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Use of *Amritpani*: An Excellent Bio-Enhancer for Sustainable Agriculture: An Overview

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ABSTRACT

Sustainable agriculture relies on conservation of agricultural resources for future generation through paradigm shift of modern day chemical based farming to organic farming. This conversion is not only required for generating quality agricultural produce but also protecting the environment from chemical hazards. Organic farming is done through adopting various organic inputs as well as sustainable practices. Beside the manures, various traditional organic formulations commonly known as bio-enhancers like *Amritpani* play a key role in organic farming through boosting agricultural productivity as well as quality in an eco-friendly way. Application of *Amritpani* in agriculture is an age old practice to achieve high as well as sustainable agricultural production. It has diversity of nutrients, beneficial micro-organisms, growth promoting hormones, enzymes, vitamins, bio-pesticidal compounds *etc*. which can improve soil health as well as crop productivity and protect the crop from pests by boosting the plant's immunity power. Encouragement of soil microbial activity through *Amritpani* is a vital factor of success of organic farming in many areas. However, *Amritpani* still lacks scientific testing and therefore, requires adequate researches on its efficacy before recommendation. This can be achieved through multi-locational, multi-crop research trials as well as bio-chemical analysis of the formulation. Further, use of raw materials and their quantities, time, method and dose of application of end product should also be properly standardised before its effective transfusion in new areas through strong extension service.

Key words: Agricultural productivity, *Amritpani*, Bio-enhancer, Organic farming, Sustainable agriculture.

Over the years, the world has experienced tremendous increase in population. It has caused both increase in food demand and reduction in agricultural land area. Even, India, being an agriculture dominated country, has got shaken up by the urge of food from the burgeoning population. In earlier days, agriculture was practiced using organic inputs and as the population was less during that time, food produced organically was sufficient to meet the demand of the population. With gradual increase of population and shrinkage of agricultural land area, organic agriculture became insufficient to ensure food security of the nation (Biswas and Das, 2022). To relieve the nation from the clutches of food scarcity, green revolution came in picture in mid 60s, which not only opened the path for intensive agriculture but also ensured jump in productivity levels to meet the food demand of the country. Green revolution introduced the use of chemicals (fertilizer and pesticides) in agriculture, which in short run, has become impressive in increasing the crop yield, but in long run, acted as slow poison towards destruction of the environmental safety. From 1990 onwards, green revolution has lost its charm due to unscientific and injudicious uses of chemical based agriculture and India has experienced set back in agricultural production (Biswas, 2020). Reasons reveals that in intensive agriculture, application of chemicals is a common practice to increase crop yield. Continuous use of chemical fertilizers and pesticides unscientifically in excessive amounts may lead to degradation of soil health in a long run. Beside depleting soil fertility, chemical agriculture reduces activity and number of beneficial microorganisms in the soil as well as hampers soil physical properties. Build-up of soil salinity, destruction of soil aggregate stability, fluctuation of soil pH, low water holding capacity *etc*. are some common phenomena observed in intensive agriculture (Sharma *et al*., 2021). Nutritional deficiency in soil directly results in poor quality of the produce along with low yield. Therefore, in order to conserve the health of the environment and to achieve sustainable agricultural production, organic agriculture is again receiving attention as researchers are trying to formulate various technological interventions to increase the production in organic agriculture.

Organic farming is a holistic production management system which promotes and enhances health of agro-ecosystem including bio-diversity, biological cycle and soil biological health. It completely avoids the use of synthetic

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fertilizers, pesticides, growth regulators and livestock feed additives and thereby, ensures environmental safety. Practicing organic farming ensures improvement of soil health which directly reflects on crop yield. Organic agriculture relies on use of green manures, crop rotations, crop residues, organic manures, biofertilizers, botanical pesticides or non-chemical options. Besides, organic agriculture utilizes various livestock based liquid organic formulations like *Panchagavya*, *Beejamrita*, *Sanjibani, Jeevamrita, Amritpani etc*. which are commonly known as bio-enhancers, for enhancing crop production. Bio-enhancers are prepared from active fermentation of plant and animal residues for a certain time period (Ram *et al*., 2018). They are rich in microorganisms, macro and micronutrients, plant growth promoting hormones, enzymes, vitamins and bio-pesticidal properties. Among these ITK (indegeneous technical knowledge) formulations, *Amritpani* is gaining popularity in recent days due to its beneficial role in crop growth and yield by improving soil physical, chemical and biological health as well as through providing bio-pesticidal properties.

