Organic Farming: A Review on Viable Path to Safe and Healthy Food Production

Sugumaran M.P[1*], Goveanthan A.S[2], Porkodi G[3], Kalaichelvi K[4], C. Indhu Parameswari[5]

[1,3,4]Sugarcane Research Station, Tamil Nadu Agricultural University, Cuddalore, Tamil Nadu, India
[2]Research Scholar, Tamil Nadu Agricultural University,Coimbatore
[5]Easa college of Engineering & Technology, Coimbatore
*Corresponding Author

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Abstract**—** *The Green Revolution, though successful in meeting rising food demands, has incurred significant environmental costs. Organic farming emerges as a holistic alternative, promoting agroecosystem health and safe food production. This paper reviews the principles and effectiveness of organic farming practices, focusing on liquid organic formulations like Panchagavya, Beejamruth, and Jeevamruth. These formulations, derived from natural sources, stimulate plant growth and immunity, addressing concerns about soil health and water contamination. Despite increasing adoption by farmers, scientific validation of these inputs is lacking. This paper highlights the importance of on-farm experimentation for wider acceptance. India, with its historical reliance on cattle-based agriculture, is poised for a transition to organic farming. Organic inputs, such as vermiwash and Panchagavya, enhance soil properties and crop productivity, offering a sustainable and eco-friendly agricultural approach. As organic farming gains momentum globally, these alternatives play a crucial role in promoting soil health, reducing chemical dependency, and ensuring food safety. Embracing organic practices aligns with the growing global shift towards environmentally conscious agriculture, promising a more sustainable future for food production.*

Keywords— Organic farming, Green Revolution, Liquid organic formulations, Panchagavya, Beejamruth, Jeevamruth, Sustainable agriculture, Agroecosystem health.

I. INTRODUCTION

The Green Revolution, while successful in meeting the escalating demand for food and fiber, has come at a considerable environmental cost, marked by the loss of natural ecosystems, groundwater depletion, food pollution, and environmental degradation. As the nation grapples with the challenge of providing safe food for its growing population, organic farming emerges as a holistic alternative to conventional food production. Organic agriculture, a comprehensive production management system, promotes the health of agro ecosystems and ensures the production of safe food for human consumption. Organic farming diverges from conventional practices by avoiding extensive use of synthetic fertilizers, growth regulators, and livestock feed additives. Instead, it relies on sustainable methods such as green manures, crop rotations, crop residues, and animal manures. Liquid organic formulations like Panchagavya, Beejamruth, Jeevamruth, and Amritpani, prepared with locally available materials, play a crucial role in supporting plant growth. These formulations, fermented products rich in beneficial microflora, stimulate vegetative growth and contribute to better yields. The modern organic movement, significantly different from its origins, is gaining recognition commercially, socially, and environmentally. Liquid formulations like Panchagavya, Beejamruth, and Jeevamruth, derived from agricultural by-products, are found to be excellent growth enhancers. The growing awareness of safe and healthy food, coupled with concerns about soil health and water contamination, has led to increased demand for organic farming practices. With farmers realizing the benefits of organic farming, the use of organic liquid manures such as Panchagavya, Beejamruth, and Jeevamruth is on the rise. While these inputs are proving successful in promoting plant growth and immunity, scientific validation is lacking. The need for alternative technologies that ensure safe and healthy food while being environmentally friendly underscores the significance of organic farming practices. Scientific validation of these organic inputs through on-farm experimentation becomes essential for wider acceptance and adoption in mainstream agriculture. Organic farming has witnessed rapid development in recent years, and India, with its lower per capita and per hectare consumption of chemical fertilizers compared to global standards, stands poised for a transition toward organic

agriculture. The historical practice of cattle-based agriculture, where cows were revered for their contributions to farming through milk, dung, and urine, lays the foundation for the integration of organic principles in Indian agriculture. Despite the success of the Green Revolution in the late 1960s, reports of stagnating or declining crop production levels, over-exploitation of natural resources, and excessive chemicalization of agriculture have raised concerns about the sustainability of conventional farming practices. In this context, organic farming emerges as a viable alternative, emphasizing a holistic production management system that promotes and enhances the health of agro ecosystems. Organic farming eschews synthetic fertilizers, pesticides, growth regulators, and livestock feed additives, relying instead on natural practices such as crop rotation, crop residues, animal manures, green manures, and biofertilizers. The use of cow-based organic manures like Panchagavya, Jeevamruth, and Beejamruth is gaining popularity due to their rich nutritional content and role in promoting plant growth.

