Effect of Liquid organic manures on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.) and soil properties

ABSTRACT

This experiment was carried out to investigate the effect of two liquid organic manures viz., 'jeevamrut' and 'panchagavya' on the growth, flowering and yield of chrysanthemum (Chrysanthemum morifolium Ramat.). 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 Jeevamrutand Panchagavyaand 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 Jeevamrutdrenching and 8 % Panchagavyafoliar 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) were observed in the same treatment. Alternate application of 500 l/ha Jeevamrutas soil drenching and 8% Panchagavyaas foliar application at 15 days interval also resulted in a 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 of only 500 l/ha Jeevamrutsoil drenching at fifteen days interval resulted in maximum available nitrogen (196.52 kg/ha) and viable bacterial count (94.78 × 10^5cfu/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 fertilizer application can only supply one or two nutrient elements and due to increased use of chemical fertilizers over time, the soil properties have been declining. This eventually, led to high demand for organic farming to protect soil and plant health. Organic agriculturein 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 Jeevamrutand Panchagavyaare fermented products, which are used as plant growth enhancing substances prepared by using material available fromfarmers. The organic amendments Jeevamrutand Panchagavyaare made fromcow products namely, dung, urine, milk, curd and ghee.It also contains growth regulatory substances such as IAA, GA, cytokinins and essential plant nutrients {Xu and Xu. (2000) and Selvaraj *et al*. (2007)}. Panchagavya, an organic product is a potential source to play great role for promoting growth and providing immunity in plant system. Bio- chemical properties of panchagavya revealed that it possesses almost all the major nutrients like N, P, K and micro nutrients essential for plant and growth hormones like IAA and GA required for crop growth (Selvaraj *et al*. 2007).Jeevamrutis 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 inthe soil and, therefore, in the recycling of nutrients in soil (Yusuf et al., 2022;

Andriani et al., 2023).Since ancient times, Panchagavyahas 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 (Raju et al., 2022). Earlier, very scanty work has been carried out on effect of liquid organic substances like Jeevamrutand Panchagavyaon loose flower production of chrysanthemum Keeping this in consideration, present study was conducted to evaluate the effect of different combinations of Jeevamrutand Panchagavyaconcentration, methods and interval of applications on growth, flowering and yield of chrysanthemum as well as soil properties.

2. MATERIALS AND METHODS

The present investigation was conducted during 2022-23 at College Farm, College of Horticulture, SardarkrushinagarDantiwada 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 vigourwasused 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 in 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: Jeevamrutdrenching (500 l/ha); T_3: 4 % Jeevamrutfoliar application; T_4: 6 % Jeevamrutfoliar application; T_5: 8 % Jeevamrutfoliar application; T_6: 4 % Panchagavyafoliar application; T_7: 6 % Panchagavyafoliar application; T_8: 8 % Panchagavyafoliar application; T_9: Jeevamrutdrenching + 4 % Jeevamrutfoliar application; T_{10}: Jeevamrutdrenching + 6 % Jeevamrutfoliar application; T_{11}: Jeevamrutdrenching + 8 % Jeevamrutfoliar application; T_{12}: Jeevamrutdrenching + 4 % Panchagavyafoliar application; T_{13}: Jeevamrutdrenching + 6 % Panchagavyafoliar application and T_{14}: Jeevamrutdrenching + 8 % Panchagavyafoliar application. The experiment was laid out in Randomized Block Design (RBD) in open field conditions with three replications. Treatment T_2 to T_8wasapplied at 15 days interval, whereas T_9 to T_{14}wasapplied 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.

2.1 Preparation of Jeevamrut

Cow dung 10 kg, cow urine 10 litre, jaggery 2 kg, gram flour 2 kg and soil under live tree 1 kg were taken in 200 litres capacity drum and the volume was made up to 200 litres with the addition of water. The drum was kept in the shade and covered and well stirred clock wise thrice in a day. After one week, jeevamrutwas ready and then it was used for application.

2.2 Preparation of Panchagavya

Fresh cow dung 5 kg, cow urine 3 litre, cow milk 2 litre, curd 2 litre, cow deshi ghee 1 kg, sugarcane juice 3 litre, tender coconut water 3 litre, banana paste of 12 fruits and grape juice 2 litre were taken for making panchagavya. Fresh cow dung and ghee were mixed in a container and fermented for three days with thorough stirring. Rest of the ingredients were added on the fourth day and fermented for 15 days with stirring twice daily. The formulation was ready in 18 days. Three litres of panchagavyawas diluted in 100 litre water and sprayed over the plants as per treatments.

