

कृषि अपशिष्ट

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संवर्धित मृदा स्वास्थ्य हेतु कृषि-में मूल्यस्थिरीकरण अपशिष्ट का उन्नत फास्फोरस-जिंक उर्वरकों में मूल्यस्थिरीकरण

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गन्ना उद्योग का कीचड़

सारांश

मृदा स्वास्थ्य एवं पोषक तत्व प्रबंधन सतत कृषि के महत्वपूर्ण घटक हैं। मिट्टी एक जीवंत वातावरण है जो फसल उत्पादन की नींव के रूप में कार्य करती है। फसल के लिए पोषक तत्वों की उपलब्धता पोषक तत्वों की उपलब्धता से नियंत्रित होती है। जिंक और फास्फोरस उर्वरक पौधों के स्वास्थ्य में महत्वपूर्ण भूमिका निभाते हैं। इन पोषक तत्वों की उपलब्धता मुख्य रूप से मिट्टी की सूक्ष्मजीव गतिविधि पर निर्भर करती है। इथेनॉल आसवन द्वारा जैव-मिथेनेशन प्रक्रिया में भुक्त धोषण से उत्पादित जैव-आपंक का निपटान उद्योगों के लिए एक बड़ी समस्या है। नए फॉस्फोरस और जिंक उर्वरक निर्माण के उत्पादन के लिए बायोमिथेनेशन के बाद के जैव आपंक के उपयोग के लिए प्रौद्योगिकी विकसित की गई है और फसलों द्वारा अनुप्रयुक्त P के उपयोग में सुधार किया गया है और सफलतापूर्वक व्यावसायीकरण किया गया है। मृदा जैव कार्बन को मृदा स्वास्थ्य का संकेतक तत्व कहा जाता है। जैविक कार्बन की मात्रा और फसल की उपज के बीच सकारात्मक संबंध देखा गया है। किसानों को मिट्टी में कार्बन की मात्रा के बारे में जागरूक करने के लिए क्षेत्र परीक्षण (फील्ड टेस्टिंग) किट विकसित की गई है। यह किट मिट्टी की उर्वरता का तत्काल परिणाम दर्शाता है। इस अध्याय में फॉस्फेट और जस्ता उर्वरक तथा मिट्टी के जैविक कार्बन का पता लगाने वाले उपकरण के महत्व का वर्णन किया गया है।

Agricultural Waste

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Valorization of Agricultural Waste into Improved Phosphorus-Zinc Fertilizers for Enhanced Soil Health

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Sugarcane industry sludge

ABSTRACT

Soil health and nutrient management are critical components of sustainable agriculture. The soil is a living environment that serves as the foundation for crop production. Availability of the nutrient to the crop is governed by availability of the nutrients. Zinc and Phosphorus fertilizers plays significant role in plant health. Availability of these nutrient is primarily depending on the soil microbial activity.

The disposal of bio-sludge produced in the bio-methanation process of spent wash generated from ethanol distilleries is a big problem for the industries. Technology for utilization of the post-biomethanation biosludge for producing new Phosphorus and zinc fertilizer formulation and improve utilization of the applied P by crops has been developed and successfully commercialized. Soil organic carbon is called as indicator element of soil health. Positive correlation has been observed between amount of organic carbon and crop yield. In order to make farmers aware about the carbon content in the soil, field testing kit has been developed. This kit gives the instant idea of soil fertility. Importance of phosphate and zinc fertilizer and soil organic carbon detection kit has been narrated in this chapter.

