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Effect of Jeevamrit on growth and flowering of marigold

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Abstract
The present investigation was carried out at Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (H.P) during 2018-19. This experiment was laid out in the field in a Randomized Block Design with 7 treatments which replicated four times. Studies revealed that maximum plant height (72.02 cm), plant spread (49.60 cm), number of side shoots (6.55), number of flowers per plant (23.55), number of flowers per square meter (211.95), individual flower weight (16.40 g), flower weight per plant (368.52 g), flower weight per square meter (3.32 kg), flower diameter (5.80 cm) and duration of flowering (21.30 days) were recorded with application of recommended dose of fertilizer NPK @30:20:20 g/m^2. However, among different Jeevamrit treatments, maximum plant height (70.45 cm), plant spread (48.55 cm), number of side shoots (5.90), number of flowers per plant (20.05), number of flowers per square meter (180.45), individual flower weight (14.94 g), flower weight per plant (279.37 g), flower weight per square meter (2.52 kg), flower diameter (5.29 cm) and duration of flowering (19.05 days) were recorded with application of Jeevamrit @ 2 litre/m^2 at 15 days interval. Minimum number of days taken to visible bud formation (47.15 days) and peak flowering (66.60 days) was recorded when no fertilizers were applied.

Keywords: Jeevamrit, fertilizer, marigold, RDF

Introduction
Marigold is one of the commercially exploited flower crop of the genus *Tagetes* and family Asteraceae. The name of *Tagetes* has been given after '*Tages*' a demigod known for its beauty. Two main popularly grown species in marigold are *Tagetes erecta* L. (African marigold) and *Tagetes patula* L. (French marigold), which owe their origin to Mexico and South Africa, respectively.

In India, marigold ranks first in loose flower market followed by Chrysanthemum, Jasmine, Tuberose, Crossandra and Barleria. Area under loose flower production in India has reached 2246 MT (Anonymous, 2018) [1]. Area under marigold flower production in India is 309 ha (Anonymous, 2018) [1]. It is cultivated commercially in Maharashtra, Karnataka, Gujarat and Andhra Pradesh. At present, area under loose flower production in Himachal Pradesh is approximately 43.63 ha.

Its leaves and flowers are equally important for medicinal purposes (Tripathy and Gupta, 1991) [10]. Leaf extract is a good remedy for ear ache. Flower extract is a good blood purifier, a cure for blood piles, ulcers and eye diseases. The leaves of marigold plants are characterized by the presence of distinct odoriferous oil. Essential oil of marigold has a great use in perfumery industries. The oil has bronchodilatory, tranquilizing, anti-inflamatory effect and juvenile hormone with insect repellent properties against flies, ants and mosquitoes. These flower extracts are used as an additive in poultry feed to impart bright yellow colour to egg yolk, skin and fatty tissues as the poultry pigmentation is associated with the good health and premier quality (Henken, 1992) [3]. It is also found beneficial to control nematode population when planted as an intercrop and also effective as an organic manure (Polthance and Yamazaki, 1996) [6].

For the optimum growth and flowering of any flower crop, including marigold a proper fertilization programme is essential. It will improve flower keeping quality, reduce disease problems, promote higher yields and extend shelf life of flowers. Marigold is heavy feeder crop and needs sufficient amount of nutrients in the soil. Organic fertilizers like jeevamrit have capacity to increase crop yield while maintaining the soil health.

Maintenance of soil fertility is a prerequisite for long term sustainable farming. Modern conventional farming uses chemical fertilizers to stimulate crop production resulting in decline in soil structure and soil aggregation, decrease in water infilteration and an increase in soil salinity and soil bulk density. Moreover, the use of inorganic fertilizers has been associated with human health problems and environment degradation (Arisha and Bardisi, 1999) [2]. Organic manures supply the required nutrients, improve soil structure, increase microbial population and at the same time maintain the quality of crop produce (Suresh *et al.*, 2004) [9].