Role of bio-enhancers

Use of bio-enhancers is a traditional practice in India (Ram *et al*., 2020). Bio-enhancers are involved in various forms of organic farming (Rishi Krishi, Biodynamic, Natural farming *etc*.) (Vaish *et al*., 2019). The quality of bio-enhancer depends on the raw materials used for its preparation (Solanki *et al*., 2015). Bio-enhancers are used to treat seed or seedlings, improving soil health and for accelerating the decomposition process during preparation of manures. They contain beneficial micro-organisms which when applied, multiply and performs soil enhancing activities. Besides, these micro-organisms pose bio-pesticidal properties (Ram *et al*., 2018). These altogether reduces the harmful impact of chemicals and improves crop yield in a sustainable manner. Presence of macro and micronutrients also enhance the soil fertility to support the crop growth. Solanki *et al.* (2015) reported increment of plant growth in terms of bigger leaf area, dense foliage, high number of branching and development of roots. Application of bio-enhancers improves soil structure, porosity and water holding capacity as well as nutrient uptake by the crop. They boost up immunity in plants and help plants to resist against pest and diseases through synthesis of various metabolites (organic acids, hydrogen peroxide, antibiotics *etc*.) by the micro-organisms. Among these bio-enhancers, *Amritpani* is one which is a cheap formulation used through treating seeds or seedling roots, foliar and soil applications for boosting the performance of many crops.

Amritpani preparation

Amritpani is known as elixir for dead soil. It contains wide range nutrients which not only improve the soil physical, chemical and biological health, but also stimulate plant growth, yield and quality. For preparation of *Amritpani*, cow dung, cow ghee, honey and water are mostly used. The quantity of these materials required for *Amritpani* preparation has been mentioned in Table 1. The average contents of nutrients present in *Amritpani* is 1.68% nitrogen, 0.33% phosphorus and 0.24% potassium (Vala and Chavda, 2021). However, nutrient contents of the organic formulation are highly variable depending on the quality of the raw materials used. Anandan *et al.* (2016) evaluated physio-chemical properties as well as microbial population of five organic formulations (*Panchagavya, Sanjivani, Amritpani, Jeevamrutha, Kunapajola*) which are shown in Table 2 and Fig 1, respectively. Their study confirmed that like the other organic formulations, *Amritpani* is also rich in primary, secondary as well as micro nutrients, growth promoting hormones and beneficial micro-organisms.

Amritpani can be prepared using the following steps:

- Firstly, fresh cow dung and honey or jaggery should be thoroughly mixed to make a creamy paste.
- Then, cow ghee is added to it and mixed properly.
- The mixture is finally poured into 200 litres of water and stirred well for achieving uniform suspension. Mouth of the container should be covered with cloth.
- Within 7-10 days, *Amritpani* is ready to be used.
- Regularly, it should be stirred 2-3 times clockwise and anti-clockwise to prevent precipitation of suspended materials.

Sometimes, *Amritpani* consists of some bio-pesticidal properties along with improving soil health and thereby, improves crop growth and yield. In this regard, it is noted that preparation of *Amritpani* is very often modified as per the its use. Raskar *et al*. (2014) have suggested modified *Amritpani* preparation which requires 1 kg fresh cow dung, 1 litre fresh cow urine, 1 kg green neem leaves, 1 kg pulse flour, 100 g jaggery and 10 litres water. Cow dung contains various nutrients. Pulse flour and jaggery are used as fermenting agents, while cow urine and neem leaves are used to add pesticidal properties in the end product (*Amritpani*). The preparation process of modified *Amritpani* has been mentioned here under.

In a plastic bucket of 15 litres capacity, all the ingredients are to mixed thoroughly with wooden stick and mouth of bucket should be covered with lid and kept under shade for 7-10 days. Every day, at 2 intervals, materials should be stirred clockwise and anticlockwise. After 10 days, *Amritpani* should be filtered through cotton cloth before use.

Application of *Amritpani*

Amritpani can be applied directly into soil or it can be applied as foliar spray (Deshpandey, 2003). It can also be used as a seed treatment material. For direct soil application, 200

Table 1: Ingredients/materials used for *Amritpani* preparation (Shekh *et al*., 2018).

Materials required	Quantity
Fresh cow dung of Indian breed	10 kg
Cow ghee	250 g
Honey or Jaggery	500 g
Water	200 litres

Table 2: Physio-chemical properties of different organic formulations including *Amritpani*.