II. ORGANIC FARMING

Organic farming is developing very rapidly in recent years. Indian agriculture has a better chance to convert itself as organic agriculture because, the per capita and per ha consumption of chemical fertilizer in the country is much lower than the global standards. In olden days, cattle based agriculture was widely practiced. Cow is greatly respected and worshipped. The cow is an inseparable part of the farming community. We directly benefit from cow in terms of milk, dung and urine.

India's food production is a success story following the green revolution in late 1960's. However, there have been reports of either stagnating or declining levels of crop production. Over exploitation of natural resources and excessive chemicalisation of agriculture have led to poor sustainability of farm production. So these technologies are not environmentally sound and sustainable. We have to think of several alternatives for sustaining our food production without sacrificing the environment and ecology. One of the alternatives is organic farming. In this context, the present investigation was taken up to evaluate organic inputs (Jeevamruth and Beejamruth) and to test their efficacy on greens. The literature relevant to the study are reviewed here under.

2.1 Concept of organic farming:

Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent possible organic farming system rely upon crop rotation, crop residues, animal manures, legumes, green manures, off farm organic wastes, mechanical cultivars, mineral bearing rocks and bio fertilizers to maintain soil productivity as well as tilth and as plant nutrients and biological means to control insects, weeds and other pests. Chakraborty (1998) stated that organic farming means farming in the spirit of organic relationship. It places farming on integral relationship between soil, water and plants; between soil microbes and waste products; between agriculture and forestry; among soil, water and atmosphere. Organic farming is known by various other names also: alternative agriculture, low external input sustainable agriculture (LEISA), ecological agriculture and regenerative agriculture.

Organic farming is both a philosophy and a system of agriculture. The objects of environments, social and economic sustainability lie at the heart of organic farming and are among the major factors determining the acceptability or otherwise of specific production practices (Stockdale *et al*., 2001).

Organic farming is focused on the whole farm system and its interaction with climate, environment, social and economic conditions, rather than considering the farm as comprising of individual enterprises. Organic farming represents the restructuring of whole farm system, rather than the adoption of current practice to reduce environmental impact (Chaudhry, 2002). The objectives of organic agriculture being concisely expressed in the standard document of the International Federation of Organic Agriculture Movement (IFOAM) are,

- To produce food of high quality in sufficient quantity
- To work within natural systems and cycles
- To encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants, and animals.
- To maintain and increase the soil fertility for long term.
- To maintain the genetic biodiversity of the production system and its surroundings.
- To promote the sustainable use of natural resources.
- To give all livestock conditions of life with due considerations for the basic aspects of their inmate behaviour.
- To consider the wider social and ecological impact of the farming system.

2.2 Organic manures for crop production:

Klute and Jacob (1949) determined that continued use of manure resulted in an increase in organic matter in the soil, which in turn increased cation exchange capacity, available water and decreased the bulk density of soil. All of these soil characteristics are favourable to crop production and soil health restoration.

The Rothamsted experiment results revealed the superiority of organic manures over NPK mineral fertilizers. In Samundham, the long range trials on a sandy clay soil for sixty years, the yields were more or less similar with FYM and mineral fertilizer. In the field experiments also, the wheat yields over a period of thirteen years with organic manure were similar to that with suitable combination of mineral fertilizers (Cooke, 1970).

It is obvious that organic manures have both direct and indirect effects on crop productivity and environment. The uptake of humic substances or its decomposition products results in better growth, yield and efficient metabolism (Mathur and Gaut, 1977).