3. RESULTS AND DISCUSSION

3.1 Growth and vegetative parameters

A perusal of data indicates that application of Jeevamrutand Panchagavyahad 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.*Jeevamrutdrenching (500l/ha) and 8% Panchagavyafoliar 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 Jeevamrutacted as a tonic for soil health and promoted growth as it contains macronutrients in the form of N (0.16 %), P (0.02 %) and K (0.123 %) (George, 2012). The auxin content in Panchagavyaupon 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 Jeevamrutalternatively at fifteen days intervals by Vanlalhruaii (2019). These results also corroborate the findings of Bunkar (2020) in French marigold after application of Panchagavya.

Table 1. Effect of Jeevamrutand Panchagavyaon growth and vegetative characters of chrysanthemum

Treatments	Plant height (cm)					Number of branches per plant	Plant spread (cm)		
	60 DAT	75 DAT	90 DAT	105 DAT	120 DAT		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) wasrecorded in the T_{14}treatments 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 a number of branches might be that drenching of Jeevamruthas significantly increased nutrient uptake, photosynthesis and source sink relationship, besides excellent biochemical activities (Bhalla *et al*., 2006). Further, presence of cytokinin in Panchagavyamight have increased cell division and cell elongation which further induced more branches in plants. These liquid organic substances (Jeevamrutand 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 Panchagavyamight have helped in better absorption of nitrogen leading to increased photosynthesis process resulting in better plant growth and spread. These results are similarthe findings of Choudhary *et al*. (2021) and Barad *et al*. (2019).

3.2 Flowering and quality parameter

The application of Jeevamrutand Panchagavyahas 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 intervals 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 flowers 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 Jeevamrutconsist of beneficial microorganisms, which act as a tonic for improving soil health. Jeevamrutincreases microbial activities in soil and convert the non-available form of nutrients into an available form which fastens the vegetative growth and results in early completion of juvenile phase further leading tothe early reproductive phase, hence early blooming. The results are in accordance with the findings in marigold after drenching with Jeevamrutat fifteen days intervals 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 intervals 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 ofsink. The increase in length of petals and pedicel accompanied by increased number of petals resulted bigger size of flower further resulting in the increase of individual flower weight.

Table 2. Effect of Jeevamrutand Panchagavyaapplication 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 Jeevamrutand Panchagavyaapplications 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) have been significantly influenced byJeevamrutand Panchagavyaapplication (Table 3). It is clear from the data that various concentrations of liquid organic substances show significant influence on anumber 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.*Jeevamrutdrenching (500 l/ha) and 8 % Panchagavyafoliar application alternatively at fifteen days interval and all these characters at par with treatment T_{13}. The reason might be that the nutrients in Jeevamrutand Panchagavyaare 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 it leads to more vegetative growth, further leading toan increase in photosynthetic area which in turn results in more synthesis and accumulation of photosynthates. The quick mobilization of these photosynthates from leaves (source) to flower (sink) might have increased number of flowers per plant. Further, GA induces cell elongation and cell division which is reflected in larger flower size and longer petals as well as subsequently in higher flower yield per plant. Higher photosynthetic activities and more carbohydrate 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).

Table 3. Effect of Jeevamrutand Panchagavyaon 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) indicates that application of Jeevamrutand Panchagavyahad non-significant effect on organic carbon (%) in soil. Data pertaining to available nitrogen (kg/ha) after

the completion of experiment showed significant differences among the treatments. Significantly maximum available nitrogen (196.52 kg/ha) was observed with treatment T_2*i.e.*Jeevamrutdrenching (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 is 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 Jeevamrutwhich helped in mineralization of soil nitrogen. These results can be supported by the findings of Siddappa (2015).

In the present investigation, viable bacterial count differed significantly after the application of Jeevamrutand Panchagavyatreatments and it can be inferred from the data that maximum viable bacterial count (94.78 × 10^5cfu/g of soil) was recorded in treatment T_2*i.e.*Jeevamrutdrenching (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 Jeevamrutand Panchagavya.

Table 4. Effect of Jeevamrutand Panchagavyaon soil chemical properties and viable bacterial count

Treatments	Organic carbon (%)	Available nitrogen (kg/ha)	Viable bacterial count (No. × 10^5cfu/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 500 l/ha of soil drenching with Jeevamrutand 8 % foliar application of Panchagavya, alternatively at fifteen days intervalsupto flower initiation stage is beneficial for obtaining better growth, higher yield with and good quality flowers in 'Ratlam Selection' variety of chrysanthemum. However, Jeevamrutdrenching (500 l/ha) at fifteen days intervals is beneficial for enhancing available nitrogen and viable bacterial count in the soil.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

REFERENCES

Barad RG, Karetha KM, Shubhrajyoti M, Maheta PV, Rathva KN.Effect of biostimulants and micronutrients grade on growth and flowering of rose cv. Top Secret under protected condition. International Journal of Chemical Studies.2019; 7(5):234-236.