Jeevamrit also contains enormous amount of microbial load which multiply and act as soil tonic. It is said to enhance microbial activity in soil and ultimately ensuring the availability and uptake of nutrients by the crops. A preharvest spray of jeevmarit has also been found to enhance the shelf life of marigold flowers (Sharma, 2017) [7] but effect of applications at growth stages need to be investigated.

Materials and Methods

The experiment was carried out at the farm of Department of Floriculture and Landscape Architecture of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan during 2017-18. The experiment i.e. effect of jeevamrit on growth and flowering of marigold was laid out in the field in a Randomized Block Design with 7 treatments i.e. T_1 (recommended dose of fertilizer (RDF) @ 30:20:20 g NPK/m^2), T_2 (no fertilizers – only FYM @ 5 kg/m^2), T_3 (no fertilizers), T_4 (jeevamrit @ 1 litre/m^2 at 15 days interval), T_5 (jeevamrit @ 2 litre/m^2 at 15 days interval), T_6 (jeevamrit @ 25 ppm at 15 days interval), T_7 (jeevamrit @ 50 ppm at 15 days interval); replicated four times. The different observations were recorded by various methods Plant height (cm), Plant spread (cm), Number of side shoots per plants, Number of days taken to visible bud formation, Number of days taken to peak flowering, Number of flowers per plant, Number of flowers per square meter, Individual flower weight (g), Flower weight per plant (g), Flower weight per m^2 (kg), Size of flowers (cm) and Duration of flowering (days).

Result and Discussion

The result show in Table 1 has significantly effect the growth parameters of marigold among treatments. The maximum plant height (72.02 cm) was recorded on application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1). However, it was *at par* with treatment jeevamrit @ 2 litre/m^2 at 15 days interval (T_5). Whereas, minimum plant height (59.57 cm) was observed when no fertilizers were applied (T_3). Increased plant height due to jeevamrit is due to essential macro and micro nutrients, many vitamins, essential amino acids, growth promoting substances like indole acetic acid (IAA), gibberellic acid (GA) and beneficial microorganisms (Palekar, 2006) [4].

The maximum plant spread (49.60 cm) was recorded on application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1). In case of jeevaamrit sprays maximum plant spread (48.55 cm) was recorded when it was used as a drench application @ 2 litre/m^2 at an interval of 15 days. Whereas, minimum plant spread (39.35 cm) was observed when no fertilizers were applied (T_3). Jeevamrit improves microbial population in the soil mainly due to their constituents such as: cow dung, cow urine, legume flour and jaggery containing both macro and essential micro nutrients, many vitamins, essential amino acids, growth promoting substances like indole acetic acid (IAA), gibberlic acid (GA) and beneficial microorganisms. Our results are in agreement with the Singh *et al.* (2015) [8] who observed maximum plant spread with application of 5% jeevamrit in marigold.

The maximum number of side shoots (6.55) was recorded on application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1), followed by jeevamrit application @ 2 l/m^2 at 15 days interval (5.90). Whereas minimum number of side shoots (3.90) was observed when no fertilizers were applied (T_3). This might be due the reason that it contains nitrogen and phosphorus which improves structural parameters. They are an important constituent of proteins and lipids which improves food supply to the plants which resulted in increased plant vigour in the form of more number of side shoots. Our results also get support from Singh *et al.* (2015) [8] who reported maximum number of branches per plant (25.45) in marigold when treated with jeevamrit.

The minimum number of days (38.40 days) taken to visible bud formation was recorded when no fertilizers were applied (T_3) followed by jeevamrit application @ 25 ppm at 15 days interval (41.25 days). Whereas, maximum number of days (48.45 days) taken to visible bud formation was recorded with the application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1).

Data presented in Table 2 & 3 resulted significantly affect the flowering parameters of marigold among the treatments. The minimum number of days taken to peak flowering (59.20 days) was recorded with no fertilizers application (T_3) followed by application of jeevamrit @ 25 ppm at 15 days interval (60.80 days). Whereas, maximum number of days taken to peak flowering (67.35 days) was recorded with an application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1), which was found *at par* with application of jeevamrit @ 2 litre/m^2 at 15 days interval (T_5). In case of RDF (recommended dose of fertilizer) and jeevamrit growth promoting nutrients like nitrogen and phosphorus are available to the plants which improves the vegetative characters of the plants and thus resulted into delayed bud formation in plants but in case of no fertilizers, bud formation was earliest because low amount of available nitrogen and phosphorus shifts plants to reproductive stage much earlier.

