Eco. Env. & Cons. 28 (November Suppl. Issue) : 2022; pp. (S376-S381)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i07s.061

Influence of Fermented Liquid Manure (Jeevamrutha) on Growth Parameters and Yield Attributes of Tomato (*Solanum lycopersicum* L.) crop

Vibha G.[1], Lingaraju H.G.[1*], J. Mahadev[2], Rakesh Sharma M.S.[3] and Shankramma Kalikeri[4]

[1]Department of Environmental Science, JSS Academy of Higher Education and Research, Sri Shivarathreeshwara Nagara, Mysuru 570 015 Karnataka, India
[2]College of Agriculture, V. C. Farm, Mandya, Karnataka, India
[3]Department of Studies in Environmental Science, University of Mysore, Manasagangothri, Mysuru 570 006, Karnataka India
[4]Division of Nanoscience and Technology, Department of Water and Health, JSS Academy of Higher Education and Research, Sri Shivarathreeshwara Nagara, Mysuru 570 015 Karnataka, India

(Received 10 April, 2022; Accepted 9 June, 2022)

ABSTRACT

Chemical fertilizers and pesticides are used intensively in modern agriculture giving rise to insects which have become resistant to pesticides. It has also resulted in the revival of pests and declining number of beneficial organisms such as honey bees, pollinators, parasites, and predators and accumulation of residues of pesticides in food and fodder. To improve soil microflora, a farm-made bio-culture called 'Jeevamrutha' is added to the soil instead of fertilizers. Jeevamrutha is made from a small amount of indigenous cow dung and urine. In red sandy loam soil, an experiment was conducted to see how varying concentrations of jeevamrutha affected the growth parameters and yield attributes of tomato. In a factorial randomized complete block design, five treatments with different combinations were laid out with three replications. The experimental results revealed that applying jeevamrutha at a 50% concentration influenced growth parameters of the crops including height of plants, total number of leaves, leaf area index, root length, and shoot length significantly. The use of jeevamrutha at 100% was significant in increasing tomato fruit yield due to improvements in yield attributes such as total number of fruits per plant, weight, length, and diameter of fruits.

Key words : *Jeevamrutha, Manure, Growth, Yield, Economics, Chlorophyll*

Introduction

The current global scenario highlights the importance of environmentally friendly agricultural operations for long-term food production. Agricultural productivity has increased since the green revolution as a result of increased use of conventional fertilizers and pesticides, improved irrigation, and innovative approaches to efficiently manage soil (Durrer *et al.,* 2021). Acidification, loss of organic matter, decrease in nutritional value, weathering, soil compaction, and xenobiotic accumulation are all considered as detrimental outcomes of agricultural intensification (Niemiec *et al.,* 2020). Organic manure has a considerable power to enhance plant growth as a supply of all needed macro and micronutrients in their accessible forms during decomposition, and soil physical and chemical properties are

improved (Maity *et al.,* 2018).

Organic liquid manures like jeevamrutha are great for seed germination. It is manufactured from native cow's urine, dung, horse gram, and jaggery, and using cow-based goods is a time-honored agricultural custom (Bharadwaj, 2021). Beneficial microorganisms in jeevamrutha help in phosphate solubilization, nitrogen fixation, and other functions. Jeevamrutha is abundant in beneficial micro flora, macronutrients, vital micronutrients, vitamins, necessary amino acids, substances that promote growth such as IAA, GA, and necessary microbes, all of which aid in enhancing vegetative growth and crop quality while also improving the overall health of the soil (Boraiah *et al.,* 2017). Jeevamrutha sprayed as a foliar spray absorb nutrients 20 times faster than those administered through the soil. Liquid organic manures can be used to alleviate temporary nutritional shortages. When nutrient uptake through the roots is interrupted, foliar spray stimulates growth (Nitin and Purohit, 2021). Jeevamrutha is only required for the first three years of the transition; then after, the system is self-sufficient (Mahanta *et al.,* 2021).

One of the most difficult challenges for organic farmers is identifying regionally appropriate crop cultivars that can grow in organic management settings without chemical inputs (Nooprom and Bueraheng, 2021). Relevant scientific data on the time and frequency of application of jeevamrutha, as well as the effect of jeevamrutha doses in various quantities on crop productivity, are lacking in Zero Budget Natural Farming. As a result, the current study was undertaken in order to assess jeevamrutha's effficacy on growth parameters and yield attributes of tomato crop.

