

A review on Effect of Organic Conditioner on Physico-Chemical and Microbiological Properties of soil

ABSTRACT

The unbalanced use of chemical fertilizers has caused adverse effects on the environment and human health, which has raised the focus on environmentally friendly agricultural techniques for sustainable farming globally. The article investigates the effects of organic conditioners on the physical, chemical, and microbiological characteristics of soil, with focus on liquid organic conditioners such as Panchagavya, Jeevamruth, and Beejamruth. In order to purify agricultural fields, the necessity of organic agriculture methods that are both commercially and environmentally feasible is emphasized. The advantages of applying Soil conditioners are explained, including increased crop production, quality, affordability, and safety for the environment in addition to increases in soil health, fertility, and pest resistance. An overview of the basic principles of liquid organic manures is provided, with a focus on their ability to release nutrients, stimulate microbial activity, and facilitate plant absorption. The review discusses how organic conditioners might improve the biological characteristics of soil, such as the presence of chemicals that promote plant growth and helpful microbes. Liquid organic manure adoption is essential for healthy ecosystems, sustainable agriculture, and increased soil fertility and productivity. Because liquid organic manures may be applied in a variety of ways and used as soil drenches, foliar sprays, and seedling treatments, they are a crucial part of environmentally friendly farming methods. It is advised to combine liquid and solid organic manures to reduce negative effects and guarantee a robust and fruitful farming environment.

Keywords – Soil conditioners, sustainable, drenches, Soil Physico – chemical.

Introduction:

The need for Eco friendly agricultural practices is emphasized worldwide for sustainable agricultural. Imbalanced use of synthetic fertilizers in agriculture not only deteriorate soil health in terms of Physico-chemical properties of soil but also effect adversely affected environment, human health and beneficial microbial habitats present in soil which ultimately leads to decline in productivity of the soil (Chandrakala &Hebsur,

2020). In order to sustain agricultural yields, organic manure application is necessary as it facilitates the soil's nutrient accumulation (Thirunavukkarasu and Vinoth,2013). Ecologically sustainable and economically viable practices of organic agriculture must be adopted in order to detoxify the agricultural fields (Sarkar *et al.* 2014).The utilisation of organic nutrient sources, such as organic manures, is important for maintaining the soil health and crop productivity (Verma *et al.* 2018). Organic manures improve the soil's physical, biological, and chemical properties, and water holding capacity (Verma *et al.*, 2019). Application of manures not only improves the cycling of nutrients but also effectively stimulates crop growth and yields.Organic products like **Beejamrit, Jeevamrit, and Panchagavya** increases crop growth, yield, and quality (Devakumar *et al.* 2008 and Tharmarajet *al.* 2011). Combined application of liquid organic manures viz, Panchgavya, jeevamruth, beejamruthwith other organic manures such as **Farm yard manure**, vermicompost, green leaf manures promote growth yield and quality of crops as it contains significant microbial count and plant growth promoting substances (Somsundaram 2003, Chandrakala *et al* 2011a and Chandrakala *et al* 2011b) and also influences nutrient uptake by plants (Chandrakala *et al* 2007). Panchagavya, jeevamrit, beejamrit are cheaper, eco-friendly fermented products of cow dung, urine, pulse flour, jaggery, living soil, and extracts from local vegetation (Kulkarni and Gargelwar, 2019). It is also known that panchagavya contains chemicals that regulate growth, including GA, cytokinin, and IAA. Application of jeevamruth in soil influence microbial activity and maintains soil fertility (Aulakh *et al.* 2018).It has been found that the biological reactions that occur during the breakdown of organics reduce the accumulation of microorganisms that cause diseases (Ramesh *et al.*, 2010). The application of liquid manures increases soil microbial activity, which contributes to increased soil fertility, sufficient crop nutrition supply, and insect control (Joshi, 2012). These liquid organic manures generally do not provide nutrients directly in the soil, they basically influence the growth and activity of microbes in the soil which helps in nutrient cycling and thereby maintain soil fertility status.Liquid Organic manures such as Panchagavya, jeevamruth, beejamrutth, are known as efficient growth stimulant whereas panchagavya is widely used as organic fertilizer and pesticide. Jeevamruth most important cost effective liquid organic manure (Bishal Chakraborty *et al.*, 2019).