KEYWORDS: Bio-sludge, Soil, Fertilizer

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Introduction

Phosphorous; being an essential element is indispensable in crop production. Phosphorus deficiency is wide spread many parts of the globe including super lands of Asia. Costly phosphatic fertilizers like single superphosphate (SSP, 16% P₂O₅), diammonium phosphate (DAP, 46% P₂O₅) and complex fertilizers (NPK containing 32% P₂O₅) need to be used by the farmers. The estimated demand of phosphatic fertilizers in 2022-2023 is 8.3 million MT of SSP, 11.5 million MT of DAP and 10 million MT of complex fertilizers. The benefit of application of phosphatic fertilizers is limited by fixation of added fertilizer P in soils which reduces the utilization of added P by the crops. This leads to lower benefit: cost ratio. Phosphatic fertilizers and soil and crop management strategies ensuring better utilization of P by the crop is a cherished goal to economize cost of crop production and maximize the returns in terms of kg marketable produce per kg of P applied through fertilizer. Earlier scientific investigations have hinted that use of adequate organic manures like farmyard manure etc. may improve the utilization of fertilizer P in agriculture as these manures render soluble organic acids to interfere with chemical transformation of soluble fertilizer P into relatively insoluble P compounds and also compete with P for irreversible ligand exchange sorption in soils[1,2].

Among organic manures, FYM is the most common source however, owing to non-scientific way it is produced in the villages it is not only poor in terms of nutrient content but also the content of water soluble organic matter. Moreover, the availability of adequate organic manures even in the rural belts is becoming problematic due to increasing mechanization in agriculture. The scope of green manuring is limited by farmer's serious concern for the loss of crop season which may generate extra income to the farmer. Among other available substitutes of FYM, biosludge produced at post-menthanation step of molasses based distilleries is very rich source of water soluble organic matter and could be used. The molasses based distilleries bear extra cost for its safe disposal. The main objective of this technology was to improve SSP fertilizer

product which could result in better use efficiency of applied fertilizer P to the current crop and ensures better utilization of residual fertilizer P to the subsequent crop as well so that the expenditure on P fertilizers can be reduced without sacrificing crop yields and P uptake. The formulation ensures better cost benefit ratio in crop production and also help the distillery to recover a part of the cost incurred in biomethanation step of spent wash generated by the distilleries.

Importance of Zinc

Zinc deficiency in soil is widespread throughout the world, especially in rice croplands of Asia and in soil order of Entisols, Aridisols, Alfisols, Mollisols and Vertisols. A Scrutiny of 1.45 lakh soil samples from different agro-ecological zones comprising different soil types of India in recent years also indicated that 45 per cent mean deficiency of Zn and 49 percent based on compilation of data of 2.52 lakh soil samples from 20 states.

Crops require only a small amount of Zn for their normal growth. A normal crop of rice yielding 7.0 t ha⁻¹ removes about 250 g Zn while soil application rates are much higher i.e. 50-60 kg zinc sulfate per hectare as the fertilizer use efficiency of Zn often remain less than 5 per cent owing to large scale fixation of Zn in soils. In Maize-Wheat-Maize cropping sequence, the percent utilization of soil applied Zn had been reported to be 0.22, 0.38 and 0.04 per cent only. Availability of fertilizer Zn to subsequent crops is also poor and keeps on declining with time. In order to economize crop production on sustainable basis, research efforts are warranted to enhance the use efficiency of Zn fertilizer on such soils. The integrated use of organic and inorganic fertilizers has been found promising to maintain higher productivity and to provide maximum stability in terms of crop yield. Bulky organic manure when applied at a rate of 5 to 10 t/ha in rice-wheat cropping system tends to build up the organic matter in wet tropics and could reduce Zn fertilizer dose to about 50 percent. The beneficial effect of organic manures had been attributed to the production of natural complexing agents forming soluble complex with zinc,