Materials and Methods

The current study took place in the naturally ventilated garden of Department of environmental sciences in the campus of Faculty of Life Sciences at Jagadguru Sri Shivarathreeshwara Academy of Higher Education and Research, Mysore district, Karnataka, India. For the experiment, red sandy loam soil, which is under the classification of Alfisol was used. The pH of the soil was alkaline (7.21), with an electric conductivity of 0.18 dSm^{-1} and the soil organic carbon content was medium (0.53 %). Nitrogen, phosphorus and potassium were present in medium range (137 kg/acre, 13 kg/acre, 61 kg/acre, respectively) (Table 2). The trial was done in Factorial Randomized Complete Block Design (FRCBD). Jeevamrutha was the factor which was in focus and tested at four levels in comparison to the control and replicated thrice (Table 1). The pots comprised Soil: Vermicompost: Coco peat as the media in the ratio of 2:1:1 per pot and this media was applied to each pot evenly by mixing before transplanting of tomato seedlings. Jeevamrutha was applied as soil application at intervals of 15, 30, 45, 60, 75 and 90 days after sowing.

Jeevamrutha preparation and application

The preparation of jeevamrutha was done by adding 125 g of dung and 50 ml of urine of native cow, 25 g of local jaggery, 25 g of pulse flour, and a handful of soil. The ingredients were carefully mixed in a drum of 1.5 l capacity, and the volume was increased to 1.5 l and it was stored in the shade, covered with a wet jute bag (Gangadhar *et al.,* 2020). The solution was stirred twice a day in the morning and evening in clockwise direction. This process took place continuously for seven days and the jeevamrutha procured was administered to the damp soil near the root zone of the crop (Rosi and Thatheyus, 2020).

Estimation of chlorophyll

Concentration of chlorophyll in the crops was assessed after collecting leaves and observing them with a spectrophotometer. Photosynthetic tissue of known size was ground to precise proportions. The ground leaves were soaked in a concentration of 1 part 0.1 normal (N) ammonium hydroxide solution to 9 parts acetone. After the slurry was centrifuged, the supernatant was diluted until a concentration required to provide an absorbance reading between 663 and 645 nanometers (nm) was obtained. At these wavelengths, the absorbance for every solution was measured, and the concentration levels of

Table 1. Details of treatments used in the study

Treatment No.	Treatments
T	Vermicompost + Coco peat (Control)
T	Jeevamrutha @ 25 % + Vermicompost + Coco peat
T	Jeevamrutha @ 50 % + Vermicompost + Coco peat
T	Jeevamrutha @ 75 % + Vermicompost + Coco peat
T	Jeevamrutha @ 100 % + Vermicompost + Coco peat

Table 2. Chemical properties of the soil used in the study

Parameter (unit)	Value	Interpretation
Moisture content (%)	1.33	-
pH	7.21	Alkaline
Electrical conductivity (EC-dsm-¹)	0.18	Harmless
Available Nitrogen (N) kg/acre	137	Medium
Phosphorus (PO) kg/acre	13	Medium
Potassium (K) kg/acre	61	Medium
Organic Carbon (OC) %	0.53	Medium

chlorophyll a and b were estimated. Chlorophyll a, chlorophyll b, and total chlorophyll concentrations were estimated by referring to research papers (Parida and Parida, 2021; Rinawati *et al.,* 2020) and employing Eqn. 1 (Singh and Lal, 2019).

Chlorophyll a: 12.7(A663) – 2.69(A645)
Chlorophyll b: 22.9(A645) – 4.68(A663)
Total Chlorophyll: 20.2(A645) + 8.02(A663)

Results and Discussion

Growth parameters

The application of jeevamrutha at varying levels has recorded significantly higher growth parameters. Application of jeevamrutha @ 50 % has recorded significantly higher plant height (65.61 cm) followed by jeevamrutha @ 100 % (63.5 cm) while significantly lower measurement in plant height was recorded in control (61.38 cm). Similarly, significantly higher leaf area index was recorded in jeevamrutha @ 50 % (1.53), followed by jeevamrutha @ 75 % (1.5) while significantly lower leaf area index was recorded in jeevamruthat @ 100 % and control (0.63, 0.86). Significant increase in number of leaves was observed between control to jeevamrutha @ 50 % followed by a steady decline (control- 163.3 < jeevamrutha @ 100 %- 183.3 < jeevamrutha @ 75 %- 193.3 < jeevamrutha @ 25 %- 222.6 < jeevamrutha @ 50 %- 300). In similarity, significant increase was found in root length (jeevamrutha @ 100 %- 23.71 < jeevamrutha @ 75 %- 30.48 < control- 42.9 < jeevamrutha @ 25 %- 48.26 < jeevamrutha @ 50 %- 57.57) and shoot length (jeevamrutha @ 100 %- 27.06 < jeevamrutha @ 75 %- 34.73 < control- 45.47 < jeevamrutha @ 25 %- 52.12 < jeevamrutha @ 50 %- 66.38) (Table 3).

