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# Influence of different dosage and frequency of liquid jeevamrutha application on plant nutrient status in marigold (*Tagetes erecta* L.) cv. Calcutta orange under northern transition zone of Karnataka

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**Abstract**
The present field experiment was conducted 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 of the experiment was to study the application of liquid jeevamrutha at different dosage and frequency on plant nutrient status (N, P & K) of marigold cv. Calcutta Orange. The experiment was designed in two factorial randomized block design with each factor having three levels. Three different levels of liquid jeevamrutha *viz.*, @ 500 l/ha, @ 750 l/ha and @ 1000 l/ha at different frequencies are 15 days, 21 days and 30 days was applied to marigold by drenching around the plant root system. The combination effect of different dosage and frequency of liquid jeevamrutha application was compared with recommended package of practice (RPP). The results revealed that application of higher dosage of liquid jeevamrutha @ 1000 l/ha at an interval of 15 days recorded significantly higher plant nutrient status. Similarly in interaction treatments pooled data, revealed that $D_3F_1$ (liquid jeevamrutha @ 1000 l/ha at 15 days interval) recorded significantly highest nitrogen (59.96 kg/ha), phosphorous (14.13 kg/ha) and potassium (43.75 kg/ha) during after harvest was compared to other treatments.

**Keywords:** Marigold, liquid jeevamrutha, plant nutrients, nitrogen, phosphorous and potassium

## Introduction
In India, floriculture industry is emerging in terms of both acreage and production of different flower crops. Among the flower crops, 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. In India, the total area under floricultural crops is around 3.13 lakh hectares with a production of 20.59 lakh metric tonnes of loose flowers (Anon, 2019) [1]. 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) [2]. In modern agriculture, excessive use of chemical fertilizers and pesticides destroys the beneficial soil micro flora and fauna that pollute soil and ground water. Further, in the near future, we may face severe problems in the fertilizer production as the reserves of some fertilizer components, especially phosphates are becoming limiting. Hence, there is an urgent need to tap the alternate sources for these nutrients, which has to be eco-friendly, low cost, locally adoptable and enhance or maintain productivity sustainably. Hence, keeping these views in mind is the need of the hour and it needs to be ascertained that the quantum of inorganic fertilizers that could substituted with natural farming preparations and practices (liquid jeevamrutha, Ghana jeevamrutha and mulching) and organic farming (FYM, poultry manures, neem based products, bio fertilizers and panchagavya etc.) practices without sacrificing the yield. In this regard present experiment entitled "Effect of different dosage and frequency of liquid jeevamrutha application on plant nutrient status in marigold (*Tagetes erecta* L.) cv. Calcutta Orange under Northern Transition Zone of Karnataka" was carried out with an objective to study the effect of application of liquid jeevamrutha at different dosage and frequency on plant nutrient status (N, P & K) of marigold cv. Calcutta Orange.

## Material and Methods

The present field experiment was conducted 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 the factorial randomized block design (FRBD) with two factors each having three levels. There are totally 12 treatments which were replicated thrice. Factor I- Dosage of liquid jeevamrutha (D) includes three levels *i.e.*, $D_1$ (@ 500 liter/ha), $D_2$ (@ 750 liter/ha) and $D_3$ (@ 1000 litre/ha) and Factor II- Frequency of liquid jeevamrutha application (F) includes three levels *i.e.*, $F_1$ (once in 15 days), $F_2$ (once in 21 days) and $F_1$ (once in 30 days). These combinations were compared with control treatment *i.*e., RPP (N: P: K @ 225:60:60 kg/ha + FYM @ 20 t/ha). In order to check the individual effect of liquid jeevamrutha and Ghana jeevamrutha, combination treatments were compared with RPP, only jeevamrutha application and only Ghana jeevamrutha application and the treatment details are furnished in table 1. The whole plant (leaves, stem, roots and flowers) was collected, crushed and made into fine powder by using a mixer. The plant samples were collected from each treatment for nutrient analysis after the harvest stage. These samples were brought to the laboratory and further, they were used for estimation of N, P and K content in plant. These samples were brought to laboratory and pre-digesting a powdered sample of 0.5 g with five ml of concentrated $HNO_3$ was followed by a di-acid combination ($HNO_3$: $HClO_4$ in a 10:4 ratio) on sand bath for analysis for mineral nutrients except nitrogen and volume was made up to 100 ml with distilled water and stored for complete elemental analysis (Jackson, 1973) [6]. Further used for estimation of N, P and K content in plant sample. Nitrogen content was determined by Kjeldhal distillation method, the phosphorous content in the digested plant samples was determined by Vanado molybdous phosphoric yellow colour method. The intensity of yellow colour developed was determined by using a spectrophotometer at 420 nm wave length (Piper, 1966) [7]. Plant samples were digested by using di-acid mixture. Potassium content in the digested samples was determined by using flame photometer method (Piper, 1966) [7].