2.3 Organic nutrient sources:

Organic manures in agriculture add much needed organic matter and minerals to the soil. The important manures used in organic farming are farmyard manure, vermicompost, green manures and liquid organic manures like Panchagavya, Jeevamruth and Beejamruth. The beneficial effects of organic manures in agricultural production and soil fertility are known for many decades, but they are inadequate in nutrient supply and low in nutrient concentrations. The total nutrients recycled from organic matter decomposition are much less than the amount of nutrients utilized by the crop plants. This necessitates the enrichment of manures with beneficial microbial inoculants like free living nitrogen fixers or phosphate solubilizers, to improve the nutritional status of the manures. The enrichment manures with rock phosphate and beneficial microbial cultures result not only in improvement of nutritive value but also in higher growth and yield of crops. The microbial enrichment of organic manures will further contribute to the enhancement of P solubilisation and N fixation. Organic manures are available in the form of green and dry plant residues, fresh animal wastes, decomposed materials of plants and animal origin and biologically, active preparations (Palaniappan *et al*., 1995). Manures and biologically active preparations of animal and plant origin were most commonly used by those farmers who aimed for sustainable production in Tamil Nadu (Somasundaram, 2002).

2.4 Vermicompost:

Vermicompost is blackish brown humus like coarse, granular material which is loose, fine, soft to touch light in weight and free from any foul smell having electrically charged particles meant for improved adsorption of plant nutrients in the soil (Neena and Battish, 2005). Marinari *et al*., (2000) also observed that vermicompost had pH of 7.7, 2.0% of N, 34.2% of total carbon, 813.0 μg N g^{-1} of NO_3-N, 133.7 μg N g^{-1} of NH_4-N, and 47.0 μg P g^{-1} of available P. Vermicompost being a rich source of macro and micro nutrients, vitamins, plant growth regulators and beneficial micro flora, appeared to be the best organic source in maintaining soil fertility on sustainable basis towards an eco-friendly environment. Vermicompost besides being a rich source of micronutrients also acts as chelating agent and regulates the availability of metallic micronutrients to the plants and increases the plant growth and yield by providing nutrients in the available form. Vermicompost contains growth promoting substances like auxins and cytokinins.

2.5 Liquid Formulation:

To overcome the problems faced with solid carrier based formulations, there is need to develop new inoculant formulations which would ensure longer survival, no contamination, ease of applicability. In recent years, many of the formulations of the liquid based inoculants are introduced which have been shown to tolerate adverse environmental conditions in a better way and are free from other problems that are encountered with solid carrier based preparations (Hynes *et al*., 2001). Liquid bioinoculants are special formulations containing not only the desired microorganisms and their nutrients, but also, special cell protectants or substances that encourage the longer shelf life and tolerance to adverse conditions (Vora *et al*., 2008). Characteristics of a good liquid inoculant include non-toxicity, low cost, readily available uniform materials, adaptable to normal cell culture conditions, amenable to nutrient supplements, rapid release of microorganisms in the soil, support their growth and survival and are easily manageable in the mixing and packaging operation (Smith, 1992).

2.6 Panchagavya:

Panchagavya is a bio stimulant consisting of a combination of five products obtained from cow, which includes cow dung, cow urine, cow milk, curd and ghee. The term Panchagavya represents 'Pancha'-five, 'Gavya'-produce from cow. It acts as an immuno stimulant that promotes growth, increases the overall yield and also renders resistance to diseases and pests. The

materials required for preparation of Panchagavya (Boomiraj, 2003) are cow dung-5 kg, cow urine-3 litre, cow milk-2 litres, curd -1 litre, ghee-1 litre, sugarcane juice-3 litres, tender coconut water-3 litre, Ripe banana (cv. Poovan)-12 numbers and coconut toddy-2 litres. Fresh cow dung (5kg) and one litre of ghee were mixed well and retained in a plastic bucket for three days under shade.

It was stirred well twice a day, then on fourth day, the remaining ingredients were added to the mixture. The slurry was mixed well three (or) more times a day up to 15th day. Thus panchagavya was ready for use in a period of 15 days which was later diluted to 3 per cent and then sprayed. Other than cow's products, the added materials like riped banana, act as fermenting agents and preservators to panchagavya (Natarajan, 2002).