Parameters	*Panchagavya*	*Sanjibani*	*Amritpani*	*Jeevamrutha*	*Kunapjola*
pH	6.3	6.7	6.8	7.0	9.1
EC (ds/m)	8.5	9.6	7.5	7.9	10.2
N (ppm)	423.3	401.9	445.3	320.4	246.5
P (ppm)	198.6	173.6	187.6	177.1	131.1
K (ppm)	309.9	255.5	223.2	132.4	168.3
Ca (ppm)	0.14	0.11	0.18	0.09	0.20
Mg (ppm)	0.34	0.43	0.41	0.21	0.46
Fe (ppm)	120.7	110.7	100.3	98.3	102.1
Zn (ppm)	34.6	29.0	35.2	13.9	20.1
OC (%)	2.57	2.38	2.34	1.38	3.02
IAA (ppm)	7.1	6.2	7.5	6.4	5.8
GA_3 (ppm)	4.6	3.8	3.8	3.2	5.1

Source: Anandan *et al.* (2016).

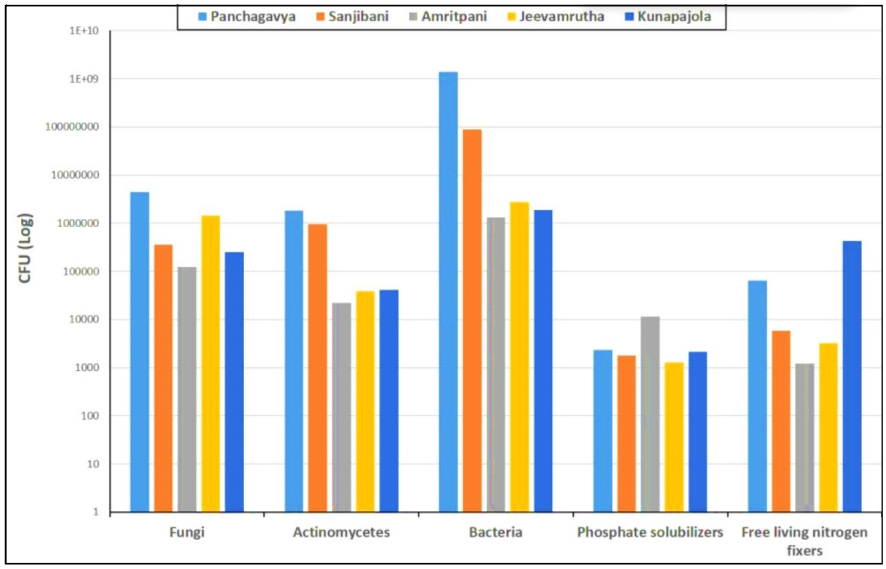


Fig 1: Distribution of micro-organisms in different organic formulations including *Amritpani* (Anandan *et al.*, 2016).

litres of *Amritpani* is recommended for one-acre area which can applied directly or with surface irrigation methods. If required, second application can be made 30 days after first one in between the two plant rows directly to soil or with irrigation water. In many places, before application of *Amritpani*, virgin soil (15 kg/acre) collected from the rhizosphere zone of banyan tree is applied over the field as the collected soil is considered to contain high microbial population (Solanki *et al*., 2015). For seed treatment, seeds or planting materials should be soaked in *Amritpani* and dried under shade prior to sowing/planting. If the seed contains hard seed coat, before treating with *Amritpani*, it should be soaked in cow urine for 12 hours. For vegetables, root dipping in *Amritpani* can be done prior to transplanting of seedlings.

Benefits of *Amritpani* use in agriculture

Amritpani improves crop growth, yield and quality. It can be applied to the crop field solely or in combination with other organic nutrient formulations. Sakubai *et al*. (2014) used mycorrhiza and organic formulations *viz*., *Panchagavya* and *Amritpani* to buckwheat field and reported that *Amritpani* improved crop response when applied with VAM and *Panchagavya* (Table 3). The favourable response of crops to *Amritpani* is speculated due to its high nutritional properties and positive influence on soil micro-flora and fauna (Yadav and Mowade, 2004).