Benefits of using Liquid Organic Manures:

- It improves soil health and fertility as it contains macro and micro nutrients.
- Liquid organic manure like Panchagavya can be used against pest and diseases.

- Promotes yield and quality of produce.
- Environmentally safe.
- Cost effective and materials are easily available.
- There's no need for specific approaches.
- Lowers cultivation costs by using less chemicals, such as growth regulators, fungicides, insecticides, and fertilisers.
- Liquid manure raises the soil's organic carbon content, which provides microorganisms with carbon and energy.

Basic Concept of Liquid Organic Manures:

Liquid organic manures are products obtained from the fermentation and decomposition of organic matter such as crop residues, animal dung, urine and other plant material. Applying green manures, crop residues, composts, and liquid manures primarily panchagavya, beejamrut, jeevamrut, and vermiwash in combination with these materials in a more systematic way can release nutrients as needed by the crop to maintain increased productivity (Kamal Kanwar et al., 2006). Eco-friendly liquid organic manures such as jeevamrutha, beejamrutha, panchagavya, sanjivak, amrithpani, vermiwash, cow urine, and enriched biodigester liquid manure are readily available and contain a variety of nutrients, including vitamins, amino acids, and growth-promoting substances like GA and IAA (Chongre et al., 2019). They are full of growth-promoting elements including GA and IAA, important micronutrients, several vitamins, necessary amino acids, and healthy microbes. An appropriate blend of organic liquid formulations and manure could be used to get around this (Gowthamchand *et al.* 2020). The helpful microorganisms help in nitrogen fixation, phosphate solubilization, and other processes. They will thrive in the liquid organic manures. As a result of their application, the soil microbial population and activity will be increased to a greater level, which will benefit crop growth and development (Boraiah et. al 2017). In contrast to bulky organic manures, liquid organic manures dissolve easily in water and are more easily absorbed by plants. Interestingly, plants can absorb nutrients through their leaves up to 20 times faster when applied as a foliar spray than when applied through the soil, which helps crops that are temporarily or severely lacking in nutrients (Dhanoji et al., 2018). Due to their capacity to promote the delayed release of nutrients, increase soil microbial activity, boost soil aggregation, and improve soil characteristics and health, liquid manures are highly valued. In jeevamrutha, beneficial organisms thrive and support several activities such as nitrogen fixation and phosphate solubilisation. The application of jeevamrutha will increase

soil microbial population and activity (Boraiah *et al.*, 2017). These liquid fertilizers can be used as foliar spray, soil drenching and seedling treatment, fertigation through irrigation water and seeds can be treated with these liquid organic manures. It provides immunity to the plant system and encourages plant growth. microbes exude a variety of useful metabolites including organic acid, hydrogen peroxide, and antibiotics that are efficient against a variety of pathogenic pathogens (Solanki *et al.*, 2015). The application of liquid manures enhances the microbial biomass and activity in the soil. Application of liquid organic inputs such as Beejamrit, Jeevamrit, and Panchagavya, etc., has a significant impact on the activity of soil enzymes and increases the population of beneficial bacteria. Liquid bio-fertilizers are essential to organic farming because they produce green food that is safer and healthier. Conventional fertilization methods suggest that a variety of plant species can be utilised as an inexpensive source to create environmentally friendly liquid organic fertilisers, which enhance crop productivity and improve physico – chemical properties of soil (Jayasundra *et al.* 2016). Applying jeevamrit to the soil at a very low rate can improve soil health by acting as a tonic (Vasanthkumar 2006). The nitrogen fixation and P solubilisation capacity of the soil could be increased by the inoculation of bacterial isolates from beejamrutha (Sreenivasa *et al.* 2006).