BhallaR, Priyanka K, Dhiman SR, Jain R. Effect of biofertilizers and biostimulants on growth and flowering in gladiolus. Journal of Ornamental Horticulture.2006; 9(4):248-252.

BhartiS,Ranjan S, Chandra R. Response of Panchagavya and manchurian mushroom tea on floral characters in tuberose (*Polianthes tuberosa* Linn.) cultivar Pearl Double. Journal of Ornamental Horticulture.2007; 10(4):250-254.

Bunkar J. Effect ofPanchagavyaon growth, flowering and yield of French marigold (*Tagetes patula*) variety Pusa Arpita. M.Sc. thesis. Department of Floriculture and Landscaping, College of Horticulture and Forestry, Jhalrapatan City, Jhalawar, Rajasthan.2020.

ChandraK, Kumar VP, SinghR,Kannojia P. Waste decomposer-A way of farmer doubling income, National Centre for Organic and Natural Farming, Ghaziabad.2017; 3-5.

Choudhary S, Bharati K, Choudhary RC, Jat ML. Effect of Jeevamrut on growth and flowering of marigold. The Pharma Innovation Journal.2021; 10(8):1037-1040.

GeorgeE. Integrated nutrient management on growth, flower, yield and postharvest quality of gerbera(*Gerbera jamesonii*Bolus)cv. 'Galileo Red' under polyhouse condition. Ph.D. thesis. University of Agricultural Sciences, Dharwad, Bangalore.2012.

PatelDM, PatelIM, Patel BT, Singh NK, Patel CK.Effect of Panchagavya and Jeevamrut on yield, chemical and biological properties of soil and nutrients uptake by *kharif* groundnut (*Arachis hypogaea* L.). International Journal of Chemical Studies.2018; 6(3):804-809.

RangaswamyG. Agricultural Microbiology. Bombay Asia Publishing, Delhi.1966; 312 p.

ReshmaS, Sujith GM, Devakumar N. Growth and yield of cowpea (*Vigna unguiculata* (L.) Walp) as influenced by Jeevamrut and Panchagavya application. Legume Research - An International Journal.2019; 1-5.

Sabhya P. Effect of Jeevamrut on flower and seed yield of China aster(*Callistephus chinensis* (L.)Nees). M.Sc. thesis. Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan.2019.

Selvaraj J, Ramaraj B, DevarajanK, Seenivasan N,Senthikumar S, Sakthi E. Effect of organic farming on growth and yield of thyme. 2007. In articles and abstracts of national seminar on production and utilization of medicinal plants, 13-14, March, 2003 held at Annamalaie University, Tamil Nadu, 63.

Sharma R. Studies on the effect of growing media and Jeevamrut on potted petunia (*Petunia* × *hybrida*Vilm.). M.Sc. thesis. Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan.2020.

Siddappa. Use of Jeevamrut and farm yard manure on growth and yield of fieldbean(*Lablab purpureus var.* Lignosus). M.Sc. thesis. Department of Agronomy, University of Agricultural Sciences, Bengaluru.2015.

Thakur D. Effect of Jeevamrut on growth and flowering of Iris (*Iris orientalis* Mill.)cv. Frigia. M.Sc. thesis. Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan.2020.

Vanlalhruaii R. Effect of Jeevamrut application on frond production and longevity of boston fern(*Nephrolepisexaltata* (L.) Schott). M.Sc. thesis. Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan.2019.

XuHL, Xu HL. Effect of a microbial inoculants and organic fertilizer on growth, photosynthesis and yield of sweet corn. Journal of Crop Production. 2000; 3(1):183-214.

Yusuf R, Syakur A, Kalaba Y, Rostiati R. The flowering of chrysanthemum (Chrysanthemum sp) growing under various concentrations of liquid organic fertilizer. InIOP Conference Series: Earth and Environmental Science 2022 Nov 1 (Vol. 1075, No. 1, p. 012001). IOP Publishing.

Andriani AS, Arjana IG, Rejeki IG. Application of Defoliated Chrysanthemum Leaves and Combination of Organic Fertilizer to the Yield and Quality of Chrysanthemum Flowers. AJARCDE (Asian Journal of Applied Research for Community Development and Empowerment). 2023 Jul 17:130-4.

Raju, GuntimaduguSanhthosh Kumar, Prudhvi Nawabpet, and Arun Kumar. 2022. “PanchagavyaAs Soil Conditioner: Ancient Traditional Knowledge for Sustainable Agriculture”. Journal of Experimental Agriculture International 44 (11):181-86. https://doi.org/10.9734/jeai/2022/v44i112065.