2.7 Jeevamruth:

Jeevamruth is a bio stimulant consisting of a combination of five products, which includes cow dung, cow urine, pulse flour, jaggery, handful of garden soil and some amount of water. The term 'Jeevamruth' represents 'Jeev'-life, 'amruth'- a valuable food. It acts as an immune-stimulant that promotes growth, increases the overall yield and also renders resistance to diseases and pests. Palekar (2006) has given the method to prepare Jeevamruth with the following ingredients,

No.	Ingredients	Quantity
1	Cow dung	10 kg
2	Cow urine	10 litres
3	Pulse flour	2 kg
4	Jaggery	2 kg
5	Soil	100 grams
6	Water	200 litres

2.8 Beejamruth

Beejamruth is used for the seed treatment and the name represents 'Beej'-seed, 'amruth' – a valuable food. Beejamruth is very useful for seed pre-treatment as it increases the germination ability of the seeds. The materials for preparing Beejamruth (Palekar, 2006) are as follows,

No.	Ingredients	Quantity
1.	Cow dung	10 kg
2.	Cow urine	10 litres
3.	Lime	200 grams
4.	Soil	100 grams
5.	Water	100 litres

2.9 Vermiwash:

Earthworm produced plant growth substances in alimentary canal and excreted it along with earthworm cast. Vermiwash, liquid organic manure is an aqueous extract of a column of fresh vermicompost and surface washing of earthworms which contain beneficial microorganisms and water soluble fractions. The nutrients present in vermiwash are in water soluble form and intermediate requirement of a number of components can be met from a single source. The vermiwash, used as the ingredient of the spray preparation, act as a nutrient medium for the crops (Dutt, 1996).

Vermiwash is a collection of excretory and secretory products of earthworm along with other micronutrients. The fresh vermiwash houses a large number of beneficial microorganisms, which helps in plant growth and protects it from a number of infestations. Vermiwash contains sugars, amino acids and phenols along with plant growth promoting hormones such as indole acetic acid and humic acid (Gulsar *et al*., 2006).

2.10 Effect of organic inputs on soil biological properties:

The various biochemical process associated with nutrient recycling are mediated by soil enzyme which are derived from microorganisms, plant roots and soil enzymes (Tabatabai, 1982). Yin-Powang and Chenchingchao (1995) reported that chicken manure used in organic farming treatment enhanced the bacterial and fungal population. A field experiment conducted in Vellayani, Thiruvanathapuram, Kerala, India during 1995– 97 on *Momordica charantia* cv. Preethi revealed that poultry manure application increased the bacterial population in soil than chemical fertilizers (Rajasree and Pillai, 2002).

2.11 Soil microorganisms:

Compost carries with it a very large population of Actinomycetes, fungi and bacteria and by their incorporation into soil, not only millions of microorganisms are added but those already present in the soils are stimulated by the fresh supply of humic materials (Gaur, 1982). Ammonification, nitrification and N fixation are increased due to improved microbiological activity. Compost also stimulates the mycorrhizae, which live in symbiotic association with the roots of plants and trees and play an important role in transferring certain nutrients from soil to plant (Gaur, 1982). The soil microbes are sole agents responsible for all of the biological transformations in the soil. These are carried out through a variety of biochemical reactions carried out or catalysed by group of enzymes (De and De, 1988).

2.12 Soil enzymes:

Soil enzymes activity is considered as an index of microbial activity in the soil. Therefore, any management practices that influences the microbial population of the soil would be expected to produce changes in the soil enzyme activity and level of enzyme activity can be used as an indicator of soil fertility (Burns, 1982). The measurement of dehydrogenase activity in soil gives correlating information on biological activities of microbial populations in soil (Casida *et al*., 1964). Organic manures stimulate soil phosphatase activity (Golian, 1968). Addition of organic matter increased activities of urease, catalase, dehydrogenase and amylase in soil (Garcia *et al*., 1993).

