2F_2	190.33^{cd}	210.67^{de}	200.50^{c}	13.34^{c}	13.81^{c}	13.58^{c}	6.86^{c}	7.13^{c}	7.00^{c}
T_6: D_2F_3	181.33^{de}	198.00^{fg}	189.67^{d}	13.12^{c}	13.55^{cd}	13.34^{cd}	6.75^{c}	6.97^{cd}	6.86^{cd}
T_7: D_3F_1	249.33^{a}	256.33^{a}	252.83^{a}	18.57^{a}	18.71^{a}	18.64^{a}	9.55^{a}	9.62^{a}	9.59^{a}
T_8: D_3F_2	217.33^{b}	228.33^{b}	222.83^{b}	17.75^{a}	18.48^{a}	18.12^{a}	9.13^{a}	9.51^{a}	9.32^{a}
T_9: D_3F_3	190.33^{cd}	216.67^{cd}	203.50^{c}	14.75^{b}	16.07^{b}	15.41^{b}	7.58^{b}	8.26^{b}	7.92^{b}
S.Em±	3.17	2.67	2.40	0.28	0.22	0.18	0.15	0.11	0.09
C.D. @ 5%	9.50	8.01	7.20	0.85	0.65	0.55	0.44	0.34	0.28
T_{10}: RPP	263.33	304.67	284.00	20.55	21.11	20.83	10.57	10.85	10.71
S.Em±	4.97	3.28	3.78	0.32	0.27	0.24	0.16	0.14	0.12
C.D. @ 5%	14.76	9.74	11.24	0.95	0.79	0.72	0.49	0.41	0.37

Note: D_1- Liquid jeevamrutha @ 500 l/ha D_2- Liquid jeevamrutha @ 750 l/ha D_3- Liquid jeevamrutha @ 1000 l/ha
F_1- Once in 15 days F_2- Once in 21 days F_3- Once in 30 days
RPP- Recommended package of practice (NPK @ 225:60:60 kg/ha + FYM @ 20 t/ha)

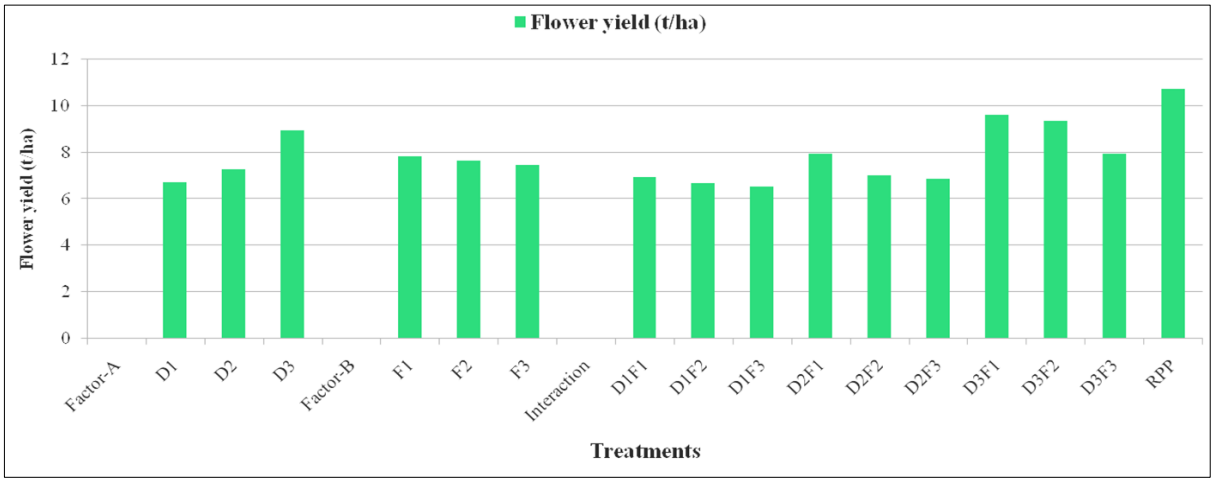
Flower yield parameters like number of flowers per plant and flower yield differed significantly. Significantly maximum number of flowers per plant and flower yield were recorded in D_3 (liquid jeevamrutha applied @ 1000 l/ha) (61.00, 226.39 g/plant, 17.39 kg/plot and 8.94 t/ha, respectively), F_1 (frequency of liquid jeevamrutha at 15 days interval) (59.78, 224.83 g/plant, 15.22 kg/plot and 7.83 t/ha) and interaction treatment D_3F_1 (liquid jeevamrutha applied @ 1000 l/ha at an interval of 15 days) (64.67, 252.83 g/plant, 18.64 kg/plot and 9.59 t/ha, respectively) in pooled data (Table 5 and Fig. 1). This might be due to favorable effects of macro and micronutrients, which helps better availability of nutrients throughout the crop growth which might be the result of improved microbial activity in the soil. These findings are in accordance with Kasbe *et al.* (2009) [6] who reported that higher nutrient status of liquid jeevamrutha formulation (2500 l /ha) produced profuse growth in the form of higher dry matter accumulation and yield parameters.