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

| | | |
|---|---|---|
| $T_1$ | $D_1$ $F_1$ | Liquid jeevamrutha applied @ 500 l/ha once in two weeks (15 days) |
| $T_2$ | $D_1$ $F_2$ | Liquid jeevamrutha applied @ 500 l/ha once in three weeks (21 days) |
| $T_3$ | $D_1$ $F_3$ | Liquid jeevamrutha applied @ 500 l/ha once in four weeks (30 days) |
| $T_4$ | $D_2$ $F_1$ | Liquid jeevamrutha applied @ 750 l/ha once in two weeks (15 days) |
| $T_5$ | $D_2$ $F_2$ | Liquid jeevamrutha applied @ 750 l/ha once in three weeks (21 days) |
| $T_6$ | $D_2$ $F_3$ | Liquid jeevamrutha applied @ 750 l/ha once in four weeks (30 days) |
| $T_7$ | $D_3$ $F_1$ | Liquid jeevamrutha applied @ 1000 l/ha once in two weeks (15 days) |
| $T_8$ | $D_3$ $F_2$ | Liquid jeevamrutha applied @ 1000 l/ha once in three weeks (21 days) |
| $T_9$ | $D_3$ $F_3$ | 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 Ghana jeevamrutha @ 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

### Nitrogen uptake by plant (kg/ha)

Different dosage, frequency and interaction of liquid jeevamrutha application influenced the nitrogen uptake by plant during 2019-20, 2020-21 and also in pooled data. In pooled data, significantly higher nitrogen uptake (53.91 kg/ha) was recorded in $D_2$ (liquid jeevamrutha applied @ 750 l/ha) among dosage, $F_1$ (15 days interval) (56.66 kg/ha) among frequencies and interaction treatment $D_3F_1$ (liquid jeevamrutha was applied @ 1000 l/ha at an interval of 15 days) (59.96 kg/ha) and significantly lower nitrogen content was recorded in $D_1F_3$ (liquid jeevamrutha was applied @ 500 l/ha at an interval of 30 days) (41.90 kg/ha) among interactions are compared to other interaction treatments (Table 2). Similar trend in nitrogen uptake was observed in both the seasons of experiment.

### Phosphorus uptake by plant (kg/ha)

Phosphorus uptake also differed significantly due to dosage, frequency of liquid jeevamrutha application and their interaction treatments in pooled data. Higher phosphorus uptake was recorded in $D_3$ (liquid jeevamrutha applied @ 1000 l/ha) (11.81 kg/ha) among dosages, $F_1$ (frequency of liquid jeevamrutha at 15 days interval) (12.26 kg/ha) and among interaction treatments $D_3F_1$ (liquid jeevamrutha applied @ 1000 l/ha at an interval of 15 days) (14.13 kg/ha). Significantly lower phosphorus uptake was recorded in $D_1F_3$ (liquid jeevamrutha was applied @ 500 l/ha at 30 days interval) (8.02 kg/ha) was compared to other interaction treatments. Similar trend in phosphorus uptake was observed in both the years of the study (Table 2).

### Potassium uptake by plant (kg/ha)

Different dosage, frequency and interaction of liquid jeevamrutha differed significantly with respect to potassium uptake in pooled data. Significantly higher potassium uptake (37.91 kg/ha) was recorded in $D_3$ (liquid jeevamrutha applied @ 1000 l/ha) among dosages, $F_1$ (frequency of liquid jeevamrutha at 15 days interval) (36.78 kg/ha) among frequencies and interaction treatment $D_3F_1$ (liquid jeevamrutha applied @ 1000 l/ha at an interval of 15 days) (43.75 kg/ha) and significantly lower potassium uptake was recorded in $D_1F_3$ (liquid jeevamrutha applied @ 500 l/ha at 30 days interval) (22.79 kg/ha) was compared to other interaction treatments in pooled data. Similar trend was observed in 2019-20 (Table 2). However, potassium uptake did not differ significantly due to dosage of liquid jeevamrutha in the year of 2020-21.

