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A Review on Effect of Organic Conditioner on Physico-chemical and Microbiological Properties of Soil

Sagnik Naskar [a], Manju Kumari [a*] and Anvesha [a]

[a] Department of Soil Science and Agricultural Chemistry, Lovely Professional University, Phagwara, Jalandhar, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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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 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

**Corresponding author: E-mail: mkmanjuthakur@gmail.com;*

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; foliar sprays; healthy ecosystems; sustainable agriculture; soil fertility; organic manures.

1. 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 [1]. In order to sustain agricultural yields, organic manure application is necessary as it facilitates the soil's nutrient accumulation [2]. 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 [3]. Organic manures improve the soil's physical, biological, and chemical properties, and water holding capacity [4]. 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 Tharmaraj *et al.*[5].Combined application of liquid organic manures viz, Panchgavya, jeevamruth, beejamruth with 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 [6], Chandrakala *et al* 2011a and Chandrakala *et al* 2011b) and also influences nutrient uptake by plants [7]. Panchagavya, jeevamrit, beejamrit are cheaper, eco-friendly fermented products of cow dung, urine, pulse flour, jaggery, living soil, and extracts from local vegetation [8]. 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 [9]. It has been found that the biological reactions that occur during the breakdown of organics reduce the accumulation of microorganisms that cause diseases [10]. The application of liquid manures increases soil microbial activity, which contributes to increased soil fertility, sufficient crop nutrition supply, and insect control [11]. 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).

2. 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.

3. 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 [12]. 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.* [13]. 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 [14]. 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 [15]. 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 [16]. 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 [17]. Applying jeevamrit to the soil at a very low rate can improve soil health by acting as a tonic [18]. 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).

4. 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., [19]. Dhama et al., [20]. It contains anticancer, antifungal, and antibacterial properties.
2. **Cow Dung:** According to Dhama et al. [20], 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 [13]. 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 at al., 2004; Dhama et al., 2005a; Mete, [21], Bellamy at al., [22].
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).

5. EFFECT OF LIQUID ORGANIC MANURES ON SOIL PHYSICAL PROPERTIES

Liquid organic manures increases soil physical properties by improving Organic Matter which improve 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 [23] observed the beneficial effect of compost tea on

improvement of soil structure and health. Vermicompost (3 t/ha) + Panchagvaya 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) + Panchagvaya 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. [24]. 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 involvin 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 m^3) 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 [25], Boraiah et al. (2015), and Ali et al. [26]. 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 Upadhya *et. al* (2018). Vasanthkumar [18] reported that soil application of jeevamrut at very low rate act as a tonic to so improving soil health. According to Bhanuvally et al. Application of vermicompost (3 t/ha) + -1 Panchagvaya 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.

6. 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*., [27]. Sreenivasa *et al.* [28] documented that Bacterial isolates from beejamrutha could enhance the soil's ability to fix nitrogen and solubilize Phosphorus. Chandralaka and Shabar [29] et al recorded that application of Beejamrut + Jeevamrut recorded significantly higher available phosphorus (12.31 kg/ha). According to Kumawat et al. [30] application of 3 ml/m^2 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 Panchagvaya 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.* [31] 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 Sanjibani on pH and EC reaches to neutrality (pH 6.8 – 7.0, EC- 0.2 to 0.3 dS/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. [32] 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.* [33] 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 Khudus *et al.* [34] 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 he 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).

7. EFFECT ON SOIL BIOLOGICAL PROPERTIES

Panchagavya and Jeevumrutha contain Actinomycetes, Pseudomonas, bacteria, fungi, P- and K-soluble microorganisms, E. Coli, Rhizobium, Azotobacter, and Azospirilum noticed by Ram et al., [35] and Parvathi and Ushakumari (2017). Singh et al. [36] found that application of both bulky as well as liquid organic manures increased the viable microbial count Similarly, Kumar and Singaram [37] found that treatment of organic manure as well as spray in green chilies increased the soil viable microbial count (bacterial, fungal and actinomycetes) [38-40] 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 [41,42]. According to result finding obtained by Ali et al. (2018) microbial count increases from $2.7X10^{-7}$ to $6.7X10^{-8}$ due to application of sanjibani and panchagavya [43-45]. Sharma et al. (2022) reported that viable microbial counts (18.53 x 105, 4.25 x 103, and 3.42 x 103 cfu g-1 for bacteria, fungi, and actinomycetes, respectively) were found to be achieved by applying 100% recommended doses of nutrients through vermicompost + jeevamrit [46-48].

8. 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

9. 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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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