The nutrients solubilized in the soil, the subsequent accumulation of those nutrients have made them available to plants throughout their growth cycle, resulting in an increase in growth attributes due to jeevamrutha application (Chaithra and Sujith, 2021). Similar results were reported in a cowpea experiment, where jeevamrutha applied at 1000 l/ha resulted in significantly taller plants with a higher number of branches per plant than jeevamrutha applied at 500 l/ha (Sutar *et al.,* 2018).

A research into the development and yield of the floribunda rose cv. Mirabel also reported taller plants, more branches, and more leaf area after using jeevamrutha infused with panchagavya at 400 l/ha (Praveen *et al.,* 2021). Plants treated with jeevamrutha grew much taller, according to a study on the impact of the natural farming system. Jeevamrutha @ 20% at a 2-week interval behaved statistically indistinguishable from jeevamrutha @ 10% at a 2-week interval and jeevamrutha @ 20% at a 3-week interval (Kaur *et al.,* 2021). The use of various biostimulants facilitates chemicals required for the growth of plants into the system as well as the uptake of macro and micronutrients, resulting in improved plant vegetative development (Bohra and Nautiyal, 2019). The findings follow a study in Uttar Pradesh that examined the effects of natural nutrient supply sources like jeevamrutha on the growth and yield of black gram. The study discovered that when

Table 3. Growth parameters in tomato as influenced by jeevamrutha application

Treatments	Plant Height (cm)	Leaf Area Index	Number of leaves	Number of branches	Root length (cm)	Shoot length (cm)	Dry matter production (g plant{ ¹)
T1	61.38	0.86	163.3	34.6	42.9	45.47	9.6
T2	62.23	1.19	222.6	47	48.26	52.12	10.52
T3	65.61	1.53	300	72	57.57	66.38	9.99
T4	62.65	1.5	193.3	83.6	30.48	34.73	10.35
T5	63.5	0.63	183.3	85.3	23.71	27.06	11.44
S.Em ±	0.93	0.03	14.78	5.94	4.23	1.21	0.05
CD(P = 0.05)	0.51Non-Significant	276 Significant	7.51 Significant	19.80 Significant	3.59 Significant	17.41 Significant	830 Significant

jeevamrutha was applied to the soil, the height of the plants, the total number of branches per plant, leaf area index, accumulation of dry matter, and other characteristics turned out to be significantly higher when compared to other treatments (Singh *et al.*, 2020).

Yield parameters

Application of jeevamrutha @ 100 % at harvest (T) recorded significantly more number of fruits (33 fruit plant^{-1}), followed by T (22.66 fruit plant^{-1}) while number of fruits was significantly lower in T (10.66 fruit plant^{-1}). Significant difference between the treatments was found in terms of average fruit weight (T- 56.25 gm > T- 31 gm > T- 30.40 gm > T- 27.6 gm > T- 29.33 gm). Significantly higher fruit length was recorded in T (7.31 cm), T (6.22), and T (6.22) in comparison with T (5.70 cm). Fruit diameter increased in accordance with increase in treatment variations (T- 12.3 cm > T- 8.67 cm > T- 8.51 cm > T- 8.26 > T- 6.4 cm). The study's findings confirmed that there was no noticeable difference in the pH of fruits from treated and control plants, as pH values did not differ significantly (Table 4).

In a study on the effect of jeevamrutha on papaya, the highest number of fruits per plant (30.45), maximum weight of fruit (1479.01 g), and diameter of fruit (24.27 cm) were recorded in crops treated with jeevamrutha (Jhade, 2020). In a field experiment at Annamalai University, the impact of jeevamrutha on maize growth and yield was investigated. According to the findings of the experiments, application of jeevamrutha at 5% in the form of foliar spray on 20, 40, and 60 DAS (Days After Sowing) increased maize grain yield (Ramesh *et al.*, 2018). All parameters in a study concerning the yield of finger millet were significantly higher when treated with jeevamrutha at 1000 l ha^{-1} which can be because of the plant growth promoting factors such as IAA, GA3, macro and micro nutrients, as well as the abundance of beneficial micro organisms in jeevamrutha (Naveena *et al.*, 2019; Chongre, 2019). When liquid manures are applied twice or more, they act as a stimulus in the plant system, causing the production of growth regulators in the cell system to increase (Manoj *et al.*, 2020). The beneficial effects of jeevamrutha were associated with greater yield, microbial activity, and growth hormones, which might have improved biomass of the soil, conserving the accessibility and absorption of applied and naturally available soil nutrients, and thus affecting the development and yield of the crop (Patel, 2018; Onte, 2019).