### Discussion

Nutrients tend to move towards the roots by diffusion in response to concentration gradients in the water phase surrounding the roots, as well as by convection during the uptake of soil and water by the roots (Smethurst, 2004) [8]. Hence, plant nutrient uptake was most important phase in the soil for proper growth and development of the crop. The increase in plant nutrient uptake with the application of higher dosages of liquid jeevamrutha and Ghana jeevamrutha can be related to their ability to trigger the soil biological activities i.e., microbial and enzyme activities which helps to enhance microbial activity in soil and ultimately ensuring the availability and uptake of nutrients by the crops as reported by Devakumar *et al.* (2008) [3]. Sreenivasa *et al.* (2009) [90]

reported that application of jeevamrutha might have helped in greater availability of nutrients in the rhizosphere soil that has enhanced the uptake of nitrogen, phosphorus and potassium. The results are in conformity with the findings of Gore and Sreenivasa (2011) [5] where in, the nutrient concentrations *viz*., N, P and K in tomato plants were significantly higher with the application of RDF + Beejamruth + Jeevamrutha + Panchagavya. Continuous application of jeevamrutha increase soil biological activity and it adds nutrients to the soil by decomposition of organic matter and this might have helped in greater availability of nutrients in the rhizospheric soil which has enhanced the uptake of nutrients by the tree. Sutar *et al.* (2017) [10] reported that, significantly the highest uptake of nitrogen, phosphorus and potassium was recorded with the application of jeevamrutha @ 1000 liter per hectare and these findings are in accordance with Gangadhar *et al.* (2020) [4] who reported that highest nitrogen, phosphorous and potassium content was recorded with jeevamrutha application as compared to application of microbial consortia and NCOF-decomposer.

**Table 2:** Nitrogen, phosphorous and potassium uptake (kg/ha) by plant sample as influenced by dosage and frequency of liquid jeevamrutha