Components of Liquid Organic Manures:

1. **Cow Urine:** Numerous researchers have investigated into how cow urine boosts a plant's immunological response (Kumar *et al.*, 2004, Dhama *et al.*, 2005). It contains anticancer, antifungal, and antibacterial properties.
2. **Cow Dung:** According to Dhama *et al.* (2005), cow dung possesses antiseptic and prophylactic (disease-preventive) qualities.
3. **Cow Milk:** It is composed of carotenes, vitamin C, vitamin B complex, and vitamin A. It offers revitalising and health-preserving qualities (Dhama *et al.*, 2005a). Because it contains immunoglobulins, lactoperoxidase, lactoferrin, and vitamin B12 binding protein, it possesses antimicrobial properties. There is antifungal action because Lactoferrin B is present. (Singh *et al.*, 2004; Dhama *et al.*, 2005a; Mete, 2009; Bellamy *et al.*, 1994)
4. **Curd:** Curd has a large number of lactic acid-producing bacteria that create cyclic dipeptides, phenyllactic acid, and 3-hydroxylated fatty acids, which are antifungal metabolites (Dharma *et al.*, 2005).

Effect of Liquid Organic manures on Soil physical properties:

Liquid organic manures increase soil physical properties by improving Organic Matter which improves overall soil health and it's found that application of liquid organic manures significantly influence physical properties of soil thereby making soil more healthy. Ryan (2007) observed the beneficial effect of compost tea on improvement of soil structure and health. Vermicompost (3 t/ha) + Panchagavya spray (3 % @ 30, 60, and 75 DAS) + liquid manure (2000 L ha⁻¹) + Jeevamruta (2000 L ha⁻¹) are the treatments applied and result found that the highest water holding capacity (55.3%) and water stable aggregates (78.2%) were substantially higher than those obtained from the application of FYM (7.5 t/ha) + Panchagavya spray (3% @ 30, 60, and 75 DAS) + Liquid manure (2000 L ha⁻¹) + Jeevamruta (2000 L ha⁻¹) recorded by Bhanuvally et al. (2014). The addition of jeevamrutha considerably decreased the bulk density and raised the water-holding capacity, according to Upperi et al. (2008). According to research findings conducted by GK et al. (2022) jeevamrutha was applied more frequently and in larger dosages, the maximum amount of soil moisture was observed. During both years, the application of jeevamrutha did not appreciably affect bulk density. The second year's bulk density dramatically decreased as a result of the interaction treatments involving jeevamrutha and FYM. According to Haynes (1986) vermiwash has the ability of binding mineral particles such as calcium, magnesium, and potassium in the form of humus and clay colloids, enabling stable soil particle aggregates with the appropriate porosity to support plant growth. Chandrakala et al. (2020) recorded the lowest bulk density (1.23 mg m³) by applying Jeevamrutha + Beejamrutha + Panchagavya combinedly. Soil enrichment with organic matter led to stable aggregation and favourable pore geometry, which in turn decreased bulk density and enhanced organic carbon. Additionally, similar findings were published by Javiya (2019), Boraiah et al. (2015), and Ali *et al.* (2011). During the two years of the study, the effects of the organic formulation treatments had no significant impact on the physical attributes of the soil, such as field capacity, permanent wilting point, bulk density, and porosity Upadhyaya *et al.* (2018). Vasanthkumar (2006) reported that soil application of jeevamrutha at very low rate act as a tonic to so improving soil health. According to Bhanuvally et al. Application of vermicompost (3 t/ha) + Panchagavya spray (3 % @ 30, 60, and 75 DAS) + Liquid manure (2000 L ha) + Jeevamruta (2000 L ha⁻¹) resulted in maximum water holding capacity (55.3 %) and water stable aggregates (78.2 %). Shaikh and Gachande (2015) reported water holding capacity (3.3 % to 8.5 %) significantly increase for adding organic inputs such as farm yard manure, beejamruth, and jeevamruth.

