Effect of *jeevamrut* and *panchagavya* on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.) and soil properties

ABSTRACT

This experiment was carried out to investigate the effect of *jeevamrut* and *panchagavya* on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.) variety 'Ratlam Selection' and soil chemical properties and viable bacterial count. The experiment was carried out during 2022-23 and laid out in a Randomized Block Design (RBD) with fourteen treatments including different combinations of concentrations, methods, and intervals of application of *jeevamrut* and *panchagavya* and control (only recommended dose of FYM 15 t/ha). Among the treatments, maximum growth and vegetative attributes *viz*., plant height at 60, 75, 90, 105 and 120 days after transplanting (29.47 cm, 42.33 cm, 50.83 cm, 54.80 cm and 56.53 cm, respectively), number of branches at full bloom stage (8.27) and average plant spread (27.22 cm) was recorded with 500 l/ha *Jeevamrut* drenching and 8 % *Panchagavya* foliar application alternatively at fifteen days interval. Earliness in flowering attributes *viz*., first bud initiation (63.20 days), first flower opening (84.53 days) and full blooming (99.13 days) was observed in the same treatment. Alternate application of 500 l/ha *Jeevamrut* as soil drenching and 8% *panchagavya* as foliar application at 15 days interval also resulted in maximum number of flowers per plant (35.52), flower yield per plant (141.39 g), flower diameter (6.32 cm) and weight of individual flower (4.11 g). While, treatment consisting only 500 l/ha *Jeevamrut* soil drenching at fifteen days interval resulted in maximum available nitrogen (196.52 kg/ha) and viable bacterial count (94.78 × 10^5 cfu/g of soil) in the soil.

Keywords: Chrysanthemum, *Jeevamrut*, *Panchagavya*, Soil chemical properties, Bacterial count

1. INTRODUCTION

Chrysanthemum, botanically known as *Chrysanthemum morifolium* Ramat., is one of the most popular flowering plants belonging to Asteraceae family. It is commonly known as 'Queen of the East' and 'Autumn Queen'. It is popular by different names in various languages in India. It is called '*Chandramallika*' in Bengali, '*Sevanti*' in Marathi and Gujarati, and '*Guldaudi*' in Hindi and Punjabi. Chrysanthemum is heavy nutrient feeder crop. Inorganic fertilizers application can only supply one or two nutrient elements and due to increased use of chemical fertilizers over the time, the soil properties have been declining. This eventually, leading to high demand for organic farming to protect soil and plant health. Organic farming in recent years is gaining impetus due to its inherent advantages in sustaining crop production and also in maintaining dynamic soil nutrient status, saving environment and increasing microbial biomass. Liquid organic substances that are used in organic horticulture like *Jeevamrut* and *Panchagavya* are fermented products, which are used as plant growth enhancing substances prepared by using material available with farmers. The organic amendments *Jeevamrut* and *Panchagavya* are made by cow products namely, dung, urine, milk, curd and ghee. *Jeevamrut* is highly nutritious organic manure made from cow products. It accelerates the proliferation of soil microflora which is beneficial to soil enrichment. Soil microorganisms play an active role in replenishing soil fertility as they are involved in the recycling of nutrients like carbon and nitrogen, which are required for plant growth and they are also responsible for the decomposition of the organic matter to the soil and, therefore, in the recycling of nutrients in soil. Since ancient times, *Panchagavya* has been recommended by our traditional knowledge system and treasure of information to protect plants and soil microbes. It can act as bio-enhancer, growth promoter and immunity booster. Maintenance of soil health and productivity is a prerequisite for long term sustainable farming.

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Earlier, very scanty work has been carried out on effect of liquid organic substances like *jeevamrut* and *panchagavya* on loose flower production of chrysanthemum Keeping this in consideration, present study was conducted to evaluate the effect of different combinations of *jeevamrut* and *panchagavya* concentration, methods and interval of applications on growth, flowering and yield of chrysanthemum as well as soil properties.

