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Organic Nutrient Management under Intensive Cropping Systems

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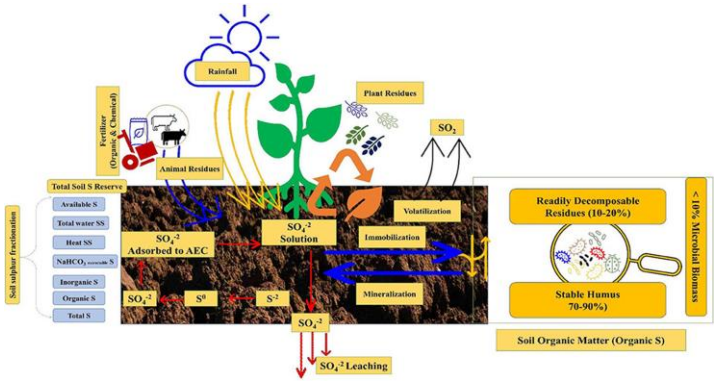
INTRODUCTION

Intensive cropping systems, characterized by multiple crops grown on the same land within a year, play a crucial role in enhancing food production and ensuring food security. These systems rely heavily on chemical fertilizers to meet the high nutrient demand of crops. Although chemical fertilizers have significantly increased crop yields, their indiscriminate and continuous use has led to serious issues such as soil degradation, nutrient mining, reduced microbial activity, groundwater contamination, and increased greenhouse gas emissions.

Organic Nutrient Management (ONM) focuses on maintaining soil fertility and productivity through the use of organic inputs and biological processes. In intensive cropping systems, ONM helps restore soil organic carbon, improve nutrient availability, enhance soil biological activity, and promote sustainable crop production. The growing concern for environmental protection, human health, and sustainable agriculture has renewed interest in organic nutrient management practices worldwide.



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2. Concept and Principles of Organic Nutrient Management

Organic Nutrient Management refers to the systematic use of organic sources of nutrients to supply essential plant nutrients, maintain soil fertility, and improve crop productivity without causing ecological imbalance.

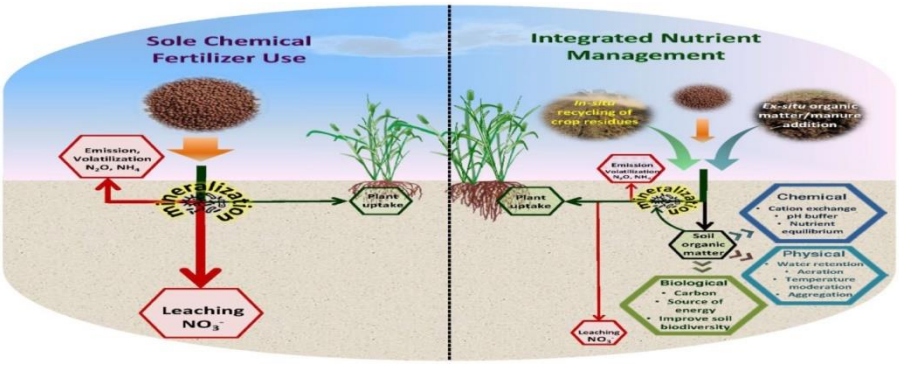
Key Principles of ONM

1. **Soil health enhancement:** Improving physical, chemical, and biological properties of soil.
2. **Nutrient recycling:** Efficient utilization of on-farm organic residues and wastes.
3. **Biological activity:** Encouraging soil microorganisms for nutrient transformation.
4. **Sustainability:** Ensuring long-term productivity without degrading natural resources.
5. **Environmental safety:** Minimizing pollution and chemical residues.

3. Organic Nutrient Sources Used in Intensive Cropping Systems

3.1 Farmyard Manure (FYM)

FYM is one of the most commonly used organic manures, consisting of decomposed cattle dung, urine, bedding materials, and farm wastes. It supplies macro- and micronutrients, improves soil structure, enhances water-holding capacity, and stimulates microbial activity. Regular application of FYM under intensive cropping improves soil organic carbon and sustains yield levels.



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3.2 Compost

Compost is produced through controlled decomposition of organic wastes such as crop residues, animal wastes, and household waste. It provides slow and steady nutrient release, enhances nutrient use efficiency, and improves soil aggregation. Compost application is particularly beneficial in intensive systems where nutrient depletion is rapid.

