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Role of Liquid Organic Formulation for Soil Health and Crop Production

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Abstract
Organic food is becoming increasingly popular. To achieve organic goals and sustainability, the use of organic liquid formulations is seen as one of the alternatives, as it avoids the use of synthetic and inorganic chemicals in agriculture. Cow dung and cow urine have been used in India from ancient times for various organic formulations and various medicines; moreover, well known for their germicidal and medicinal properties. Bijamrita is a technique of seed treatment using locally available ingredients, including local desi cow urine and cow dung. These organic formulations are prepared from the raw materials obtained from plants, animals, and their waste materials, such as cow dung, cow urine, cow milk, cow curd, honey, jaggery *etc*. The studies indicating the importance and benefits of liquid organic nutrient management for agricultural production and soil health maintenance have been reviewed in the present work.

Keywords: Amritpani, Jeevamruth, Panchagavya, Vermiwash

Introduction
The continuous use of inorganic fertilizers hazards the soil health in respect of physical, chemical and biological properties of soil. Therefore, it is necessary to minimize the application of inorganic fertilizers by substituting them with organics. It is well established that the improvement in the quality and productivity of the crops, either food grain, oilseed or fruit crop, could be made possible with combined application of organic manure and balanced chemical fertilizers. Amritpani, beejamruth, jeevamruth and panchagavya are some of the organic liquid formulations that have been in practice from ancient times (Devakumar *et al.*, 2014). Vermiwash is a liquid extract produced from vermicompost in a medium where earthworms are richly populated. It comprises a massive decomposer bacteria count, mucus, vitamins, different bioavailable minerals, hormones, enzymes, different antimicrobial peptides, etc. These formulations can either be given as individual doses or as a combination of two or more. Panchagavya, vermiwash, amritpani, beejamruth and jeevamruth help in the enrichment and revitalization of soil, contributing to better yields. Use of organic liquid preparations has been an old practice in India. Amritpani, panchagavya, cow pat pit and jeevamrita are used in different organic farming systems, *viz.* rishi krishi, panchagavya, biodynamic and natural farming (Shaikh and Gachande, 2015). Jeevamrita is a low-cost bio-enhancer that enriches the soil with indigenous microorganisms required for mineralization of the soil. Cow pat pit, panchagavya and amritpani are also cost-effective preparations (Khan *et al.*, 2014).

Soil Health

Organic agriculture should be based on living ecological systems and cycles, work with them, emulate them, and help sustain them. Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. Soil health or quality is the soil's fitness to support crop growth without resulting in soil degradation or otherwise harming the environment. Soil health, provides an overall picture of the condition of many properties and processes. Soil health changes slowly because of natural processes, such as weathering, and more rapidly under human activity, land use and farming practices may change soil health.

Sustainable Crop Production

Sustainable crop production refers to agricultural production in such a way that does not impose any harm to the environment, biodiversity, and the quality of agricultural crops. Producing crops sustainably increases the ability of the system to maintain stable levels of food production and quality for the long term without increasing the demand and requirements for agricultural chemical inputs to control the system. Dotaniya *et al.*, (2022) results shown that different INM modules dramatically increased soil organic matter and improved soil health in terms of physical and chemical qualities, in addition to higher chickpea crop performance and productivity when compared to using only inorganic fertilizer. Sustainable crop production deals with keeping the soil alive with organic matter, integrated pest management and reduction in usage of pesticides, protecting biodiversity, ensuring food safety and food quality, improving nutrient quality, and fertilizing the soil with organic fertilizers.

Liquid Organic Formulations

Liquid organic formulations are prepared from the fermentation and decomposition of cow dung, cow urine, milk, curd, ghee, legume flour, jaggery. Liquid manures, liquid fertilizers, preparations are obtained by active fermentation of animal and plant residues over a specific duration. On average, preparation of liquid manure takes 2-3 weeks. Organic fertilizers/ organic liquid manures plays an important role in quick decomposition of organic wastes, improve humus content of the soil which is essential to maintain the activity of microorganisms and other life forms in the soil.

Role of Liquid Organic Formulations in Indian Agriculture

The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable agriculture Figure 1. Chemical agriculture has made an adverse impact on the healthcare of not only soil but also the beneficial soil microbial communities and the plants cultivated in these soils. The cost of inorganic fertilizers is increasing enormously to an extent that they are out of reach of small and marginal farmers. In the past few year thousands of farmers in India have committed suicide due to increased cost of production and low productivity.