2. MATERIALS AND METHOD

The present investigation was conducted during 2022-23 at College Farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Mehsana, Gujarat. The soil of experimental field was loamy sand in texture, low in organic carbon and available nitrogen, medium in available phosphorus and potassium and moderately alkaline in reaction. One month old rooted cuttings of chrysanthemum cv. 'Ratlam Selection' having uniform size and vigour were used for the experiment. The land was brought to a fine tilth by tractor drawn cultivator and well rotten FYM (15 t/ha) was uniformly mixed in the soil. The rooted cuttings were planted at a spacing of 30 cm x 30 cm on raised beds of 1.5 m × 1.5 m size. Transplanting of rooted cuttings was done in the last week of August, 2022. There was total fourteen treatments *viz*.; T_1: Control (Only recommended dose of FYM 15 t/ha); T_2: *Jeevamrut* drenching (500 l/ha); T_3: 4 % *Jeevamrut* foliar application; T_4: 6 % *Jeevamrut* foliar application; T_5: 8 % *Jeevamrut* foliar application; T_6: 4 % *Panchagavya* foliar application; T_7: 6 % *Panchagavya* foliar application; T_8: 8 % *Panchagavya* foliar application; T_9: *Jeevamrut* drenching + 4 % *Jeevamrut* foliar application; T_{10}: *Jeevamrut* drenching + 6 % *Jeevamrut* foliar application; T_{11}: *Jeevamrut* drenching + 8 % *Jeevamrut* foliar application; T_{12}: *Jeevamrut* drenching + 4 % *Panchagavya* foliar application; T_{13}: *Jeevamrut* drenching + 6 % *Panchagavya* foliar application and T_{14}: *jeevamrut* drenching + 8 % *Panchagavya* foliar application. The experiment was laid out in Randomized Block Design (RBD) in open field condition with three replications. Treatment T_2 to T_8 were applied at 15 days interval, whereas T_9 to T_{14} were applied alternatively at 15 days interval (*i.e.*, drench and foliar application alternatively). In the present investigation, different organic liquid substances were prepared freshly as per the procedure of NCOF, Ghaziabad (Chandra *et al*., 2017). Spread plate method (Rangaswamy, 1966) was used for counting population of bacteria from soil sample by using standard procedure. Observations on different growth, flowering, yield and quality parameters of chrysanthemum as well as chemical properties and viable bacterial count of soil were recorded and analyzed statistically.

3. RESULTS AND DISCUSSION

3.1 Growth and vegetative parameters

A perusal of data clearly indicates that application of *jeevamrut* and *panchagavya* had significant effect on growth and vegetative characters (Table 1). At all the stages of plant growth *i.e*., 60, 75, 90, 105 and 120 days after transplanting, maximum plant height (29.47 cm, 42.33 cm, 50.83 cm, 54.80 cm and 56.53 cm, respectively) was observed in treatment T_{14} *i.e. Jeevamrut* drenching (500l/ha) and 8% *Panchagavya* foliar application alternatively at fifteen days interval which was at par with T_{13}, T_2 and T_{12}. The increase in plant height might be due to the reason that drenching of *jeevamrut* acted as a tonic for soil health and promoted the growth as it contains macro nutrients in the form of N (0.16 %), P (0.02 %) and K (0.123 %) (George, 2012). The auxin content in *panchagavya* upon its application might have activated cell division and cell elongation in the auxiliary buds and promoted plant growth (Reshma *et al*., 2019). The outcome of these parameters is in close conformity with the previous findings of Sharma (2020) in a pot experiment of petunia after drench application of *jeevamrut*. Similar results have been reported in Boston fern after drenching and foliar application at *jeevamrut* alternatively at fifteen days interval by Vanlalhruaii (2019). These results also corroborate the findings of Bunkar (2020) in French marigold after application of *panchagavya*.

Table 1. Effect of *jeevamrut* and *panchagavya* on growth and vegetative characters of chrysanthemum

Treatments	Plant height (cm)	Number	Plant spread (cm)

