

Crop Production and Protection Applying ITK-Based Organic Formulations For a Sustainable Agriculture

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Abstract

For many centuries, farmers have relied on Indigenous Technical Knowledge (ITK), which they have acquired via observation and experience. ITK-based organic formulations, which are created from easily available organic materials and have demonstrated potential in boosting plant growth and managing pests and diseases, have garnered more attention recently for use in crop production. This work aims to give a thorough overview of the many forms, compositions, and applications of ITK-based organic formulations in crop production as they are now understood. Along with offering recommendations for additional study in this area, it also looks at the advantages and difficulties of adopting ITK-based organic forms.

Key words : Indigenous Technical Knowledge (ITK), Panchagavya, Jeevamrut, Beejamrita, Dashparni Ark.

ITK is referred to as "all of the knowledge and practices which are based on people's accumulated experiences in coping with circumstances and issues in all facets of life and that are distinctive to a given culture." Local knowledge that is exclusive to specific communities or cultures is referred to as indigenous technical knowledge. The special features of indigenous technical knowledge are (World Bank, 1998) as follows. It is „local“, as it is rooted in particular community and situated within broader cultural traditions; It is a set of experiences generated by people living in those communities. Therefore, separating the technical from the nontechnical, the rational from the non-rational could be problematic. There is a potential that indigenous technological knowledge will be dislocated when it is moved. Since it is tacit information, it is difficult to change. Some of its characteristics might be lost as a result of standardization. It is spread verbally or by demonstration and imitation. It is information gained via experience

rather than theory. Experience and trial and error, tested in the rigorous laboratory of survival of local communities constantly reinforce indigenous knowledge. It is learned through repetition, which is a defining characteristic of tradition even when new knowledge is added. Repetition aids are the retention and reinforcement of indigenous technical knowledge. Constantly changing, being produced as well as reproduced discovered as well as lost; through it is often perceived by external observers as being somewhat static.

Farmers in our country frequently use chemical farming. With this approach, crops are grown using chemical insecticides and fertilizers. Farmers were forced to use this strategy in order to increase agricultural output because of the growing population and need for food. However, there are negative effects of chemical farming, including increased greenhouse gas emissions, biodiversity loss, and soil deterioration. Overuse of synthetic pesticides and fertilizers causes the soil to become severely depleted of nutrients, which eventually lowers

land production. Overuse of synthetic fertilizers and pesticides results in significant nutrient exhaustion in the soil, leading to decreased productivity of land over time. These chemicals also lead to water pollution as they leach into nearby rivers or groundwater systems through runoff during rainfall events. Chemical farming practices may increase crop yields initially but fail to account for the long-term effects that can harm not only the environment but also human health. Overreliance on chemical inputs contributes significantly to climate change-induced events such as droughts or floods that further degrade soils' fertility levels (Thorat and More, 2022). The rise in health consciousness amongst the populace in recent times has led to a surge of interest towards sustainability within the Indian agricultural sector. Organic farming has gained popularity, with consumers increasingly demanding sustainably produced food. However, organic farmers face significant challenges when it comes to crop protection against pests and diseases. ITK-based organic formulations have become a successful means of advancing sustainable agriculture in response to this requirement. Indigenous Traditional information, or ITK for short, is the information that indigenous communities have accumulated through experience and observation over many generations. The use of ITK based organic foliar formulations in crop production has shown great potential in improving plant health and productivity while reducing reliance on conventional chemical fertilizers that can harm both human health and the environment (Priya *et al.*, 2019; Biswas and Das, 2022). This approach represents a significant departure from traditional farming methods that rely heavily on synthetic inputs such as pesticides and chemical fertilizers. By adopting this innovative method, farmers can reduce their environmental footprint while also creating healthier crops with higher yields.

Composition of ITK-based Organic Formulations : Depending on the specific formulation and the availability of materials in that region, different substances are employed in ITK-based organic formulations. While some formulations maintain the basic ingredients, farmers may also add other materials. For instance, panchagavya uses cow dung, cow urine, curd, milk and ghee as main ingredients; however, Tamil Nadu farmers tend to include coconut water and bananas to their mixture. Similarly, farmers from Maharashtra and Uttar Pradesh add jaggery and herbal extracts such as neem, amla and brahmi to their formulations (Gawade *et al.*, 2007).