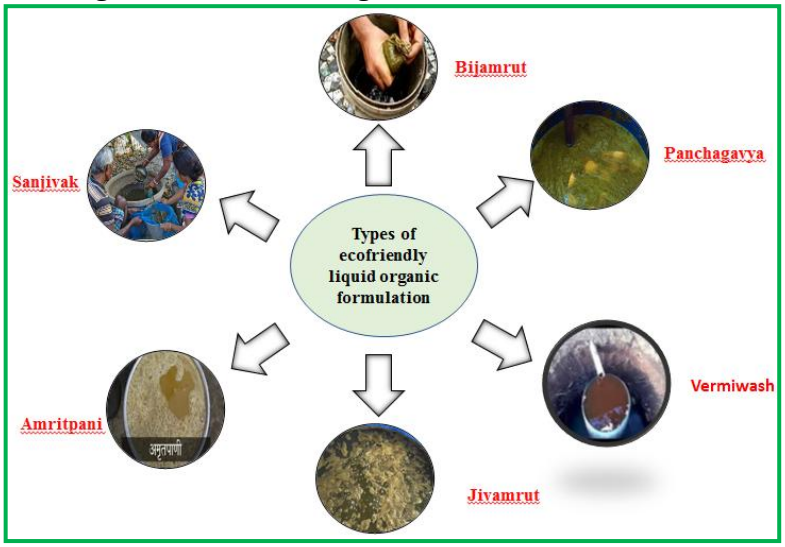

Figure 1: Types of ecofriendly liquid organic formulation [Adapted from Devakumar *et al.*, (2014)]

Bijamrut

1. Take 5 kg of cow dung in cotton cloth and deep in water.
2. Add 1 litre of water and 50 g of lime to it, let it stay stable for a night.
3. Separate the solid portion of cow dung by squeezing it.
4. Add 5 litres of cow urine, 1 litre of lime water, 50 g soil and 20 litre normal water.
5. Keep this mixture for 12-16 hrs.

Application: Add bijamrut to seeds of any crop, coat them, mix by hand, dry them and use them for sowing. For seedlings, just dip them in bijamrut and dry.

Panchagavya

It literally means a mixture of five cow organic products like cow milk, cow urine, cow dung, curd and ghee (Table 1). Panchagavya is also used for detoxification of minerals and metals. Cow's urine is especially used for detoxification of metals.

Table 1: Composition of panchagavya and its benefit

	Cow dung.	Mix cow dung 5 kg.
	Cow Ghee 500 g	Ghee 500 g keep it for 3 days.
	Cow urine 3 litre	After 3 days add cow urine and water.
	Water 100 litre	Keep it for 15 days with regular mixing both in morning and evening.
	Milk 2 litre	After 15 days mix the milk, curd, jaggery and banana.
	Curd 2 litre	Close the mouth of drum.
	Jaggery 500 g	Stir twice a day. Panchagavya will be ready after 30 days.
	Ripe banana 12	20 litre panchagavya is needed $acre^{-1}$.

Application of Panchagavya

1. Spray system: 3% solution was found to be most effective compared to the higher and lower concentrations investigated. Three liters of Panchagavya for every 100 litres of water is ideal for all crops.
2. Flow system: The solution of panchagavya can be mixed with irrigation water at 50 liter hectare^{-1} either through drip irrigation or flow irrigation.
3. Seed/ seedling treatment: 3% solution of panchagavya can be used to soak the seeds or dip the seedlings before planting. Soaking for 20 minutes is sufficient.
4. Seed storage: 3% of panchagavya solution can be used to dip the seeds before drying and storing them.

Methods of Vermiwash Production

1. A big earthen pot/ plastic drum with a tap fitted to the bottom are placed in the shade.
2. Laid out concrete or red sand 5 cm at the bottom.
3. A 30-40 cm thick layer of cow dung 15-20 days old filled the pot.
4. Introduce 500-1000 earthworms in the pot.
5. An earthen pot with a minute hole in the bottom hanged over the pot after 15 days of inculcation.
6. After 2-5 days, the extract collected in the earth earthen pot from the tap is called Vermiwash.

Application of Vermiwash

- **Spray system:** vermiwash is diluted in the water 5 times and sprayed on the foliage of crops.
- **Flow system:** The solution of vermiwash can be mixed with irrigation water at 50 litre hectare^{-1} either through drip irrigation or flow irrigation.
- **Seed/ seedling treatment:** The seedlings before transplanting are dipped in vermiwash solution which is diluted 5 times with water for 15-20 minutes and then transplanted.