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	60 DAT	75 DAT	90 DAT	105 DAT	120 DAT	of branches per plant	N-S	E-W	Average
T_1	22.13	34.93	44.70	50.20	52.17	5.60	23.80	21.93	22.87
T_2	27.17	39.93	48.77	53.40	55.33	7.80	27.07	25.53	26.30
T_3	22.67	35.80	45.57	50.87	52.43	6.27	23.97	22.57	23.27
T_4	23.27	36.07	45.93	50.90	52.87	6.33	24.30	23.00	23.65
T_5	23.53	36.33	46.10	51.13	53.00	6.60	24.43	23.13	23.78
T_6	24.13	36.67	46.47	51.27	53.33	6.67	24.90	23.50	24.20
T_7	24.27	36.73	46.57	51.63	53.40	6.80	24.93	23.70	24.32
T_8	24.40	37.80	46.93	51.67	53.53	7.07	25.40	24.10	24.75
T_9	25.00	38.40	47.20	51.87	53.73	7.33	26.00	24.93	25.47
T_{10}	25.53	39.00	47.27	52.03	53.87	7.40	26.03	25.10	25.57
T_{11}	26.27	39.47	47.87	52.13	53.97	7.53	26.37	25.17	25.77
T_{12}	27.13	39.87	48.67	53.53	55.30	7.73	26.40	25.37	25.88
T_{13}	27.53	40.27	49.57	54.00	55.60	7.93	27.60	26.07	26.83
T_{14}	29.47	42.33	50.83	54.80	56.53	8.27	27.87	26.57	27.22
S.Em. ±	0.84	0.87	1.01	0.91	0.88	0.25	0.84	0.79	0.60
C.D. at 5%	2.43	2.52	2.94	2.65	2.55	0.73	2.45	2.30	1.75
C.V. (%)	5.75	3.94	3.70	3.03	2.82	6.11	5.69	5.63	4.17

*Treatment T_2 to T_8 were applied at fifteen days interval and T_9 to T_{14} were applied at fifteen days interval, alternatively till flowering

Among the treatments, maximum number of branches per plant (8.27) were recorded in the T_{14} treatment which was at par with treatment T_{13}, T_2 and T_{12}. Maximum plant spread (27.87 cm, 26.57 cm and 27.22 cm in N-S direction, E-W direction and average plant spread, respectively) was also recorded in the same treatment which was at par with treatment T_{13}, T_2, T_{12}, T_{11}, T_{10} and T_9. The possible reason for increase in number of branches might be that drenching of *jeevamrut* has significantly increased nutrient uptake, photosynthesis and source sink relationship, besides excellent biochemical activities (Bhalla *et al*., 2006). Further, presence of cytokinin in *panchagavya* might have increased cell division and cell elongation which further induced more number of branches in plants. These liquid organic substances (*Jeevamrut* and *Panchagavya*) consist of NPK. Nitrogen is a major constituent of proteins and also helps in increasing growth of plant. Increased number of branches might have contributed to increase in plant spread. Further, foliar application of *panchagavya* might have helped in better absorption of nitrogen leading to increased photosynthesis process resulting in better plant growth and spread. These results are in accordance with the findings of Choudhary *et al*. (2021) and Barad *et al*. (2019).

3.2 Flowering and quality parameter

The application of *jeevamrut* and *panchagavya* has significantly influenced various flowering and quality attributes *viz*., days to first bud initiation, days to first flower opening, days taken to full blooming, flower diameter (cm), weight of individual flower (g) and shelf life (days) of chrysanthemum cv. 'Ratlam Selection' (Table 2). The earliest first bud initiation (63.20 days), first flower opening (84.53 days) and full blooming (99.13 days) was recorded in treatment T_{14} alternatively at fifteen days interval and the results were at par with treatment T_{13}, T_2, T_{12}, T_{11}, T_{10}, T_9 and T_8. The possible reason for earliness in flower opening might be attributed to the faster vegetative growth and storing sufficient reserved food materials for differentiation of buds into flowers which ultimately resulted in earliest blooming. These results are in conformity with the findings of Bharti *et al*. (2007) who recorded early flowering in tuberose after foliar spray of *panchagavya*. The outcome of these parameters is in accordance with the previous findings of Barad *et al*. (2019) and Bunkar (2020). It is well known that *jeevamrut* consist of beneficial microorganisms, which act as a tonic for improving soil health. *Jeevamrut* increases microbial activities in soil and convert the non-available form of nutrients into available form which fasten the

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vegetative growth and results in early completion of juvenile phase further leading to early reproductive phase, hence early blooming. The results are in accordance with the findings in marigold after drenching with *jeevamrut* at fifteen days interval as compare to its foliar application (Choudhary *et al.*, 2021).