| Treatments | Nitrogen | | | Phosphorous | | | Potassium | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2019-20 | 2020-21 | Pooled | 2019-20 | 2020-21 | Pooled | 2019-20 | 2020-21 | Pooled |
| **Factor-A: Dosage of liquid jeevamrutha (D)** | | | | | | | | | |
| $D_1$ | 45.08$^{c}$ | 51.95$^{c}$ | 48.52$^{b}$ | 6.56 | 12.20$^{c}$ | 9.38$^{b}$ | 22.62$^{b}$ | 27.02 | 24.82$^{b}$ |
| $D_2$ | 48.19$^{b}$ | 59.64$^{a}$ | 53.91$^{a}$ | 7.22 | 13.42$^{b}$ | 10.32$^{b}$ | 34.45$^{a}$ | 34.07 | 34.26$^{a}$ |
| $D_3$ | 49.67$^{a}$ | 57.12$^{b}$ | 53.39$^{a}$ | 8.29 | 15.33$^{a}$ | 11.81$^{a}$ | 36.75$^{a}$ | 39.07 | 37.91$^{a}$ |
| S. Em± | 0.44 | 0.53 | 0.36 | 0.77 | 0.30 | 0.43 | 2.29 | 3.24 | 1.71 |
| C.D. @ 5% | 1.31 | 1.58 | 1.08 | NS | 0.89 | 1.30 | 6.88 | NS | 5.14 |
| **Factor-B: Frequency of liquid jeevamrutha (F)** | | | | | | | | | |
| $F_1$ | 52.99$^{a}$ | 60.32$^{a}$ | 56.66$^{a}$ | 8.90 | 15.61$^{a}$ | 12.26$^{a}$ | 36.51$^{a}$ | 37.05 | 36.78$^{a}$ |
| $F_2$ | 47.56$^{b}$ | 56.34$^{b}$ | 51.95$^{b}$ | 7.19 | 13.72$^{b}$ | 10.45$^{b}$ | 29.95$^{ab}$ | 33.24 | 31.59$^{b}$ |
| $F_3$ | 42.39$^{c}$ | 52.05$^{c}$ | 47.22$^{c}$ | 5.98 | 11.61$^{c}$ | 8.80$^{c}$ | 27.37$^{b}$ | 29.87 | 28.62$^{b}$ |
| S. Em± | 0.44 | 0.53 | 0.36 | 0.77 | 0.30 | 0.43 | 2.29 | 3.24 | 1.71 |
| C.D. @ 5% | 1.31 | 1.58 | 1.08 | NS | 0.89 | 1.30 | 6.88 | NS | 5.14 |
| **Interaction (D×F)** | | | | | | | | | |
| $T_1$: $D_1F_1$ | 50.43$^{bc}$ | 56.97$^{cd}$ | 53.70$^{c}$ | 7.56 | 13.78$^{bc}$ | 10.67$^{bcd}$ | 25.29$^{cd}$ | 29.15 | 27.22$^{de}$ |
| $T_2$: $D_1F_2$ | 46.65$^{d}$ | 53.23$^{e}$ | 49.94$^{d}$ | 6.58 | 12.32$^{cd}$ | 9.45$^{cde}$ | 22.16$^{d}$ | 26.76 | 24.46$^{de}$ |
| $T_3$: $D_1F_3$ | 38.16$^{g}$ | 45.65$^{f}$ | 41.90$^{f}$ | 5.54 | 10.49$^{e}$ | 8.02$^{e}$ | 20.42$^{d}$ | 25.15 | 22.79$^{e}$ |
| $T_4$: $D_2F_1$ | 52.45$^{b}$ | 60.16$^{b}$ | 56.30$^{b}$ | 8.74 | 15.19$^{b}$ | 11.96$^{ab}$ | 41.21$^{ab}$ | 37.51 | 39.36$^{ab}$ |
| $T_5$: $D_2F_2$ | 43.72$^{e}$ | 59.51$^{bc}$ | 51.62$^{d}$ | 6.96 | 13.65$^{c}$ | 10.31$^{bcd}$ | 32.13$^{a-d}$ | 34.00 | 33.07$^{bcd}$ |
| $T_6$: $D_2F_3$ | 48.40$^{cd}$ | 59.25$^{bc}$ | 53.83$^{c}$ | 5.96 | 11.42$^{de}$ | 8.69$^{de}$ | 30.00$^{bcd}$ | 30.69 | 30.35$^{cde}$ |
| $T_7$: $D_3F_1$ | 56.08$^{a}$ | 63.84$^{a}$ | 59.96$^{a}$ | 10.40 | 17.87$^{a}$ | 14.13$^{a}$ | 43.02$^{a}$ | 44.47 | 43.75$^{a}$ |
| $T_8$: $D_3F_2$ | 52.31$^{b}$ | 56.27$^{d}$ | 54.29$^{c}$ | 8.02 | 15.19$^{b}$ | 11.60$^{bc}$ | 35.55$^{abc}$ | 38.96 | 37.25$^{abc}$ |
| $T_9$: $D_3F_3$ | 40.61$^{f}$ | 51.25$^{e}$ | 45.93$^{e}$ | 6.45 | 12.92$^{cd}$ | 9.69$^{cde}$ | 31.69$^{a-d}$ | 33.77 | 32.73$^{bcd}$ |
| S. Em± | 0.76 | 0.91 | 0.62 | 1.34 | 0.51 | 0.75 | 3.97 | 5.61 | 2.97 |
| C.D. @ 5% | 2.27 | 2.73 | 1.87 | NS | 1.54 | 2.24 | 11.91 | NS | 8.90 |
| $T_{10}$: RPP | 50.38 | 67.53 | 58.96 | 9.45 | 13.49 | 11.47 | 47.50 | 58.99 | 53.25 |
| S. Em± | 1.39 | 1.35 | 1.26 | 1.28 | 0.50 | 0.71 | 3.82 | 5.29 | 2.83 |
| C.D. @ 5% | 4.13 | 4.02 | 3.75 | NS | 1.50 | 2.11 | 11.36 | NS | 8.42 |

**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

From the results of the study it concluded that, more frequent application of higher dosage of liquid jeevamrutha improved the plant nutrient uptake. Significantly higher plant nutrient status (N, P and K) was recorded with application of liquid jeevamrutha @ 1000 liter per hectare at an interval of 15 days compared to other interaction treatments.

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