Effect of Organic Formulations on Growth and Yield : Panchagavya A traditional Indian treatment that has gained popularity as an efficient organic fertilizer is panchagavya, which is prepared from cow dung, urine, milk, curd, and ghee. Panchagavya has been used as a natural plant growth enhancer since the Vedic era, when farmers employed it widely to increase crop productivity and improve soil health. Along with a variety of micronutrients, this special blend includes vital elements like calcium (Ca), magnesium (Mg), sulfur (S), potassium (K), phosphorus (P), and nitrogen (N). Because of its many nutritional contributions and soil conditioning qualities, Panchagavya has been demonstrated to improve crop development and production. A study conducted by (Kumar and Singh, 2020) discovered that panchagavya can boost productivity by promoting the growth of roots, stems, branches, and leaves. The researchers also observed an improvement in various associated and other quality parameters which ultimately led to better overall yield characteristics. In their study (Shekh *et al.*, 2018) found that using 5 tons per hectare of farmyard manure resulted in increased yields of both pods and haulms. Additionally, a foliar spray containing 3% panchagavya was also

effective in increasing yields for summer ground nut. According to (Swarnam *et al.*, 2016) findings, the foliar application of 3% Panchagavya resulted in an overall increase in plant height and number of branches across all stages of plant growth. Additionally, a considerable rise was observed in the average fruit yield, with an output of 824.7g per plant compared to the control group's yield of 330.1g per plant. As per the study carried out by (Sudhakar *et al.*, 2011), It has been discovered that foliar spraying panchagavya has a significant impact on maize crop productivity. Applying the full recommended dose of fertilizers (RDF) plus three sprays of 3% Panchagavya at various periods of the crop's growth (20, 40, and 60 days after sowing) produced the best maize yield. In a field experiment conducted by Rakesh *et al.* (2017), the impact of Panchagavya on the growth and yield of *Abelmoschus esculentus* cv. Arka Anamika was investigated. The outcomes revealed that the application of Panchagavya positively impacted crop growth and yield through its various nutrient contributions and soil conditioning properties. Specifically citing how it remedied modern chemical agriculture issues due to being an organic farming remedy for curing ills associated with modern chemical agriculture. Patel *et al.*, (2013) supported these findings by concluding that panchagavya had a significant influence on plant height along with stem girth diameter increases along improved vegetative traits such as increases leaf area index leading to more effective photosynthetic activity where there was higher oil-content production consequently resulting in better yields.

Jeevamrut : An organic solution called jeevamrut is created by combining urine and cow dung with additional ingredients like gram flour and jaggery. These ingredients are combined and left to ferment for a number of days to make it. The resulting fluid contains beneficial microbes such bacteria, fungus, and protozoa that fix

nitrogen and dissolve P. By breaking down organic matter into nutrients that plants may readily absorb, these microbes significantly improve the health of the soil. Jeevamrut has an acidic property with a pH value of 4.93 and serves as an excellent source of both macro and micro nutrients including N (1.97%), P (0.172%), K (0.29%), Mn (47 ppm) and Cu (50 ppm). (Kumar *et al.*, 2021). The application of Jeevamrut has demonstrated remarkable advantages in enhancing the development and production of crops. According to Rathore *et al.* (2023) the use of fermented liquid organic nutrient formulations (FLONFs) such as jeevamrut can significantly contribute to the soil dehydrogenase enzyme activity, phosphatase enzyme activity, and urease enzyme activity (25.5 moles PNP h⁻¹ g⁻¹ soil) leading to higher yields and soil longevity in crops like brinjal. A study was performed by Patel *et al.* (2021) which demonstrated that the utilization of jeevamrut at a quantity of 500 liters ha⁻¹ in conjunction with irrigation at 30 and 45 days after sowing resulted in noteworthy enhancements to both growth indicators and yield attributes for summer pearl millet. While the straw yield reached a record high of 7567 kg ha⁻¹, the grain yield rose to 4393 kg ha⁻¹. Furthermore, by enhancing soil health and boosting crop nutrient availability, jeevamrut can improve plant development and yield, according to Somdutt *et al.* (2019). This implies that using this organic fertilizer can be a useful strategy to increase crop yields without using dangerous chemicals. Furthermore, Dhomne *et al.*, (2021), conducted a field experiment with pigeonpea where they applied jeevamrut through soil application at different stages of growth. The researchers discovered that the utilization of soil application at a rate of 500 L per hectare, in addition to plant growth regulators, led to notable enhancements in various growth parameters such as plant height, leaf area per plant, total dry matter production per plant, and

yield/yield attributes. The findings show that jeevamrut has a lot of potential as a substitute for artificial fertilizers because it has several advantages, including improving soil health and supplying nutrients for the best crop growth.

