RECENT COMPOSTING TECHNIQUES: AN OVERVIEW

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Indian agriculture is one of the best agricultural models that perfectly merge science and philosophy for food production while nurturing the soil. Presently, the country ranks second in terms of global population and also holds significant position in livestock population. Modernization and intensification of agriculture had been inevitable to ensure the food security of 135 million human populations in the country. However, this increase in food grain production concomitantly increased quantity of crop residue. Unscientific and inappropriate management or burning of these residues eventually affected not only the quality of environment but also human and soil health. On the other hand, declining organic carbon content in majority of Indian soils is also another emerging threat for the sustainable food grain production.

To provide the scientific solution of these problems, several technologies have been developed to convert these crop residues into valuable organic fertilizers and improve soil health. Among the technologies for recycling of organic wastes, vermicomposting, phospho-sulpho-nitro composting, microbial enriched composting, rapo-composting, in-situ decomposition of crop residue are the important ones which can potentially convert 173.0 million metric tonnes of available crop residues and 35.7million metric tonnes of available cattle dung into organic manures to supplement around 5.68 million metric tonnes of NPK for crop production.

Vermicomposting is the method of converting organic wastes, crop residue, cattle dung etc into organic manure using earthworms. Epigeic earthworm species such as *Eisenia fetida, Eudrilus eugeniae* and *Perionyx excavatus* (Figure 1.) are suitable species to convert agro-wastes into vermicompost within a period of 90-110 days (depending upon the nature of agro-waste used). Use of vermicompost augments soil microbial activities and improves soil health. Though permanent pits are ideal for large scale vermicompost production, ready to use silpaulin vermibeds will be more economical for small and marginal farmers having one or two cattle (Figure 2.).

Figure 1. Earthworms used for vermicomposting

Figure 2. Vermicomposting in permanent pits

Phospho-sulpho-nitro (PSN) compost is value added compost produced from organic waste by enriching it with natural rock minerals. To prepare PSN compost, the crop residue and cattle dung is mixed in equal proportion along with rock phosphate, pyrite and urea at the rate of 5, 10,1 kg per quintal waste used. Here, the compost pit need to be covered with polythene sheet to maintain moisture and temperature required for the decomposition process. The compost gets ready within 110 to 120 days and the composting mixture need to be turned 2-3 times during the composting period at interval of 15 days. Compost produced using this method contains higher quantity of nitrogen, sulphur, iron and phosphorus compared to conventional composts (Figure 3.). To decrease the length of composting period, efficient lignocellulolytic microbial cultures can be added so that more quantity of crop residue can be recycled efficiently within shorter time.

Figure 3. Phospho-Sulpho-Nitro compost production

To further improve the quality of the prepared compost, agriculturally important beneficial microbes such as *Azotobacter,* phosphate solubilizers, potassium solubilizers or microbial biocontrol agents can be added at the end of composting. This microbial enriched compost improves soil health and nutrient use efficiency of the applied fertilizers besides improving soil biodiversity.

Rapo-composting is an innovative composting technique developed at ICAR-Indian Institute of Soil Science Bhopal. Here, a consortium of microbes capable of degrading lignocellulosic materials at higher temperature is mixed with the waste materials. This whole mixture then feed in to the rapo-composter machine (Figure 4) and temperature inside the machine is set at 55-60°C. To prepare one ton of compost, fresh biomass (1.5 tonnes), cattle dung (500kg), urea (11 kg), fungal culture mat (500g) and bacterial and actinobacterial culture (10 L) is required. The composting mixture need to be turned frequently to maintain uniform temperature and aeration. This method is effective for composting biodegradable city wastes from vegetable markets in a period of 30 to 45 days. The prepared compost contains 1.5 to 2.3% nitrogen and 0.5% phosphorus besides other macro and micro nutrients.

In-situ decomposition technique: In recent years, the practice of crop residue burning has emerged as a big problem in the country which destroys the nutrients contained in the residues besides killing the soil organisms. To combat this problem, the in-situ decomposition technique for rice wheat residue has been developed. Here, the decomposer culture is sprayed over the residue in field. To bring C:N ratio in favorable range of mineralization, 30 kg of urea can be spread in the field and entire material is incorporated using a rotovator. The field is irrigated immediately and left for decomposition for 30 days. During this period the residue will be decomposed and converted to organic manure in field itself (Figure 5 and 6).

Figure 5. Spraying microbial culture for In Situ decomposition of Rice residue

Figure 6. View of wheat in In Situ decomposition plot in farmers Fields

For the convenience of the farmers, the microbial cultures have also been formulated in gelatin capsules by various ICAR Institutes. Farmers can easily activate these cultures at their farm and apply in the field. Using this In-situ decomposition technique, the organic carbon and soil fertility gets improved.

Figure 4. Schematic representation of Rapo-Composting Technology

CONCLUSIONS

The soil is foundation for food security. Poor soil will produce nutrient deficient grain which will eventually produce unhealthy population. Key to this lies in addition of organic matter in soil through recycling of organic wastes using composting or any other green approaches. Several techniques and interventions are available for rapid recycling of organic matter. Depending upon local condition and need of farmers, they may opt for suitable techniques for adoption. The time is approaching when organic matter addition to soil is becoming compulsion and not an option, for sustainable soil health and food security.

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