Apart from improving the nutritional status of the soil, *Amritpani* is known to have bio-pesticidal properties. Raskar and Wani (2014) in their study, noticed that application of *Amritpani* reduced pest problems in rice and thereby, improved growth and yield of the crop (Table 3). Ram *et al*. (2020) assessed the anti-microbial properties of *Amritpani, cow pat pit, Jeevamrita* and *panchagavya* against pathogens *Colletotrichum gloeosporioides, Fusarium solani* and *Aspergillus fumigatus* through plate assay method and reported that the growth of these pathogens under the bio-enhancers were relatively less or nil as compared to the

Table 3: Impact of *Amritpani* application on performance of different crops.

Crop	Application	Impact	Reference
Brinjal	Basal application of	Earliest flowering	
Tomato	*Amritpani* by mixing with compost	High number of flowers and less flower drop	Bindumathi (2008)
Cape gooseberry	*Amritpani* @ 5%	Improvement of fruit yield	Dwivedi *et al*. (2014)
Soybean	FYM @ 5 t/ha+*Amritpani*+PSB+rhizobium		More *et al*. (2008)
Buckwheat	VAM+*Panchagavya*+*Amritpani* @ 3% drench and spray	High growth and yield attributes	Sakubai *et al*. (2014)
Rice	*Amritpani* application	Improvement of root length, shoot length, fresh and dry weight of plants	Anandan *et al.* (2016)
		Reduction of pest infestations	Raskar and Wani (2014)

Table 4: Growth of pathogens against various organic formulations and their comparisons with control.

Treatments	*Colletotricum gloeosporioides* colony size (mm)	*Fusarium solani* colony size (mm)	*Aspergillus fumigatus* colony size (mm)
Control	40	8	10
Panchagavya	20	0	0
Cow pat pit	10	0	0
Jeevamrita	11	0	0
Amritpani	12	0	0

Source: Ram *et al.* (2020).

control (Table 4). In resonance with earlier findings by Swain *et al*. (2008) and Waziri and Suleiman (2013), they concluded that presence of cow dung containing various beneficial microorganisms might be the reason for controlling many diseases of crops through bio-enhancers.

Amritpani is a good source of beneficial microorganisms which multiply and decompose organic wastes after application to the soil (Anandan *et al*., 2016). Kate and Pathe (2009) in their study noticed that in *Amritpani* formulation, there were 1.03×10^6, 1.12×10^5 and < 30 colonies (count/ml) of bacteria, fungi and actinomycetes, respectively. Ram *et al.* (2018) evaluated microbial population in *Amritpani* and observed that there was steady increase of bacterial population up to 9th day from start of *Amritpani* preparation. Fungi, *Azotobacter* and *Azospirillum* numbers declined as the days progressed. However, populations of *Pseudomonas*, *Rhizobium*, P-solubilizing microorganisms gradually increased. They, further, observed that actinomycetes population decreased from the start of *Amritpani* preparation up to 6th day and thereafter, enhanced up to 9th day. Ram *et al.* (2018) also compared microbial population of *Amritpani* with other organic formulations such as *Panchagavya*, *Jeevamrita*, biodynamic liquid pesticides and observed higher populations of actinomycetes, gram negative bacteria and P-solubilizing microorganisms in *Amritpani* over others.

CONCLUSION

Various research works confirmed that bio-enhancer *Amritpani* is rich in different types of nutrients, beneficial micro-organisms, growth promoting hormones, enzymes, vitamins, bio-pesticidal compounds *etc*. and therefore, has immense potential in organic farming to achieve sustainable quantitative and qualitative agricultural production. Encouragement of soil microbial activity through *Amritpani* is a vital factor of success of organic farming in many areas. Still, various reasons behind its efficacy or quality attributes lack scientific proof. As most the ITKs are based on the beliefs rather than scientific testing, adequate research is required to confirm the efficacy of the formulations. It has been also observed that research works on *Amritpani* is relatively scanty as compared to other such bio-enhancers/organic formulations. Therefore, research trials in various locations, agro-climatic situations, on various crops can, further, confirm the performance of *Amritpani* in commercial agricultural production. Besides, there is a need to identify the most suitable form of *Amritpani* from its various modifications available in different locations. Use of raw materials and their quantities, time, method and dose of application of end product should also be properly standardised through adequate research works. Finally, strong extension works are required to disseminate knowledge about *Amritpani* to new areas through awareness campaign, demonstration *etc*. for better introduction and use of this bio-enhancer which not only can improve the agricultural production but also can ensure environmental safety to a high extent.

Conflict of interest

All authors declare that they have no conflict of interest.

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