Chlorophyll content

Jeevamrutha significantly influenced chlorophyll 'a', chlorophyll 'b' and total chlorophyll content in all the treatments (Fig. 1). Chlorophyll 'a' was found to be the highest in T treatment (0.733 µg/ml). Gradual decline in chlorophyll 'a' content with the increasing concentration of jeevamrutha at T was recorded (0.333 µg/ml). The lowest chlorophyll 'a' content

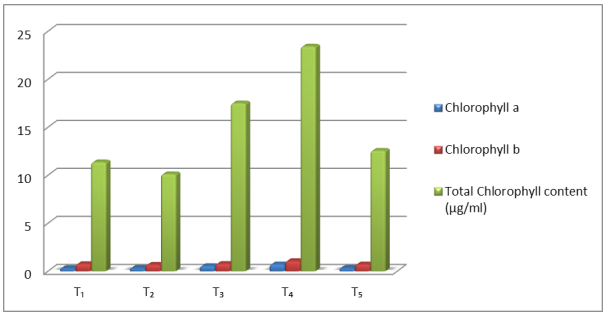

Fig. 1. Influence of jeevamrutha on chlorophyll content of leaves of tomato crop

Table 4. Effect of jeevamrutha treatments on yield parameters of tomato

Treatments	Number of flowers (plant^{-1})	Number of fruits (plant^{-1})	Fruit pH	Average weight of fruits (grams)	Average fruit length (cm)	Average fruit diameter (cm)
T	11.66	10.66	5.76	27.6	5.70	6.4
T	19	18	5.75	29.33	6.18	8.26
T	23.66	22.66	5.76	31	6.22	8.67
T	22.33	21.33	5.74	30.40	6.22	8.51
T	33.66	33	5.74	56.25	7.31	12.3
S.Em ±	1.39	1.95	0.00	0.68	0.15	0.51
CD(P = 0.05)	3.59	123	4.04	4.29	48.16	76.91
	Significant	Significant	Non-significant	Significant	Significant	Significant

was found in treatment without jeevamrutha (0.312 µg/ml). In the same way chlorophyll 'b' content was maximum in T (1.073 µg/ml) in comparison to treatment without jeevamrutha (0.768 µg/ml). Total chlorophyll content was maximum in T (23.42 µg/ml) in comparison to without jeevamrutha treatment (11.36 µg/ml).

A study on sweet basil that was subjected to NaCl-induced salt stress and the effect of jeevamrutha on this factor revealed that plants treated with jeevamrutha had increased levels of chlorophyll 'a', 'b', and carotenoid. According to the findings, the organic liquid formulation jeevamrutha is successful in helping plants in optimum growth and progress under NaCl-induced stress (Singh and Lal, 2019). Similar research has shown that using jeevamrutha in conjunction with other organic fertilizers has a good impact on the chlorophyll content of treated plants (Ekanayake, 2020). A study was done to analyze the quality and biochemical features of strawberries as influenced by organic manures; the plants treated with jeevamrutha had the maximum chlorophyll content (Sahana, 2020).

Economics

Among the different treatment combinations, application jeevamrutha application @ 50 % recorded higher gross return (Rs. 400/ pot), net return (Rs. 65/ pot) and benefit-cost ratio (0.19) (Table 5) compared to without jeevamrutha application (Rs. 310/ pot, Rs. 30/ pot, 0.10, respectively). The highest cost of cultivation (Rs. 345/ pot was incurred in treatment with jeevamrutha @ 100 % but gross return (Rs. 387/ pot), net return (Rs. 42/ pot) and benefit-cost ratio (0.12) was relatively lower when compared to jeevamrutha treatment @ 50 %. The greater net return was primarily due to the increased tomato fruit yield from organic manurial treatments (Upendranaik *et al.*, 2018; Siddapaa, 2015).