Effect of Soil organic conditioners on Soil chemical properties:

Liquid organic manures have profound effect on soil chemical properties. Research findings proved that soil chemical properties are greatly influenced by application of liquid organic manures such as Panchagavya, Jeevamruth, Beejamruth, Vermiwash etc. The application of vermiwash improved the physical, chemical, and biological qualities of the soil and enhanced its capacity to produce crops by raising the soil's organic carbon content (Gopal *et al.*, 2010). Sreenivasa *et al.* (2009) documented that Bacterial isolates from beejamrutha could enhance the soil's ability to fix nitrogen and solubilize Phosphorus. Chandralaka and Shabar (2011) et al recorded that application of Beejamrut + Jeevamrut recorded significantly higher available phosphorus (12.31 kg/ha). According to Kumawat *et al.* (2013) application of 3 ml/m² of panchgavya solution to the soil caused a significant drop in soil pH from 9.0 to 8.3. However, it also increased the amount of organic carbon in the soil by 50% and increased the availability of P, Fe, Cu, Zn, and Mn in the rhizosphere by 17% compared to the control during all stages of crop growth. Bhanuvally *et al.* (2014) reported that Application of vermicompost (3 t/ha) + -1 Panchagavya spray (3 % @ 30, 60, and 75 DAS) + Liquid manure (2000 L/ha) + Jeevamruta -1 (2000 L/ha) resulted in significantly higher available nitrogen (269.9 kg/ha), phosphorus (45.9 kg/ha), potassium (389.1 kg/ha), iron (6.22 ppm), zinc (1.77 ppm), copper (0.68 ppm), manganese (9.87 ppm). According to Shaikh and Gachande (2015) adding organic inputs such as farm yard manure, beejamruth, and jeevamruth greatly enhances the nutritional qualities of the soil, increasing its fertility and productivity for sustainable development. soil parameters such as organic carbon (0.11 % to 0.34 %), phosphorus (6.62 kg/h to 15.16 kg/h) significantly increased. Sutar *et al.* (2017) reported that Applying different amounts of jeevamrit and panchagavya spray resulted in significant differences in the uptake of nitrogen, phosphorus, and potassium in the soil. Therefore, spraying and applying liquid organic compositions through the soil increased the soil's fertility state. Ali *et al.* (2018) documented that effect of Panchagavya and Sanjibanion pH and EC reaches to neutrality (pH 6.8 – 7.0, EC- 0.2 to 0.3dS/m). Other soil parameters like organic Carbon content increased (OC-1.1 to 0.71%), available phosphate and potassium content increased two to three times. The chemical characteristics of the soil, such as the amount of accessible P, K, and OC (organic carbon), and the microbiological count of bacteria, are significantly improved by applying treatment combination of panchagavya, jeevamrit (Patel *et al.* 2018). Yadav *et al.* (2023) reported the application of Panchagavya at 4% resulted in the highest nitrogen availability (341.0 kg/ha), while the minimum nitrogen availability (337.2 kg/ha). GK *et al.* (2022) studied on Effect of jeevamrutha on soil Physico-chemical parameters of mango var. Alphonso, The result recorded maximum soil organic

carbon content during flowering (1.09%) and after harvest (1.04%), available nitrogen (at flowering (339.22 kg/ha) and after harvest (304.85 kg/ha)), available phosphorous (during flowering (26.92 kg/ha) and after harvest (15.93 kg/ha)), available potassium (during flowering (228.42 kg/ha) and after harvest (204.30 kg/ha)) and highest yield (9.71 t/ha). According to result obtained by Khuduset al. (2021) application of 6% Panchagavya along with common basal dose is applied, both the microbial population and essential nutrients increased in soil. The pH, E.C and organic carbon concentrations were all close to neutral. Beejamrutha (seed treatment) + Jeevamrutha (soil application @ 500 L/ha) + 100 % RDN through vermicompost resulted significantly increased the available nitrogen (296.80 kg ha⁻¹), phosphorus (98.61 kg ha⁻¹), potassium (173.18 kg ha⁻¹), exchangeable Ca, Mg, available sulphur and DTPA-extracted micro nutrients (Zn, Cu, Fe and Mn) status were significantly higher (Gowthamchand et al. 2020).