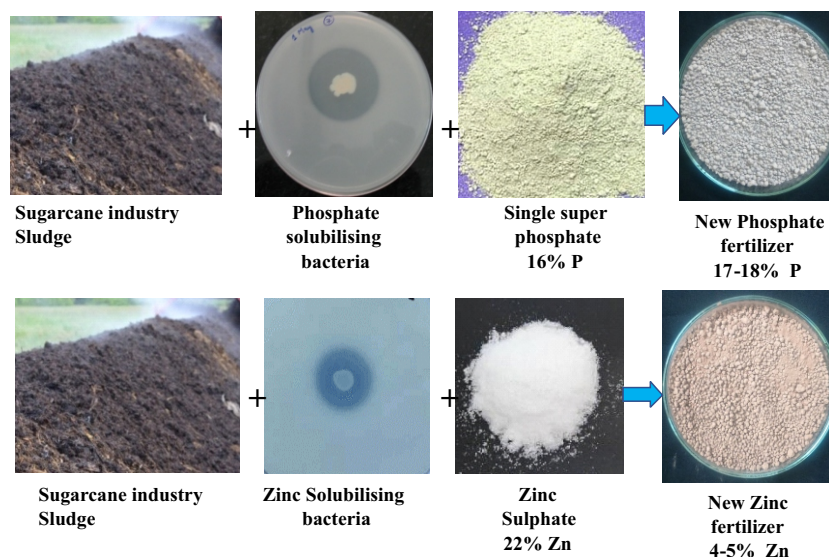


Fig.1,2: Phosphate and Zinc fertilizer formulation developed from biosludge.

which may be efficiently utilized by crops. However, despite the well-known benefits of organic manures, farmers in Asia often do not get adequate supply of FYM to reduce their chemical fertilizer requirement of Zn and other nutrients. In this invention, the process of making Zn formulation based on post-methanation bio-sludge from a molasses based distillery which has higher efficiency than conventional Zn fertilizer ($ZnSO_4 \cdot 7H_2O$) has been described.

The formulation ensures better cost benefit ratio in crop production and also help the distillery to recover a part of the cost incurred in biomethanation step of 'spentwash' generated by the distilleries.

Technology development and transfer to industries

Sugar industry biosludge was used for the development of the Phosphorus and Zinc enriched fertilizer and tested under field conditions (Fig.1,2). Both the formulations gave excellent performance under field condition for two successive crops.

Both the products are patented and developed as a technology[3,4] has been launched by the companies in the market. Fig.1,2 Phosphate and Zinc fertilizer formulation developed from biosludge[5,6].

Soil organic carbon detection kit

Organic carbon plays significant role in improvement of soil fertility. All the soil fertility parameters like crust formation, drainage, salt accumulation, alkalinity, beneficial microbes, pathogens are linked to organic carbon. If organic carbon is low all these parameters get affected badly. In order to maintain the soil fertility to achieve higher crop yield, improving soil organic carbon is a prerequisite. So periodical monitoring of soil organic carbon is as essential component of soil health management.

Importance of soil organic carbon

Understanding soil Organic Carbon helps farmer in the following ways:

- It increases growth soil microorganisms, which help in effectively maintaining elemental biogeochemical cycles, and makes these nutrients available to the plants in smooth manner.
- It is an excellent soil conditioner and provides a good infrastructure for soil microorganisms.



Fig.3: Different components of soil organic carbon detection kit.

- The porosity of soil increases due to addition of organic carbon, thereby increasing aeration and avoiding water stagnation and overall improving soil health.
- Soil organic carbon helps to stabilize soil particles, thus decreasing erosion. It also improves soil structure and workability, enhances aeration and water penetration, increases water-holding capacity and improves nutrients supply for growth of both plants and soil micro-organisms.

Existing methods of soil organic carbon analysis

Presently organic carbon is analysed by using acid titration and CHNS analyser. But there are limitations to analyze organic carbon of soil regularly due to specific reagents, skills and proper setup that are available only at approved laboratories. As these laboratories are in low number and farmers are unable to monitor soil organic carbon on regular basis. Ideally a quick, accurate and field test will be able to guide the farmer for this purpose[7,8,9].

Then how to know the organic carbon content of your soil?

Technology of soil organic carbon detection kit has been developed at BARC for instant analysis of soil organic carbon on the field (Fig.3).