The maximum number of flowers per plant (23.55) was recorded with application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1) followed by application of jeevamrit @ 2 litre/m^2 at 15 days interval (20.05). Whereas, minimum number of flowers per plant (14.75) was observed when no fertilizers were applied (T_3) which was found *at par* with an application of jeevamrit @ 25 ppm at 15 days interval (15.55).

The maximum number of flowers per square meter (211.95) was recorded with an application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1) followed by jeevamrit @ 2 litre/m^2 at 15 days interval (180.45). Whereas, minimum number of flowers per square meter (132.75) was observed when no fertilizers were applied (T_3). The significant increase in number of flowers per plant and per square meter in jeevamrit might be due to the reason that nitrogen, phosphorus and potassium are directly available to the plants and jeevamrit also increases beneficial microorganisms in the soil in comparison to inorganic fertilizers. Number of flowers per plant may have increased with the increase in number of branches per plant as well as due to the effect of inoculants capable of providing

phosphorous useful in increasing the number of flowers per plant. The increase in number of flowers per plant in marigold was also observed with jeevamrit treatment (Singh *et al*., 2015) [8].

The maximum individual flower weight (16.40 g) was recorded with an application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1) followed by jeevamrit @ 2 litre/m^2 at 15 days interval (14.94 g). Minimum individual flower weight (7.79 g) was observed when no fertilizer was applied (T_3).

The maximum flower weight per plant (368.52 g) was recorded with an application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1) followed by jeevamrit @ 2 litre/m^2 at 15 days interval (279.37 g). Whereas, minimum individual flower weight (132.29 g) was observed when no fertilizers were applied (T_3) which was found *at par* with an application of jeevamrit @ 25 ppm at 15 days interval (T_6) (151.92 g) and jeevamrit @ 50ppm at 15 days interval (T_7) (171.00 g).

The maximum flower weight per m^2 (3.32 kg) was recorded with an application of recommended dose of fertilizer (RDF) @ 30:20:20 g NPK/m^2 (T_1) followed by jeevamrit @ 2 litre/m^2 (2.52 kg). Whereas, minimum individual flower weight (1.19 kg) was observed when no fertilizers were applied (T_3), which was found *at par* with application of jeevamrit @ 25 ppm at 15 days interval (T_6) (1.37 kg) and jeevamrit @ 50 ppm at 15 days interval (T_7) (1.54 kg). The increase in flower weight per plant and per square meter area on application of jeevamrit @ 2 litre/m^2 at 15 days interval among different jeevaamrit treatments might be due to the reason that application of jeevamrit significantly increases root geometry, nutrient access and supply, resulting in the development of sound and healthy rhizosphere. Another cause might be increased nutrient uptake, photosynthesis, source sink relationship, besides excellent biochemical activities and jeevamrit also increased growth permoting hormones availability (GA_3 and IAA) responsible for increased flower weight. Our results on increased weight of flowers are in close confirmation with Pamya (2018) [5].

The maximum size of flower (5.80 cm) was recorded with an application of recommended dose of fertilizer (RDF) @ 30:20:20g NPK/m^2 (T_1) followed by an application of jeevamrit @ 2 litre/m^2 (5.29 cm). Whereas, minimum size of flowers (3.79 cm) was observed when no fertilizers were applied (T_3). In case of different jeevamrit applications maximum flower diameter (5.29 cm) was recorded in (T_5) jeevamrit @ 2 litre/m^2 at 15 days interval. Minimum flower diameter (3.79) was observed in T_3.