Effect on Soil biological properties:

Panchagavya and Jeevamrutha contain Actinomycetes, Pseudomonas, bacteria, fungi, P- and K-soluble microorganisms, E. Coli, Rhizobium, Azotobacter, and Azospirillum noticed by Ram et al., (2017) and Parvathi and Ushakumari (2017). Singh et al. (2008) found that application of both bulky as well as liquid organic manures increased the viable microbial count. Similarly, Kumar and Singaram (2011) found that treatment of organic manure as well as spray in green chilies increased the soil viable microbial count (bacterial, fungal and actinomycetes). Boraiah et al. (2017) application of Jeevamrutha and panchagavya 6 percent spray resulted in significantly higher Nitrogen fixers and P- solubilizer. Srinavasa et al. (2017) The fermented liquid organic manures also contain microbial load and plant growth promoting substances. According to result finding obtained by Ali et al. (2018) microbial count increases from 2.7×10^{-7} to 6.7×10^{-8} due to application of sanjibani and panchagavya. Sharma et al. (2022) reported that viable microbial counts (18.53×10^5 , 4.25×10^3 , and 3.42×10^3 cfu g⁻¹ for bacteria, fungi, and actinomycetes, respectively) were found to be achieved by applying 100% recommended doses of nutrients through vermicompost + jeevamrit.

Problems, Constraints, Barriers and Difficulties in Adopting Liquid organic manures:

- Lack of awareness about its uses
- Sometimes during fermentation contamination occurs
- Slow action
- Limited availability of its products in markets
- It encourages weed growth also as it is non selective

- Less utilisation by farmers
- It may reduce quality of the produce sometimes

Conclusion:

The rising focus on sustainable, environmentally friendly farming methods worldwide has raised awareness of the need of fertilisation management. The imbalance caused by synthetic fertilisers affects ecosystems, soil health, and human health. In order to promote healthy ecosystems and soil nutrient accumulation, organic manure is essential. The physical, chemical, and biological qualities of soil are improved by organic manures, increasing fertility and productivity while preserving resources. Because of their growth-promoting ingredients, liquid formulations such as Beejamrutha, Jeevamrutha, and Panchagavya promote crop growth, yield, and quality. These organic solutions have drawbacks, like slow release and low nutrient content. This disadvantage can be minimised by mixing liquid and solid organic manures together. By increasing microbial count and nutrient uptake, the combined application of liquid manures lowers the accumulation of harmful microorganisms. By promoting microbial activity, liquid organic manures help to improve soil fertility and nutrient cycling. By acting as foliar sprays, soil drenches, and seedling treatments, they provide versatility in application techniques while promoting plant development and immunity. Because they improve soil health, support beneficial bacteria, and encourage crop growth while leaving the least possible environmental impact, liquid organic manures are essential to sustainable agriculture. Adopting them will ensure a more resilient and productive agricultural environment in line with eco-friendly farming practices.

References:

- [1] Ali, M.N., Ghatak, S.S., & Ragul, T. (2011). Biochemical analysis of Panchagavya and Sanjibani and their effect in crop yield and soil health. *Journal of Crop and Weed*, 7, 84-86.
- [2] Aulakh, C. S., Singh, H., Walia, S. S., Phutela, R. P. and Singh, G. 2018. Effect of farmyard manure and jeevamrit in maize-wheat organic production system in Punjab. *Agric. Res. J.*, 55: 485-89.
- [3] Bellamy, W., Yamauchi, K., Wakabayashi, H., Takase, M., Takakura, N., Shlmamura, S. and Tomita, M. 1994. Antifungal properties of lactoferricin B, a peptide derived from the N-terminal region of bovine lactoferrin. *Letters in Applied Microbiology*, 18: 230-233.