3.3 Green Manuring

Green manuring involves growing fast-growing leguminous crops (e.g., Sesbania, Sunhemp, Dhaincha) and incorporating them into the soil at the flowering stage. Green manures enrich soil nitrogen, improve soil structure, and enhance microbial activity. In rice–wheat and rice-based intensive systems, green manuring has shown significant benefits.

3.4 Crop Residue Management

Retention and incorporation of crop residues play a vital role in organic nutrient management. Crop residues contribute organic matter, recycle nutrients, reduce soil erosion, and improve soil moisture retention. Conservation agriculture practices promote residue recycling in intensive systems.

3.5 Biofertilizers

Biofertilizers contain beneficial microorganisms that enhance nutrient availability through biological processes.

- Nitrogen fixers: Rhizobium, Azotobacter, Azospirillum
- Phosphorus solubilizers: PSB, mycorrhiza
- Potassium mobilizers: KSB

Biofertilizers reduce dependence on chemical fertilizers and improve nutrient use efficiency.

3.6 Organic Amendments

Vermicompost, oil cakes, bone meal, poultry manure, and biochar are important organic amendments. These materials enrich soil fertility, improve microbial activity, and support intensive cropping systems.

4. Mechanisms of Nutrient Availability in ONM

Organic nutrient sources release nutrients slowly through microbial decomposition. Soil microorganisms mineralize organic matter into plant-available forms, ensuring a sustained nutrient supply. Organic acids produced during decomposition enhance nutrient solubility, particularly phosphorus and micronutrients. Improved soil structure and moisture retention further increase nutrient uptake efficiency.

5. Role of ONM in Soil Health Improvement

Organic nutrient management significantly improves soil health under intensive cropping systems by:

- Increasing soil organic carbon content
- Improving soil aggregation and porosity
- Enhancing water infiltration and retention
- Stimulating microbial biomass and enzymatic activity
- Reducing soil compaction and erosion

6. Productivity and Yield Stability

Several long-term experiments have demonstrated that organic nutrient management can maintain or even increase crop yields in intensive cropping systems. Although initial yields may be lower compared to chemical fertilizers, yields stabilize over time due to improved soil fertility and biological activity. Integration of organic inputs ensures yield sustainability and reduces yield fluctuations.

7. Environmental Benefits

Organic Nutrient Management (ONM) plays a significant role in promoting environmental sustainability in intensive cropping systems. It helps reduce nitrate leaching and groundwater pollution by supplying nutrients in slow-release forms, thereby improving nutrient use efficiency. ONM minimizes greenhouse gas emissions by lowering dependence on synthetic fertilizers and enhancing soil biological activity. The continuous addition of organic matter increases carbon sequestration, contributing to climate change mitigation. Furthermore, ONM improves biodiversity in agro-ecosystems by supporting beneficial soil microorganisms and fauna. Reduced use of chemical inputs also lowers chemical residues in food products, making ONM a vital component of climate-smart and eco-friendly agriculture.

8. Economic and Social Benefits

Organic nutrient management reduces input costs by utilizing locally available organic resources. It promotes self-reliance among farmers and generates employment in composting, vermicomposting, and biofertilizer production. Improved soil health ensures long-term profitability and livelihood security for farmers.

9. Constraints in Adoption of ONM

Despite its benefits, adoption of organic nutrient management faces several challenges:

- Limited availability of organic inputs
- Bulky nature and transportation issues
- Slow nutrient release compared to chemical fertilizers
- Lack of awareness and technical knowledge
- Requirement of skilled management

10. Future Prospects and Strategies

Future prospects of Organic Nutrient Management (ONM) under intensive cropping systems depend on technological integration, research advancement, and policy support. Integration of ONM with precision agriculture tools such as soil sensors, GPS-based mapping, and decision-support systems can optimize nutrient application and improve efficiency. Development of enriched composts and fortified organic inputs will help meet crop nutrient demands more effectively. Capacity building through farmer training programs is essential to enhance awareness and technical skills. Supportive government policies and financial incentives can accelerate adoption. Additionally, crop-specific organic nutrient schedules backed by research will further improve productivity and sustainability.

CONCLUSION

Organic Nutrient Management under intensive cropping systems is a sustainable and environmentally friendly approach to maintaining soil fertility and crop productivity. By improving soil health, enhancing nutrient cycling, and reducing environmental degradation, ONM ensures long-term sustainability of intensive agriculture. While challenges exist, appropriate policy support, technological innovations, and farmer awareness can accelerate adoption. Organic nutrient management, when integrated with modern agronomic practices, holds immense potential for achieving sustainable food production and resilient farming systems.

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