The maximum duration of flowering (21.30 days) was recorded with an application of recommended dose of fertilizer (RDF) @ 30:20:20 g NPK/m^2 (T_1) followed by application of jeevamrit @ 2 litre/m^2 (19.05 days). Whereas, minimum duration of flowering (13.25 days) was observed when no fertilizers were applied (T_3). Duration of flowering is very important which signifies the availability of the flower in the market. Among the different treatments maximum duration of flowering (21.30 days) was recorded in application of (T_1), in case of different jeevamrit applications maximum duration of flowering (19.05 days) was recorded in (T_5) jeevamrit @ 2 litre/m^2 at 15 days interval. Our results on maximum duration of flowering in days are in agreement with that of Pamya (2018) [5] in gerbera.

Conclusions

Based on the studies it can be concluded that recommended dose of fertilizers NPK @ 30:20:20 g/m^2 was found to be best for most of the growth and flowering parameters. In case of jeevamrit drench and spray application- drench application of jeevamrit @ 2 litre/m^2 at 15 days interval was found to be the best as compared to other applications.

Table 1: Effect of Jeevamrit on growth parameters of Marigold

Treatments	Plant height (cm)	Plant spread (cm)	Number of side shoots	Number of days taken for visible bud formation
Recommended Dose of Fertilizer (RDF) @ 30:20:20 g NPK/m^2 (T_1)	72.02	49.60	6.55	48.45
FYM @ 5 kg/m^2 (T_2)	68.49	44.91	5.20	44.25
No fertilizers (T_3)	59.57	39.35	3.90	38.40
Jeevamrit @ 1 litre/m^2 at 15 days interval (T_4)	69.47	46.82	5.50	46.05
Jeevamrit @ 2 litre/m^2 at 15 days interval (T_5)	70.45	48.55	5.90	47.15
Jeevamrit @ 25 ppm at 15 days interval (T_6)	64.34	41.27	4.55	41.25
Jeevamrit @ 50 ppm at 15 days interval (T_7)	65.23	42.63	4.75	42.85
$C.D._{0.05}$	1.60	0.89	0.35	0.84

Table 2: Effect of Jeevamrit on flowering parameters of Marigold

Treatments	Number of days taken for peak flowering	Number of flowers per plant	Number of flowers per square meter	Individual flower weight (g)
Recommended Dose of Fertilizer (RDF) @ 30:20:20 g NPK/m^2 (T_1)	67.35	23.55	211.95	16.40
FYM @ 5 kg/m^2 (T_2)	63.05	17.95	161.55	12.73
No fertilizers (T_3)	59.20	14.75	132.75	7.79
Jeevamrit @ 1 litre/m^2 at 15 days interval (T_4)	65.45	18.45	166.05	13.68
Jeevamrit @ 2 litre/m^2 at 15 days interval (T_5)	66.60	20.05	180.45	14.94
Jeevamrit @ 25 ppm at 15 days interval (T_6)	60.80	15.55	139.95	9.59
Jeevamrit @ 50 ppm at 15 days interval (T_7)	61.55	16.45	148.05	10.53
$C.D._{0.05}$	0.81	1.32	11.87	0.86

Table 3: Effect of Jeevamrit on flowering parameters of Marigold

Treatments	Flower weight per plant (g)	Flower weight per m^2 (kg)	Size of flowers (cm)	Duration of flowering (days)
Recommended Dose of Fertilizer (RDF) @ 30:20:20 g NPK/m^2 (T_1)	368.52	3.32	5.80	21.30
FYM @ 5 kg/m^2 (T_2)	209.50	1.89	4.41	16.75
No fertilizers (T_3)	132.29	1.19	3.79	13.25
Jeevamrit @ 1 litre/m^2 at 15 days interval (T_4)	257.61	2.32	4.92	17.50
Jeevamrit @ 2 litre/m^2 at 15 days interval (T_5)	279.37	2.52	5.29	19.05
Jeevamrit @ 25 ppm at 15 days interval (T_6)	151.92	1.37	4.06	14.50
Jeevamrit @ 50 ppm at 15 days interval (T_7)	171.00	1.54	4.18	15.00
$C.D._{0.05}$	46.37	0.42	0.22	0.46

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