When interaction treatments are compared with RPP. It was found that significantly maximum number of flowers per plant, flower yield (69.83, 284 g/plant, 20.83 kg/plot and 10.71 t/ha, respectively) were recorded in RPP in pooled data. The per cent increase in flower yield (t/ha) in RPP over D_3, F_1 and D_3F_1 was 19.79, 36.78 and 11.67, respectively on pooled basis (Table 5 and fig. 1). The increased yield in RPP due to application of nutrients through FYM and chemical fertilizer might be attributed to the quick release and availability of nutrients in required quantity with the application of fertilizers. Further, FYM acts as store house for various micro and macro nutrients that are released during the process of mineralization. The results are supported with the findings of Gorabal (2020) [5].

Higher growth and growth attributing parameters produced higher biomass in crop plants. This is evident from the fact that fresh and dry biomass yield (12.73 t/ha and 3.54 t/ha, respectively) was recorded significantly higher in D_3 (liquid

jeevamrutha applied @ 1000 l/ha), F_1 (frequency of liquid jeevamrutha at 15 days interval) (12.56 t/ha and 3.52 t/ha, respectively) and D_3F_1 (liquid jeevamrutha applied @ 1000 l/ha at an interval of 15 days) (14.13 t/ha and 3.87 t/ha, respectively) (Table 6) where growth parameters are also recorded higher. This might be due to the continuous supply of nutrients and plant growth promoting substances present in jeevamrutha which might have resulted in better growth and yield of french bean (Boraiah, 2013) [2] and also reported that presence of higher number of beneficial microbial population and the beneficial effect of jeevamrutha in enhancing the growth and yield.

When interaction treatments are compared with RPP (recommended package of practice) it was found that significantly maximum fresh and dry biomass yield was recorded in RPP (15.43 t/ha and 4.30 t/ha, respectively) in pooled data (Table 6). Fertilizer application might have provided the required NPK for plant growth at early stages. The application of RDF had better effect on the dry matter production as compared to individual treatments of organic liquid manures (Neelima and Sreenivasa, 2011) [8].



Note: D_1- Liquid jeevamrutha @ 500 l/ha D_2- Liquid jeevamrutha @ 750 l/ha D_3- Liquid jeevamrutha @ 1000 l/ha
F_1- Once in 15 days F_2- Once in 21 days F_3- Once in 30 days
RPP- Recommended package of practice (NPK @ 125:60:60 kg/ha + FYM @ 20 t/ha)

Fig 1: Yield (t/ha) in marigold cv. Calcutta Orange as influenced by dosage and frequency of liquid jeevamrutha