2.13 Effect of organic inputs on crops:

All crops respond to organic manuring and the extent of response depends on several factors such as degree of humification, maturity of the compost, its C/N ratio, the time and method of its application and on soil type, agro climatic conditions and moisture regime of soil during the growth of the crop (Gaur, 1982). From various pot culture and field experiments, it is evident that increased yield and nutrient uptake were related mainly to the improved physical condition or to the nutrient contents of the organic manure or wastes (Narwal *et al*., 1993; Kapur, 1995).

2.14 Field Crops

Dwivedi *et al*., (1993) reported that the application of nitrogen through compost accelerated the metabolic activities, which enhanced the synthesis of aminoacids, protein and carbohydrate resulting in higher assimilation of these contents in black gram and wheat. Subbaraj and Ramaswami (1995) studied the effect of organic amendments on oil yield of groundnut and recorded the highest oil content in composted coir pith treatment, which ranged from 34.7 to 47.7 %. Thilagavathi and Mathan (1995) reported an increase in panicle length, grain per panicle, root length, density and grain yield of coir pith amended soils. Amanullah (1997) reported that the growth parameters and yield of cassava increased due to application of organic manures especially composted poultry manure either alone or with FYM. Math and Trivedi (2000) reported an increased wheat yield and grain yield in organic amended soils over control.

2.15 Horticultural crops:

The results of more than thirty experiments with potato showed that there has been an increase in yield with application of organic manure varying from 4 to 30% over control (Gaur, 1982). The yield increase was also reported in Chillies, Fenugreek, Onion, Sweet potato and Tomato. Organic waste materials can be used as a medium for growing cucumbers in glass house condition with encouraging results (Tzvetkove and Vargov, 1991). According to Kostov *et al*., (1995), the production of fruits on the compost applied field, started 10 to 12 days earlier and compost treatments showed a significantly higher yield. Compost application has an added advantage of being suppressive to numerous plant diseases (Shyng, 1994) and weed population (Son, 1995).

2.16 Panchagavya:

2.16.1 Properties of Panchagavya

Cow's urine (Gomoothra) is rich in urea and acts both as a nutrient as well as hormone. Urine also contained uric acid and hippuric acid in large quantities along with other minerals like NaCl, sulphates of Ca and Mg and potassium hippurate.

Cowdung is rich in bacteria, fungi and other microbial organisms. Cowdung has 82% of water and solid matter of 18% (Singh, 1996). Cow's milk is a good medium for saprophytic bacteria and acts as virus inhibitor. Milk contains protein, fat, carbohydrate, amino acid, calcium, hydrogen, lactic acid and *Lactobacillus bacterium*. Many microorganisms could ferment either five or six carbon sugars, but the *Lactobacillus bacterium* could ferment both (Linda Mc Graw, 1999).

2.16.2 Effect of Panchagavya on growth, yield and quality of crops:

Panchagavya sprayed on chillies crop produced dark green color in leaves and new growth within 10 days (Subhashini Sridhar *et al*., 2001). Vivekanandan (1999a) reported that the panchagavya spray on 25 DAS and 40 DAS had advanced the paddy harvest by ten days. Pod yield of moringa was increased by the treatment combinations of poultry manure + neem cake + panchagavya along with increased dose of fertilizer (Beaulah *et al*., 2002a). The key feature of panchagavya was its efficacy to restore the yield level of all crops during the transitory period of switching over to organic farming from the very first year (Natarajan, 2002).

2.17 Microbiological aspects:

Effective microorganism like *Lactobacillus, Saccharomyces, Streptomyces, Aspergillus* found in panchagavya improved the soil quality and growth and yield of sweet corn, which was equal to or higher than from chemical fertilizer (Xu and Xu, 2000). In Panchagavya, proven bio fertilizers such as Azospirillium (1010), Azotobacter(109), Phosphobacterium (107) and *Pseudomonas* (106) were found besides *Lactobacillus* (Solaiappan, 2002). The crude extract of *Pseudomonas* was found to enhance the growth of garden pea seeds as compared to control (incubated with distilled water), since it contained IAA and GA3 (Mahalingam and Sheela, 2003).