This is very quick and reliable method of organic carbon estimation which helps farmers to decide the doses of fertilizers in proper time and their by helps for improvement of crop yield. Timely application of manures and fertilizers plays key role to increase the crop yield. The technology developed at BARC thus helps to the farmers as well as soil testing laboratories for improvement of soil health.

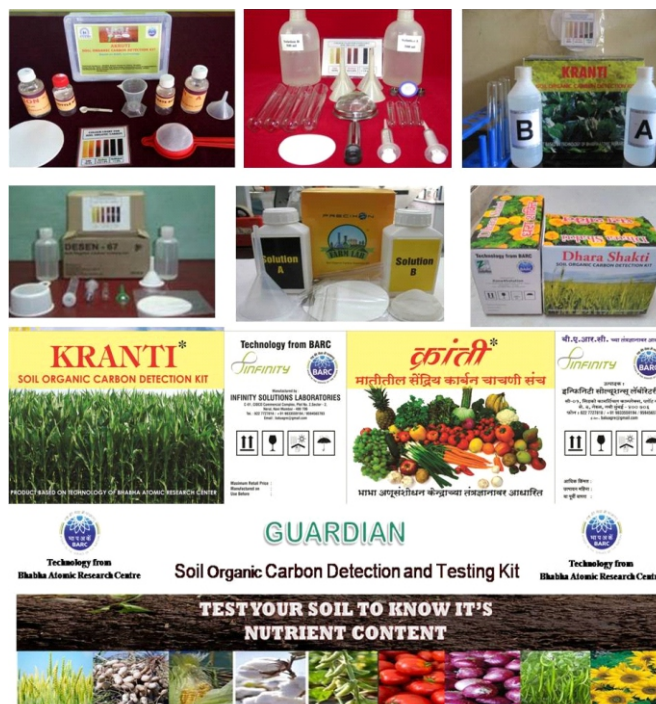


Fig.4: Different products based on the technology are available in the market.



Fig.5: Technology published as impact story on IAEA Webpage.

Farmers have become more aware about ill effects of chemical day by day and consumers are also demanding organic foods. This kit is an excellent tool to test the organic nature of soil. As this is quick method and all the farmers can perform it on the field, then farmer doesn't have to rely on other agencies for the results. Organic carbon detection kit has become an important tool in organic agriculture which is going to be agriculture of coming years.

Technology dissemination and spread

The technology has been included as a technology package for implementation of AKRUTI programme of DAE. Under this programme use of the technology has been used by farmers on large scale. Farmers are checking their soils regularly and found it very useful. Under this programme this technology has been transferred to about 40 institutes/individuals and they have come up with the products useful for the farmers.

Technology to commercialize the kit has also been transferred to several entrepreneurs and different products are available in the market (Fig.4). This technology has been also included for Start-up programme of Government of India. International Atomic Energy Agency (IAEA) has published the impact story of the technology on the webpage and appreciated the simplicity of the technology effectively solving the problem of the ordinary farmers (Fig.5).

Movement of water conservation and soil improvement in Maharashtra

Panni Foundation (an NGO by Mr Amir Khan) has started an initiative for conservation of water in Maharashtra state for last 4-5 years. Under this programme different villages are taking part for water conservation in the soil by building check dams, terrace and contour bunds, tree plantation etc. It is obvious that in order to conserve water, it is equally important to improve the organic carbon content of soil. So testing soils from entire state has been planned under this activity and thousands of samples are tested every year. Soil carbon improvement has become a movement in entire state and included in all the training programme of this purpose.

Conclusion

Agro waste generated during different processes creates problem either to the environment of other component of ecosystem. But these agro waste if utilized in proper way can be

effectively converted to useful fertilizer. Two technologies developed from sugar industry biosludge has shown the way towards sustainable management of waste for production of fertilizer that not only increases the yield but also improves the fertility of soil.

Fertility of the soil was again tested by using soil organic carbon detection kit developed for making farmers aware about the importance.

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