Amrutpani Organic Liquid Fertilizer

1. Combine half a liter of honey and one liter of ghee and stir it well.
2. Add and stir a handful of soil under the Banyan tree.
3. Mix 3 litres of cow urine and 3 kg of cow dung in it and mix well.
4. Now add this mixture in 10 to 20 litres of water.
5. Your amrutpani liquid organic fertilizer is ready to use.
6. Use amrutpani when planting seedlings or when seedlings are ready or if seedlings are drying.
7. Amrutpani is more effective than the organic fertilizer jeevamrut.
8. If amrutpani is used and seedlings do not get water for 21 days, they will sustain.
9. Jeevamrut organic fertilizer and amrutpani increase the immunity of the crop and also increase water tolerance.
10. The maximum cost is rs. 1,000.00 acre^{-1} if we use homemade organic fertilizer.

Application: Use this bijamrita for the treatment of any crop as a seed. Cover the seed; mix them with bijamrita by hands and dry to use for sowing.

Organic Fertilizer Jeevamrut Preparation

1. Take 100 litre of water in the barrel.
2. Add 10 kg Indian/ desi breed cow dung and stir well for 5 minutes.
3. 5 to 8 litre of Indian/ desi breed cow urine, and stir well.
4. 1 kg black jaggery (used for winemaking), then stir the solution for 5 minutes.
5. 1 kg Gram Flour (Besan), and stir well for 5 minutes.
6. 1 kg Soil taken from the roots of a Banyan Tree.

7. Generally, this soil is free from chemical fertilizers. Then stir the solution for 15 minutes.
8. Add another 100 litre of water to it and stir well.
9. The above ingredients should be stored in a cool place and away from sunlight for 6-7 days.
10. The mixture needs to be stirred a couple of times (10 min. every time) in a day.
11. Jeevamrut has a very foul smell. Also, it is difficult to handle liquid fertilizer with a shelf life of 10-12 days.

Uses and Application

- For a spray of liquid organic fertilizer jeevamrut. Apply 5-10% in water.
- For soil, use 100-200 litres acres^{-1} during irrigation.
- According to the growth of the crop, use it once at an interval of 15-30 days.
- Jeevamrut liquid organic fertilizer is for vegetable, indoor plants, and agricultural farms.

Role of Liquid Organic Formulations in Soil Health and Crop Production

Beejamrit protects the crop from harmful soil borne and seed borne pathogens during the initial stages of germination and establishment. The physio-chemical characteristics of different organic formulations for soil health (Table 2). It increases germination percentage, seedling growth and seed vigour index. Plants sprayed with panchagavya produce bigger leaves, develop denser canopy, the roots spread and grow into deeper layers and improve fertility status in soils by increasing macronutrients, micronutrients and beneficial microorganisms, improving soil health. Panchagavya has shown its effect on maintaining soil aggregate stability and increasing soil porosity. Jivamrut boosts plant growth and the plant gives good yield. Jivamrut increases the microbial count and beneficial bacteria in the soil.

Table 2: Physio-chemical characteristics of organic formulation for soil health

Parameters	pH	EC	Available N	Available P	Available K	References
Panchagavya	4.60	0.54	84	34	43	Naik *et al.*, 2013
Vermiwash	8.77	0.04	338.88	57.2	154.94	Khan *et al.*, 2014
Amritpani	6.96	0.242	193	53.14	507.8	Shaikh and Gachande, 2015
Beejamruth	6.964	0.242	156.8	53.148	507.8	

Benefits of Liquid Organic Formulation: The ingredients used in liquid organic formulation are available in ample quantities and they are very cheap as compared to chemical fertilizers and this is an effective alternative to chemical fertilizers for farmers. Liquid organic formulation increases beneficial microorganisms like nitrogen fixers, phosphorus solubilizers, bacteria, actinomycetes, fungi and promotes organic carbon in the soil. Nutrients provided by this formulation are 100% natural & organic substances. It improves the water holding capacity of soil. The various beneficial metabolites such as organic acid, hydrogen peroxide and antibiotics are produced by microorganisms which are effective against various pathogenic microorganisms. Slow and consistent nutrient releases at a natural rate that plants are able to use.

Disadvantages of Liquid Organic Formulation

- High loss of nitrogen due to volatilization.
- Nutrient levels are low.
- Hard to remove solids.
- Phosphorus may build up in solids.
- May not be appropriate for areas with high water tables.

Epilogue

From the foregoing discussion, it can epilogue that use of liquid organic formulations like panchagavya, vermiwash, beejamrut, jivamrut, amritpani, sanjivak, cow urine when applied alone or with organic the manure improves crop growth, yield, quality, nutrients content and uptake by the crops and soil fertility status by increasing macronutrients and micronutrients status and also increased beneficial microorganisms in soil, ultimately improve soil health. The liquid organic formulation acts not only as a liquid organic fertilizer but also as a mild biocide, which can be used as an effective input in organic agriculture for both soil health and disease management for sustainable crop production at low cost.

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