Table 6: Biomass yield (both fresh and dry biomass) (t/ha) in marigold cv. Calcutta Orange as influenced by dosage and frequency of liquid jeevamrutha

Treatments	Fresh Biomass (t/ha)			Dry Biomass (t/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor-A: Dosage of liquid jeevamrutha (D)						
D_1	10.47^{c}	10.95^{c}	10.71^{c}	2.98^{c}	3.14^{c}	3.06^{c}
D_2	11.10^{b}	11.75^{b}	11.43^{b}	3.17^{b}	3.34^{b}	3.26^{b}
D_3	12.37^{a}	13.09^{a}	12.73^{a}	3.45^{a}	3.63^{a}	3.54^{a}
S.Em±	0.13	0.09	0.10	0.02	0.02	0.02
C.D. @ 5%	0.38	0.28	0.30	0.06	0.07	0.05
Factor-B: Frequency of liquid jeevamrutha (F)						
F_1	12.39^{a}	12.74^{a}	12.56^{a}	3.46^{a}	3.58^{a}	3.52^{a}
F_2	11.10^{b}	11.82^{b}	11.46^{b}	3.15^{b}	3.34^{b}	3.25^{b}
F_3	10.45^{c}	11.22^{c}	10.84^{c}	2.99^{c}	3.20^{c}	3.09^{c}
S.Em±	0.13	0.09	0.10	0.02	0.02	0.02
C.D. @ 5%	0.38	0.28	0.30	0.06	0.07	0.05
Interaction (D×F)						
T_1: D_1F_1	11.01^{c}	11.46^{ef}	11.24^{cd}	3.15^{c}	3.28^{ef}	3.21^{c}
T_2: D_1F_2	10.34^{de}	10.82^{gh}	10.58^{e}	2.95^{ef}	3.11^{gh}	3.03^{de}
T_3: D_1F_3	10.05^{e}	10.55^{h}	10.30^{e}	2.86^{f}	3.03^{h}	2.94^{e}
T_4: D_2F_1	12.18^{b}	12.46^{c}	12.32^{b}	3.44^{b}	3.50^{bc}	3.47^{b}
T_5: D_2F_2	10.76^{cd}	11.66^{de}	11.21^{cd}	3.07^{cd}	3.36^{de}	3.21^{c}
T_6: D_2F_3	10.37^{cde}	11.13^{fg}	10.75^{de}	2.98^{de}	3.17^{fg}	3.08^{d}
T_7: D_3F_1	13.96^{a}	14.31^{a}	14.13^{a}	3.80^{a}	3.94^{a}	3.87^{a}
T_8: D_3F_2	12.21^{b}	12.97^{b}	12.59^{b}	3.43^{b}	3.56^{b}	3.50^{b}
T_9: D_3F_3	10.94^{cd}	11.99^{cd}	11.46^{c}	3.12^{c}	3.40^{cd}	3.26^{c}
S.Em±	0.22	0.16	0.17	0.04	0.04	0.03
C.D. @ 5%	0.66	0.48	0.52	0.11	0.11	0.09
T_{10}: RPP	14.63	16.24	15.43	4.09	4.51	4.30
S.Em±	0.23	0.18	0.19	0.09	0.08	0.08
C.D. @ 5%	0.68	0.52	0.55	0.26	0.22	0.24

Note: D_1- Liquid jeevamrutha @ 500 l/ha D_2- Liquid jeevamrutha @ 750 l/ha D_3- Liquid jeevamrutha @ 1000 l/ha
F_1- Once in 15 days F_2- Once in 21 days F_3- Once in 30 days
RPP- Recommended package of practice (NPK @ 225:60:60 kg/ha + FYM @ 20 t/ha)

Conclusion

Research results indicated that in natural farming practices, among interaction treatments, application of liquid jeevamrutha @ 1000 litre per hectare at an interval of 15 days registered the higher growth parameters, early flowering, highest flower yield of 9.59 t/ha and more plant biomass with good maintenance of soil nutrient status by increasing the microbial load and enzyme activity in the soil are compared to other interaction treatments. However, RPP (recommended package of practice) recorded significant improvement in flower yield of 10.71 t/ha with good management of pest and diseases.