- [4] Chakraborty Bishal and Sarkar Indrajit 2019. Quality Analysis and Characterization of Panchagavya, Jeevumrutha and Sasyamrutha. *International Journal of Current Microbiology and Applied Sciences*. 8(05): 2018-2026.
- [5] Kumar, V. K., and Singaram, P. 2011. Impact of organic manure and organic spray on soil microbial population and enzyme activity in green chillies. *Journal of Eco-Friendly Agriculture*., 6: 10-12.
- [6] Boraiah B, Deva kumar N, Shubha S, Palanna KB. Effect of panchagavya, jeevamrutha and cow urine on beneficial microorganisms and yield of capsicum (*Capsicum annum* L. var. *grossum*). *International Journal of Current Microbiology and Applied Sciences*. 2017;6(9):3226-3234
- [7] Chandrakala, M., Hebsur, N.S. (2020). Effect of FYM and fermented liquid manures on some physico-chemical and biological properties of soil and nutrient status at harvest of chilli (*Capsicum annum* L.). *Agropedology* 30 (01), 55-62.
- [8] Chandrakala, M., Hebsur, N.S. and Mahendra Kumar, M.B. (2011a). Effect of FYM and fermented liquid manures on quality of chilli (*Capsicum annum* L.). *Research Journal of Agricultural Sciences* 2,761-763.
- [9] Chandrakala, M., Hebsur, N.S. and Nalina, C.N. (2011b). Effect of FYM and fermented liquid manures on yield and economics of chilli (*Capsicum annum* L.). *Research Journal of Agricultural Sciences* 2,722-724.
- [10] Chandrakala, M., Hebsur, N.S., Bidari, B.I. and Radder, B.M. (2007). Effect of FYM and fermented liquid manures on nutrients uptake by chilli (*Capsicum annum* L.) and soil nutrient status at harvest. *Journal of Asian Horticulture* 4, 19-24.
- [11] Chongre S, Mondal R, Biswas S, Munshi A, Mondal R, Pramanick M, et al. Effect of liquid manure on growth and yield of summer green gram (*Vigna radiata* L. Wilczek). *Current Journal of Applied Science and Technology*. 2019;38(6):1-7
- [12] Devkumar. N., Rao, G. G. E., Shubha, S., Imran Khan, Nagaraj and Gowda, S. B., 2008, Activities of Organic Farming Research Centre, Navile, Shimoga, *University of Agriculture Science*, Bengaluru, Karnataka, India.
- [13] Dhama, K., Rathore, R., Chauhan, R.S. and Tomar, S. 2005a. Panchgavya: an overview. *International Journal of Cow Science*, 1(1): 1-15.