Table 5. Tomato cultivation costs, gross profit, net profit, and Benefit: Cost ratio as impacted by jeevamrutha

Treatments	Cost of cultivation (Rs/pot)	Gross return (Rs/pot)	Net return (Rs/pot)	B:C ratio
T	280	310	30	0.10
T	330	380	50	0.15
T	335	400	65	0.19
T	340	380	40	0.11
T	345	387	42	0.12

Conclusion

In conclusion, jeevamrutha has the potential to increase crop productivity and quality. It has aided in the improvement of the tomato plants utilized in the study in terms of growth and output. On a big scale, jeevamrutha has the potential to become a viable alternative to conventional fertilizers. As a result, organic manures and liquid formulations are effective natural substitutes for increasing yield while also improving soil nutrient status.

References

Bharadwaj, K. 2021. Influence of ZBNF components on the growth and yield of Wheat in combination with FYM, Biofertilizer and Nitrogen. *International Journal of Creative Research Thoughts*. 9(5).

Bohra, M. andNautiyal, B. P. 2019. Sustainable production of tuberose (*Polianthes tuberosa*) through integrated nutrient management: a review. *Current Horticulture*. 7(1) : 12-17.

Boraiah, B., Deva Kumar, N., Shubha, S. and Palanna, K. B. 2017. Effect of panchagavya, jeevamrutha and cow urine on beneficial microorganisms and yield of capsicum (*Capsicum annuum* L. var. grossum). *International Journal of Current Microbiology and Applied Sciences.* 6(9) : 3226-3234.

Chaithra, M. and Sujith, G. M. 2021.Influence of Farmyard Manure and Jeevamrutha on Growth and Yield of Sunflower. *International Journal of Environment and Climate Change*. 11(11) : 135-141.

Chongre, S., Mondal, R., Biswas, S., Munshi, A., Mondal, R and Pramanick, M. 2019. Effect of liquid manure on growth and yield of summer green gram (*Vigna radiata* L. Wilczek). *Current Journal of Applied Science and Technology*. 38(6) : 1-7.

Durrer, A., Gumiere, T., Zagatto, R. G. M., Felier, P. H., Silva, M. A. M., Longaresi, H. R., Homma, S. K and Cardoso, E. J. B. N. 2021. Organic farming practices change the soil bacteria community, improving soil quality and maize crop yields. *Chemical Studies*. 8(6): 2083-2087.

Ekanayake, E. M. U. I., Eranga, G. A. S. and Fernando, K. M. C. 2020. Effect of organic and inorganic liquid fertilizers on growth and yield of *Centella asiatica* (L.) and *Capsicum annuum* (L.) var. annuum. *Tropical Agricultural Research & Extension*. 23 : (3 & 4).

Gangadhar, K., Devakumar, N., Vishwajith and Lavanya, G. 2020. Growth, yield and quality parameters of chilli (*Capsicum annuum* L.) as influenced by application of different organic manures and decomposers.

International Journal of Chemical Studies. 8(1): 473-482.

Jhade, R. K., Ambulkar, P. L., Shrivastava, D. C., Alawa, S. L. and Pannase, S. K. 2020. Efficacy of INM with Jeevamrutha on Growth, Yield and Quality of Papaya (*Carica papaya* L.) cv. Taiwan Red Lady under Satpura Plateau Region of Madhya Pradesh District Chhindwara. *International Journal of Current Microbiology and Applied Sciences*. 11: 3050-3056.

Kaur, P., Saini, J. P., Meenakshi and Avnee. 2021. Optimization of Jeevamrit doses and application time for enhancing productivity of wheat under natural farming system. *Journal of Pharmacognosy and Phytochemistry.* 10(1): 405-408.

Mahanta, B. S., Abraham, T., Singh, V. and Achary, D. G. S. 2021. Organic source of nutrients effect on growth, yield, quality and economy of black rice (*Oryza sativa* L.) varieties. *Journal of Pharmacognosy and Phytochemistry*. 10(4) : 218-221.

Maity, P., Rijal, R. and Kumar, A. 2018. Application of Liquid Manures on Growth of Various Crops: A Review. *International Journal of Chemical Studies.* 6(6): 974-978.

Manoj, K. N., Uma, V. and Kiran, S. C. 2020. Significance of liquid organic manures in sustainable crop production: A review. *International Journal of Ecology and Environmental Sciences*. 2(4) : 445-449.

Naveena, M., Sujith, G. M. and Devakumar, N. 2019. Growth and yield of finger millet (*Eleucine coracana* L.) as influenced by liquid organic manures. *IJABR.* 9(2): 157-160.