Significantly largest flower diameter (6.32 cm) and maximum individual flower weight (4.11 g) was obtained with the T_{14} alternatively at fifteen days interval which was at par with treatment T_{13}, T_2 and T_{12} for both the characters. Increment in flower diameter might be due to enhanced cell division and cell enlargement and promotion of protein synthesis. Greater flower diameter is caused by drawing photosynthates to the flower as a consequence of intensification of sink. The increase in length of petals and pedicel accompanied by increased number of petals resulted bigger size of flower further resulting in increase of individual flower weight.

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Table 2. Effect of *jeevamrut* and *panchagavya* application on flowering and quality characters of chrysanthemum

Treatments	Days to first bud initiation	Days to first flower opening	Days taken to full blooming	Flower diameter (cm)	Weight of individual flower (g)	Shelf life (days)
T_1	66.60	88.13	102.00	5.60	3.37	6.67
T_2	63.67	85.07	99.60	6.15	3.82	7.27
T_3	66.33	87.13	101.80	5.80	3.39	6.73
T_4	66.07	87.00	101.60	5.93	3.41	6.73
T_5	66.00	86.60	101.47	6.00	3.46	6.80
T_6	65.80	86.53	101.40	5.90	3.50	6.87
T_7	65.33	86.33	101.20	5.96	3.55	6.93
T_8	65.27	86.27	100.80	5.99	3.58	7.00
T_9	65.13	86.00	100.67	6.00	3.54	7.07
T_{10}	64.80	85.87	100.53	6.05	3.63	7.13
T_{11}	64.60	85.80	99.87	6.10	3.71	7.20
T_{12}	64.53	85.73	99.80	6.13	3.81	7.20
T_{13}	63.40	84.67	99.47	6.20	4.02	7.27
T_{14}	63.20	84.53	99.13	6.32	4.11	7.33
S.Em. ±	0.72	0.62	0.59	0.07	0.11	0.16
C.D. at 5%	2.10	1.79	1.71	0.21	0.31	NS
C.V. (%)	1.92	1.24	1.01	2.09	5.06	3.88

*Treatment T_2 to T_8 were applied at fifteen days interval and T_9 to T_{14} were applied at fifteen days interval, alternatively till flowering

The effect of *jeevamrut* and *panchagavya* applications on shelf life of flowers was found non-significant.

3.3 Yield parameters

The yield characters *viz.*, number of flowers per plant, flower yield per plant (g), flower yield per plot (kg) and flower yield per hectare (q) has been significantly influenced with *jeevamrut* and *panchagavya* application (Table 3). It is clear from the data that various concentrations of liquid organic substances show significant influence on number of flowers per plant. It is evident from the data that maximum number of flowers per plant (35.52), flower yield per plant (141.39 g), flower yield per plot (1.23 kg) and flower yield per hectare (151.57 q) was recorded in treatment T_{14} *i.e. Jeevamrut* drenching (500 l/ha) and 8 % *Panchagavya* foliar application alternatively at fifteen days interval and all these characters at par with treatment T_{13}. The reason might be that the nutrients in *Jeevamrut* and *Panchagavya* are readily soluble as they are in liquid forms and can be taken up by the plants at once. As, plant receives regular supply of N and P that leads to more vegetative growth, further leading to increase in photosynthetic area which in turn resulted in more synthesis and accumulation of photosynthates. The quick mobilization of these

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photosynthates from leaves (source) to flower (sink) might have increased number of flowers per plant. Further, GA induces cell elongation and cell division which reflected in larger flower size and longer petals as well as subsequently in higher flower yield per plant. Higher photosynthetic activities and more carbohydrates accumulation resulted in better plant growth and consequently improved flower yield per plot and hectare. These outcomes are in accordance with the previous findings of Choudhary *et al*. (2021) and Sabhya (2019).