2.18 Effect on pest and diseases:

Ramachandra Reddy and Baskara Padmodaya (1995) reported that the Panchagavya spray controlled the wilt of banana. Soil drenched with 10% successfully controlled the wilt of tomato (Mishra, 2002) and it was found to be superior to carbendazim in reducing the plant disease index and increasing the vigour of the plant and fruit yield of tomato. Panchagavya was found to activate soil microorganisms and to protect plants from diseases (Upendra Shendy *et al*., 2000). Panchagavya spray with Agniastra (fumigation in the field) recorded the least population of cutworms and highest yield of potato (Selvaraj, 2003). Contrary to the above, on the fourth day after spraying panchagavya, there was an aphid attack on the crops. Flowers started withering due to sucking of sap (Jayashankar *et al*., 2002).

2.19 Characterization of organic inputs in soil:

2.20 Panchagavya:

The chemical characteristics of Panchagavya reveal that they possess almost all the major nutrients, micronutrients and hormones (IAA and GA) required for crop growth. Predominance of microorganisms like yeast and Lactobacillus in Panchagavya is due to the combined effect of low pH, milk products and addition of jaggery as substrate for their growth. The low pH of the medium is due to the production of organic acids by the fermentative microbes as evidenced by the population dynamics and organic acids determination in GC analysis. Lactobacillus produces various beneficial metabolites such as organic acids, hydrogen peroxide and antibiotics which are effective against other pathogenic microorganisms besides its growth promotion effect on animals and human beings as probiotics. The mixture of 1 part of Panchagavya with 50 parts of water has some notable physico-chemical characteristics. The pH range of mixture is around 4.60 and the EC is around 0.54 mS cm^{-1}. The IAA is around 12.1 ppm and the GA content is around 5.2 ppm. The observed values of N, P & K are 6650 ppm, 4310 ppm and 5200 ppm respectively.

2.21 Jeevamruth:

The filtered extract from Jeevamruth is used as soil application and is believed to enrich soil microbiologically through in-numerous beneficial microorganisms. Jeevamruth is reported to contain very large population of nitrogen fixers, phosphate solubilizes and siderophore producers. Microbial fermentation during preparation is also believed to develop some growth promoting hormones which help in better germination and seedling emergence (Sanjeev kumar *et al*, 2012).

2.22 Beejamruth:

The application of Beejamruth in soil application results in rapid proliferation of microbes. This adds up to the beneficial effect of the application of Beejamruth. These microorganisms produced IAA and GA which resulted in the improvement of seed germination and seedling length and seed vigour in chilli (Nemagoudar *et al*., 2012).

III. CONCLUSION:

In conclusion, the utilization of organic inputs, exemplified by vermiwash and Panchagavya, represents a crucial paradigm shift towards sustainable and eco-friendly agricultural practices. These organic alternatives not only enhance soil biological properties and stimulate microbial activity but also significantly contribute to the growth, yield, and quality improvement of crops. The positive impact extends across various aspects of agriculture. Vermiwash, with its rich nutrient content and beneficial microorganisms, emerges as a potent liquid organic manure, fostering plant growth and fortifying crops against infestations. Meanwhile, the holistic composition of Panchagavya, combining cow-derived elements, demonstrates diverse properties that advance crop maturity, induce vibrant growth, and fortify plants against diseases. The integration of organic inputs into farming practices is not only environmentally responsible but also economically viable. As organic farming gains momentum, these alternatives play a pivotal role in promoting soil health, reducing dependence on synthetic chemicals, and fostering a more sustainable agricultural ecosystem. By embracing these organic practices, farmers can contribute to mitigating environmental degradation, ensuring food safety, and promoting long-term soil fertility. As the world faces escalating challenges in agriculture, the adoption of organic inputs stands as a beacon for a resilient and sustainable future in farming. This shift aligns with the growing global consciousness towards environmentally conscious and socially responsible agricultural practices, paving the way for a healthier planet and more sustainable food production systems.

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