Niemiec, M., Chowaniak, M., Sikora, J., Szel¹g-Sikora, A., Szostak, Z. G and Komorowska, M. 2020. Selected Properties of Soils for Long-Term Use in Organic Farming. *Sustainability.* 12(6): 2509.

Nitin. Purohit, H. S. 2021. Effect of different Jeevamrut based liquid organic formulations on biochemical properties of soil and on plant growth of blackgram [*Vigna mungo* (L.) Hepper] under pot culture conditions. *International Journal of Chemical Studies.* 9(1): 2280-2283.

Nooprom, K.and Bueraheng, N. 2021. Effects of cultivation systems and cultivars on growth and yield performance of Japanese eggplant in Thailand. *Journal of Experimental Biology and Agricultural Sciences*. 9(1): 36 – 43.

Onte, S., Singh, M., Kumar, S. and Pyati, P. S. 2019. Impact of Organic Nutrient Management on Crop Quality, Yield and Soil Health: A Review. *International Journal of Current Microbiology and Applied Sciences.* 8(05): 394-402.

Parida, K. and Parida, S. 2021. Nutritional analysis using XRF technique and chlorophyll estimation of two varieties of lettuce. *Plant Archives.* 21(1): 816-820.

Patel, D. M., Patel, I. M., Patel, B. T., Singh, N. K. and Patel, C. K. 2018. Effect of Panchgavya and jivamrut on yield, chemical and biological properties of soil and nutrients uptake by *kharif* groundnut (*Arachis hypogaea* L.). *International Journal of Chemical Studies*. 6(3): 804-809.

Praveen, T. M., Patil, S. R., Patil, B. C., Seetharamu, G. K., Rudresh, D. L., Pavankumar, P. and Patil, R. T. 2021. Influence of biostimulants on growth and yield of floribunda rose cv. Mirabel. *Journal of Pharmacognosy and Phytochemistry*. 10(1) : 2701-2705.

Ramesh, S., Sudhakar, P and Elankavi, S. 2018. Effect of organic foliar nutrition on growth and yield of maize (*Zea mays* L.). *International Journal of Research and Analytical Reviews Research.* 5(3): I.

Rinawati, M., Sari, L. A. and Pursetyo, K. T. 2020. Chlorophyll and carotenoids analysis spectrophotometer using method on microalgae, *2nd International Conference on Fisheries and Marine Science IOP Conf. Series: Earth and Environmental Science.* 441: 012056.

Rosi, M. B. and Thatheyus, A. J. 2020. Effect of Vermicompost, Jeevamrutha and G5- Soil Enricher Granules on the Growth of Amaranthus caudatus. *Specialty Journal of Agricultural Sciences.* 6 (1) : 14-27.

Sahana, B. J., Madaiah, D., Sridhara, S., Pradeep, S. and Nithin, K. M. 2020. Study on Effect of Organic Manures on Quality and Biochemical Traits of Strawberry (*Fragaria×ananassa* Duch.) under Naturally Ventilated Polyhouse. *International Journal of Current Microbiology and Applied Sciences.* 9(10): 2692-2698.

Siddappa. 2015. *Use of jeevamrutha and farmyard manure on growth and yield of field bean (Dolichos lablab L.),* M.Sc. (Agri.) Thesis was submitted to the University of Agricultural Sciences, Bangalore, Karnataka, India.

Singh, A. S. and Lal, E. P. 2019. Impact of organic liquid formulation, jeevamrutha on photosynthetic pigments of *Ocimum Basilicum* L. (sweet basil) under NaCl induced salinity stress. *Plant Archives.* 19(2): 1997-2001.

Singh, S., Singh, P. K. and Yadav, S. 2020. Effect of different natural sources of nutrient supply on growth and yield of black gram (*Vigna mungo* L.) in Western U.P. *International Journal of Chemical Studies*. 8(6): 2083-2087.

Sutar, R., Sujith, G. M. and Devakumar, N. 2018. Growth and yield of Cowpea [*Vigna unguiculata* (L.) Walp] as influenced by jeevamrutha and panchagavya application. *Legume Research*. 3932 : 1-5.

Upendranaik, P., Rao, S., Desai, B. K., Krishnamurty, D. and Vidyavathi, G. 2018. Effect of Different Sources of Organic Manures on Growth and Yield of Foxtail Millet (*Setaria italica* L.) under Integrated Organic Farming System. *Advances in Research.* 13(2): 1-6.