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Table 3. Effect of *jeevamrut* and *panchagavya* on yield characters of chrysanthemum

Treatments	Number of flowers per plant	Flower yield per plant (g)	Flower yield per plot (kg)	Flower yield per hectare (q)
T_1	23.40	76.84	0.67	82.55
T_2	33.00	124.33	1.08	133.54
T_3	23.93	79.05	0.70	86.62
T_4	24.20	81.36	0.75	92.61
T_5	25.40	83.92	0.78	96.73
T_6	25.60	86.18	0.80	98.36
T_7	26.07	88.25	0.84	103.10
T_8	26.87	91.90	0.86	105.77
T_9	27.20	92.68	0.86	106.72
T_{10}	28.27	96.14	0.88	109.00
T_{11}	29.20	98.83	0.92	113.03
T_{12}	32.87	118.69	1.03	126.83
T_{13}	33.40	133.67	1.18	145.51
T_{14}	35.52	141.39	1.23	151.57
S.Em. ±	0.83	3.20	0.04	4.72
C.D. at 5%	2.42	9.29	0.11	13.73
C.V. (%)	5.12	5.56	7.38	7.38

*Treatment T_2 to T_8 were applied at fifteen days interval and T_9 to T_{14} were applied at fifteen days interval, alternatively till flowering

3.4 Soil chemical properties and viable bacterial count

A perusal of data (Table 4) clearly indicates that application of *jeevamrut* and *panchagavya* had non-significant effect on organic carbon (%) in soil. Data pertaining to available nitrogen (kg/ha) after the completion of experiment showed significant difference among the treatments. Significantly maximum available nitrogen (196.52 kg/ha) was observed with treatment T_2 *i.e. Jeevamrut* drenching (500 l/ha) at fifteen days interval and which was at par with treatment T_{14}, T_{13}, T_{12} and T_{11}. The increase in available nitrogen might be due to build up of soil micro flora The fertility of soil not only depends on its chemical composition, but also on the qualitative and quantitative nature of microorganisms. The buildup of soil available nitrogen could be attributed to greater multiplication of microbes with *jeevamrut* which helped in mineralization of soil nitrogen. These results can be supported by the findings of Siddappa (2015).

In the present investigation, viable bacterial count was differed significantly after the application of *jeevamrut* and *panchagavya* treatments and it can be inferred from the data that maximum viable bacterial count (94.78 × 10^5 cfu/g of soil) was recorded in treatment T_2 *i.e. Jeevamrut* drenching (500 l/ha) at fifteen days interval. The most dominant group of microorganisms in soil are bacteria probably, one half of the microbial biomass. Increase in microbial population might be due to organic inputs which provide food and micro environment to the microbes by releasing CO_2 during the process of decomposition in the soil which helps in multiplication and growth of microbes. These results are in accordance with the findings of Patel *et al*. (2018) and Thakur (2020) who recorded increase in viable bacteria in soil after application of *jeevamrut* and *panchagavya*.

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Table 4. Effect of *jeevamrut* and *panchagavya* on soil chemical properties and viable bacterial count

Treatments	Organic carbon (%)	Available nitrogen (kg/ha)	Viable bacterial count (No. × 10^5 cfu/g of soil)
Before	0.28	191.20	78.26
After			
T_1	0.26	121.26	71.33
T_2	0.31	196.52	94.78
T_3	0.27	128.23	73.11
T_4	0.28	133.67	74.28
T_5	0.27	137.98	75.33
T_6	0.28	142.17	76.56
T_7	0.28	146.35	77.67
T_8	0.29	158.89	78.89
T_9	0.27	167.25	83.89
T_{10}	0.28	171.43	85.56
T_{11}	0.29	179.80	85.78
T_{12}	0.29	183.98	87.22
T_{13}	0.30	188.16	88.44
T_{14}	0.30	192.34	89.11
S.Em. ±	0.01	7.76	0.88
C.D. at 5%	NS	22.57	2.55
C.V. (%)	5.46	8.38	1.86

*Treatment T_2 to T_8 were applied at fifteen days interval and T_9 to T_{14} were applied at fifteen days interval, alternatively till flowering

4. CONCLUSION

Based on the results of the present investigation it is concluded that soil drenching with *jeevamrut* @ 500 l/ha and foliar application of *panchagavya* @ 8 %, alternatively at fifteen days interval upto flower initiation stage is beneficial for obtaining better growth, higher yield with and good quality flowers in 'Ratlam Selection' variety of chrysanthemum. However, *Jeevamrut* drenching (500 l/ha) at fifteen days interval is beneficial for enhancing available nitrogen and viable bacterial count in the soil.

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