Acknowledgement

The authors are thankful to Department of Agriculture, Government of Karnataka and University of Horticultural Sciences, Bagalkot for financial assistance.

References

1. Anonymous, Indian Horticultural Database, National Horticulture Board, Gurgaon; c2020. http://www.nhb.gov.in.
2. Boraiah. Effect of organic liquid formulations and manures on growth and yield of capsicum. Ph.D. thesis (unpub.), Univ. Agric. Sci. Bangalore, Karnataka, India, 2013.
3. Chaupoo AS, Kumar S. Integrated Nutrient Management in Marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. Int. J Curr. Microbiol. App. Sci. 2020:9(5):2927-2939.
4. Gangadhar K, Devakumar N, Vishwajith, Lavanya G. Growth, yield and quality parameters of chilli (*Capsicum annuum* L.) as influenced by application of different organic manures and decomposers. Int. J Chemi. Stud. 2020:8(1):473-482.
5. Gorabal DA. Effect of different levels of jeevamrutha and ghanajeevamrutha on yield and quality of rainfed groundnut. M.Sc. Thesis. Univ. Agril. Hort. Sci. Shivamogga, India, 2020.
6. Kasbe SS, Mukund J, Bhaskar S. Characterization of farmers jeevamrutha formulations with respect to aerobic rice. Mysore J Agric. Sci. 2009:43(3):570-573.
7. Maheshbabu HM, Ravi H, Biradar PNK, Babalad HB. Effect of organic manures on plant growth, seed yield and quality of Soybean. Karnataka J Agril. Sci. 2008:21(2):219-221.
8. Neelima SG, Sreenivasa MN. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* L.) in the sterilized soil. Karnataka. J Agric. Sci. 2011:24(2):153-157.
9. Palekar S. Text book on Shoonya bandovalada naisargika krushi., published by Swamy Anand. Agri Prakashana, Bangalore, 2006.
10. Siddappa. Use of jeevamrutha and farm yard manure on growth and yield of field bean (*Dolichos lablab* L.). M.Sc. (Agri.) Thesis submitted to Univ. Agril. Sci. Bangalore, Karnataka, India, 2015.
11. Siddappa Murali K, Devakumar N. Organically grown field bean (*Lablab purpureus var. lignosus*) using jeevamrutha and farm yard manure. Natnl. Conf. on Sustain and Self Sufficient Prodn. of Pulses through an integrated approach, Bengaluru, 2016, 105.
12. Singh SK, Varu DK. Effect of Integrated nutrient management in Papaya (*Carica papaya* L.) cv. Madhubindu. The Asian J Hort. 2013:8(2):667-670.
13. Singh L, Gurjar P, Barholia A, Haldar A, Shrivastava H. Effect of organic manures and inorganic fertilizers on Growth and flower yield of marigold (*Tagetes erecta* L.) var. Pusa Narangi Gainda. Plant Archive. 2015:15(2):779-783.
14. Singh P, Prakash S, Kumar M, Malik S, Singh MK, Kumar A. Effect of integrated nutrient management (INM) on growth, flowering and yield in marigold (*Tagetus erecta* L.) cv. Pusa Basanti. Annals of Horticulture. 2015:8(1):73-80.
15. Sreenivasa MN, Naik N, Bhat SN, Nekar MM. Effect of organic liquid manures on growth, yield and quality of chilli (*Capsicum annuum* L.) Green Farming. 2010:1(3):282-284.
16. Sweta Shikta M, Sunita N, Reddi RY, Prasanthi Y. Efficacy of different organic nutrient management practices on growth and yield of finger millet. Andhra pradesh. J Agril. Sci. 2017:3(3):165-170.