Beejamrita : Beejamrita has been an important part of farmers' traditional practices since the beginning of time. This organic blend of soil, water, lime, cow dung, and cow urine helps protect plants from dangerous diseases in the seeds and soil while also promoting plant growth. Cow dung (5 kg) is used to make beejamrita. It is wrapped in linen and let to soak overnight in a bucket with 50 liters of water. The feces in the cloth is compressed and repeatedly dipped in the water the next day. Additionally, 5 liters of cow urine, a small amount of soil, and 50g of calcium chloride are included in this solution. Several studies have investigated the effects of Beejamruta on crop yield and growth. Beejamrita solution contains various advantageous microorganisms including nitrogen-fixing bacteria, phosphorus-solubilizing agents, actinomycetes, and fungi (Devakumar *et al.*, 2014). Dhomne *et al.* (2021) found that Beejamrita can increase the nutrient availability in soil by promoting microbial activity. This increased microbial activity leads to improved nitrogen fixation and phosphate solubilization which ultimately enhances plant growth. Similarly, Nirmale and Ulape (2020) found that "Beejamrita" contains beneficial microorganisms that enhance nitrogen fixing capabilities while also protecting plants from harmful pathogens present in both soil and seeds. Additionally, it was demonstrated in this research that the application of Beejamrita enhances the accessibility of vital nutrients within the soil, resulting in a notable enhancement in crop yield. Shyamsunder and Menon (2021) further supported these findings by showing how Beejamrita improves soil health through enhancing microbiological activities leading to

better nutrient cycling resulting in enhanced plant growth capacity.

Strategies for integration of ITKs into scientific research process : Nowadays, it is generally acknowledged by agricultural experts worldwide that reevaluating local technical knowledge is a crucial step in implementing new agricultural technology. It is acknowledged that before developing and distributing any new technology, farmers' expertise must be considered. This perspective is predicated on the idea that farmers possess a lot of information about their own surroundings and have honed specialized abilities to maximize their utilization. Documentation, Validation, Refinement, and Integration are the four crucial processes in incorporating ITKs into the technology development, reevaluation, and adaption process.

Dashparni Ark : Made from fermented extracts of 10 medicinal herbs, Dashparni Ark is a natural, organic pest repellent and plant tonic. It is used in nurseries, farms, and home gardens to increase plant immunity, enhance growth, and ward off pests. After diluting it with water, it can be sprayed over foliage. Known for its ability to repel pests and promote growth, Dashparni Ark is a traditional, organic solution produced from fermented extracts of 10 medicinal herbs. It acts as both a plant tonic and a natural pesticide, boosting plant immunity and deterring pests. It's typically diluted in water and applied as a foliage spray on leaves. It's a chemical-free and organic solution for pest control, promoting healthy plant growth. (Kasarkar *et al.*, 2021)

In most of the states leaves of Neem (*Azadirachta indica*), Nirgudi (*Vitex negundo*) Karanj (*Pongamia pinnata*) Supla (*Mundulea sericea*) Tun (*Toona ciliata*), Teak (*Tectona grandis*) Young leaves of Komal (*Koelzella apadularia*) Bhang (*Cannabis sativa*) and

MethoDodi (*Leptadenia reticulata*) have been used. In addition wood ash of some plants such as Babhul (*Acacia nilotica*), Suru (*Casurina equisetifolia*) Mango (*Mangifera indica*), Tamarand (*Tamarindus indica*) are used. Some places powdered rhizome of sweet flag (*Acorus calamus*) or turmeric (*Curcuma longa*) is used to protect crops from pest attack (Kulkarni and Kumbhojkar, 1996). Mahadeokoli tribe from Maharashtra uses leaves of Kulith (*Dolicho suniflorus*) and Sag (*Tectona grandis*) as preservatives for seed storage (Kulkarni and Kumbhojkar, 2003). In Tamil Nadu, *Ipomoea fistulosa* is kept with paddy and sorghum grains to seed off pest attacks. Tribal pesticides are an efficient way to control major store grain pests like rice weevil, pulse beetle, red flour beetle, and rice moth. Salt powder, kitchen ash, vitex leaves, cow dung ash, turmeric powder, and a blend of neem leaves, vitex leaves, and turmeric powder were all used in the successful treatment.

Conclusion

By reducing the negative environmental effects of crop production and promoting sustainable agricultural practices, ITKbased organic formulations have the potential to make significant improvements to sustainable crop production. Nevertheless, further research is needed to confirm their safety and effectiveness as well as to identify the best formulations for certain crops and pests or illness. To ensure the efficacy of these formulations, standardization in their development and application is also required. Generally speaking, ITKbased organic formulations present a promising approach to crop disease and insect management while promoting environmentally friendly farming techniques.

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