- [14] Dhanoji MM, Meena MK, Naik MC. Manure and plant extracts for foliar nutrition in organic farming: A Review. *International Journal of Chemical Studies*. 2018; 6(6):1447-1454.
- [15] Gopal, M., Gupta, A., Palaniswami, C., Dhanapal, R. and George, V. T. 2010. Coconut leaf vermivash: a bio-liquid from coconut leaf vermicompost for improving the crop production capacities of soil. *Current Science*, 98 (9): 1202-1208.
- [16] Gowthamchand, N.J., Ganapathi and Soumya, T.M. (2020). Changes in soil chemical and biological properties as influenced by organic nutrient management practices under rainfed condition. *Asian Journal of Soil Science.*, 15 (1) : 1-10 : DOI : 10.15740/HAS/AJSS/15.1/1-10.
- [17] Javiya PP. Evaluation of some cow-based bio-enhancers and botanicals for organic cultivation of wheat (*Triticum aestivum* L.). Ph.D. Thesis (Unpublished), Junagadh Agricultural University, Junagadh, 2019.
- [18] Jayasundara, J & Jayasekera, Ranjith & Ratnayake, R M C S. (2016). Liquid organic fertilizers for growth enhancement of *Abelmoschus esculentus* (L.) Moench and *Alternanthera sessilis* (L.) DC. *Tropical Plant Research*. 3. 334-340.
- [19] Joshi, M. 2012. *New Vistas of Organic Farming*. Scientific publishers, New Delhi. pp140.
- [20] Khudus, Ajit Kumar, Ranjan Srivastava , B. D. Bhuj , Satish Chand and S. K. Guru. Influence of Organic and Biodynamic Manures on Soil Microbial Dynamics and Soil Nutrient Parameters in *Chrysanthemum* (*Dendranthema grandiflora* Tzvelev) cv. Thai Chen Queen Syed. *Chemical Science Review Letters* 2021, 10 (39), 336-342
- [21] Kulkarni, S. S. and Gargelwar, A. P. (2019). Production and microbial analysis of jeevamrutham for Nitrogen fixers and Phosphate solubilizers in the rural area from Maharashtra. *Journal of Agriculture and Veterinary*, 12:85-92.
- [22] Parvathi, S. U and Ushakumari K. 2017. Preparation and characterization of onfarm liquid organic manures, *Trends in Biosciences*, Volume 10(32):6880-6885.
- [23] Kumar, R., Chauhan, R.S., Singhal, L.K., Singh, A.K. and Singh, D.D. 2004. A comparative study on immunostimulatory effects of Kamdhenu Ark and Vasant Kusumakar in mice. *Journal of Immunology and Immunopathology*, 4:104-106.

- [24] Kumawat, Ram & Mahajan, S & Santra, Priyabrata. (2013). Effect of panchgavya on soil chemical properties of groundnut (*Arachis hypogaea*) rhizosphere and crop productivity in western Rajasthan. *Journal of Food Legumes*. 26. 39-43.
- [25] L., 2018. Soil quality – a review. *Soil Biology and Biochem*. 120, 105–125.
- [26] Manjunath Bhanuvally, Rajanaika, Mudalagiriappa, Ramesha, Y.M. and Yogeeshappa, h. Effect of different organic sources of nutrients on, physical, chemical and biological properties of soil after the harvest of groundnut (*arachis hypogaea* l.). *International Journal on Agricultural Sciences* Vol. V (Issue 2), pp.121-126, 2014
- [27] Manjunath Bhanuvally, Rajanaika, Mudalagiriappa, Ramesha, Y.M. and Yogeeshappa, H. 2014. *International Journal on Agricultural Sciences* Vol. V (Issue 2), pp.121-126.
- [28] Mete, E. 2009. Comparison of human milk, cow's milk and infant formulas for their antifungal effects against environmental fungi. *Turkish Journal of Medical Science*, 39(1): 67-72.
- [29] Patel, D & Patel, I & Patel, B & Singh, Nirbhay & Patel, C. (2018). Effect of Panchgavya and jivamrut on yield, chemical and biological properties of soil and nutrients uptake by kharif groundnut (*Arachis hypogaea* L.).
- [30] Ramesh, P., Panwar, N. R., Singh, A. B., Ramana, S., Yadav, S. K. and Rao, A. S. 2010. Status of organic farming in India. *Current. Science.*, 98: 1190-94.
- [31] Ravi GK, Kulapati H, Mastiholi A, Prasanna SM and Rudresh DL. 2022. Effect of jeevamrutha on soil Physico-chemical parameters of mango var. Alphonso. *The Pharma Innovation Journal* 2022; 11(4): 246-252
- [32] Ryan, M. 2007. Compost tea production, application and benefits. *The Rodale Institute Sustainable Food and Farming Systems News letter of the Pennsylvania association for sustainable agriculture*.
- [33] Ram, R. A., Singha, A., Vaish, S. 2017. Microbial characterization of on-farm produced bio-enhancers used in organic farming. *Indian Journal of Agricultural Sciences*, 88(1): 35-40.
- [34] Shaikh N.F., Gachande B.D. Influence of Organic and Inorganic Inputs on Soil Physico-Chemical Properties of Jowar Field. *International Journal of Science and Research (IJSR)*. 2014; 2319-7064.

- [35] Solanki, Shivendu Pratap Singh, *et al.*, "Folk Liquid Manures for Sustainable Horticulture." *International Journal of Economic Plants* 2.4 (2015): 175-177.
- [36] Somasundaram, E. (2003). Evaluation of organic sources of nutrients and panchagavya spray on the growth and productivity of maize – sunflower – greengram system. Ph.D thesis submitted to Tamil Nadu Agricultural University Coimbatore. (published)
- [37] Sreenivasa, M. N., Nagaraj, N. And Bhat, S.N. 2009. Beejamrutha: A source for beneficial bacteria, *Karnataka Journal of Agriculture Science*. 22 (5): 1038-1040.
- [38] Sutar, Reshma & Sujith, Goudra& Devakumar, N.. (2017). Nutrient status and microbial activity as influenced by jeevamrutha and panchagavya in cowpea [*Vigna unguiculata* (L.) Walp.] grown on Alfisols. *Crop Research*. 52. 218. 10.5958/2454-1761.2017.00020.1.
- [39] Singh, A. B., Saha, J. K. and Ghosh, P. K. 2008. Effect of nutrient management practices on soybean –chickpea cropping system for improving seed yield quality and soil biological health under rainfed condition. *Indian Journal of Agriculture Science*., 78, 485-489.
- [40] K. SHARMA, R. KAUSHAL, S. SHARMA AND M. NEGI. 2022. Effect of organic and inorganic nutrient sources on soil physico-chemical and microbiological properties in cauliflower (*Brassica oleracea* var. botrytis L.) under mid hills of Himachal Pradesh. *Journal of Crop and Weed*, 18(1): 01-06
- [41] Tharmaraj, G. P., Suresh, R., Anandan, A. And Kolanjinathan, K., 2011, A Critical Review on Panchagavya – A Boon Plant Growth. *International Journal of Pharmaceutical & Biological Archives*, 2(6) : 1611-1614.
- [42] Thirunavukkarasu, M. and Vinoth, R. 2013. Influence of Vermicompost application along with nitrogen on growth, nutrients uptake, yield attributes and economics of rice (*Oryza sativa* L.). *Int. J. Agric. Environ. Biotechnol.*, 6: 599-604.
- [43] Upperi SN, Manjunatha GS, Lokesh BK, Yelledalli NA, Kuligoud VB. Quantification of changes in soil nutrients status and yield of sunflower by the use of jeevamrutha treated organics. *Environment Ecology*. 2008;26(2):811-815.
- [44] Vasanthkumar, H.H.A. 2006. Jeevamrut slurry preparation, Siri Samruddhi, pp. 4-5.

- [45] Verma S, Ajay Babu, Alok Patel, Singh SK, Pradhan SS, Verma SK, et al. Significance of vermiwash on crop production: A review. *J Pharmacogn. Phytochem.* 2018;7(2):297-301
- [46] Verma, A. K., Trivedi, H., & Kumar, S. (2019). Response of bio-enhancers on plant growth and yield of broccoli (*Brassica oleracea* L. var. Italica) F-1 hybrid green magic. *International Journal of Chemical Studies*, 7(6), 302-305.
- [47] VG Raut, Dr. US Surve, KA Chavan and P Kharche. Residual impacts of green manuring and organic formulations on physical and chemical characteristics of soil. *The Pharma Innovation Journal* 2022; 11(12): 2708-2711
- [48] Yadav, R., Aravindakshan, K., Singh, B., Sharma, R. K., Kumawat, V. K., & Ujjwal, R. (2023). Influence of Soil Physio-chemical Properties and Available Nutrient Status by Organic Growth Promoters under Pea (*Pisum sativum* L.) Cultivation. *International Journal of Plant & Soil Science*, 35(21), 613–619.