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Integrated Nutrient Management Strategies for Enhancing Pea Yield

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Abstract: -

Pea (Pisum sativum L.) is a major pulse crop with significant nutritional and agro-ecological importance. Despite its ability to fix atmospheric nitrogen, pea productivity remains constrained by imbalanced nutrient management and declining soil fertility. Integrated Nutrient Management (INM), which involves the combined use of inorganic fertilizers, organic manures, and biofertilizers, offers a sustainable approach to enhance pea yield while improving soil health. This article critically reviews the role of INM in pea cultivation, emphasizing nutrient dynamics, biological nitrogen fixation, micronutrient management, and soil fertility improvement. Adoption of INM practices improves nutrient use efficiency, yield attributes, and long-term sustainability of pea-based production systems.

Introduction:

The growing demand for pulses, coupled with concerns over soil degradation and environmental sustainability, necessitates improved nutrient management strategies in legume cultivation. Pea (*Pisum sativum* L.) is widely grown as a vegetable and grain legume, contributing significantly to dietary protein intake and soil fertility enhancement. However, the yield potential of pea is often not fully realized due to inadequate and imbalanced nutrient supply.

Although pea is capable of biological nitrogen fixation through symbiosis with *Rhizobium*, it requires sufficient availability of phosphorus, potassium, sulphur, and micronutrients for optimal growth and effective nodulation. Continuous use of chemical fertilizers alone has led to declining soil organic carbon and nutrient imbalances, whereas exclusive reliance on organic sources fails to meet crop nutrient demand. Integrated Nutrient Management (INM) provides a

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scientifically sound framework for optimizing nutrient supply while sustaining soil productivity.

Principles of Integrated Nutrient Management

Integrated Nutrient Management aims to maintain soil fertility and plant nutrient supply by harmonizing different nutrient sources. The core principles include:

- Integration of organic, inorganic, and biological nutrient sources
- Enhancement of nutrient use efficiency
- Maintenance of soil organic matter and microbial activity
- Reduction of environmental pollution from excessive fertilizer use

INM promotes synchronized nutrient release with crop demand, which is particularly important for legumes like pea with dynamic nutrient requirements.

Nutrient Requirements and Uptake in Pea

Macronutrients

- **Nitrogen (N):** Required for vegetative growth and protein synthesis. A starter dose of nitrogen enhances early growth before nodulation becomes effective.
- **Phosphorus (P):** Crucial for root growth, nodulation, energy transfer, and seed development.
- **Potassium (K):** Enhances photosynthesis, enzyme activity, and resistance to abiotic stress.

- **Secondary and Micronutrients**

- **Sulphur (S):** Plays a vital role in synthesis of sulphur-containing amino acids.
- **Zinc (Zn):** Influences enzyme activity and hormone regulation.
- **Boron (B):** Essential for flowering, pollen viability, and seed set.
- **Iron (Fe):** Important for chlorophyll formation and nitrogen fixation.

Balanced nutrient availability is essential for maximizing yield and quality in pea.

Integrated Nutrient Management Strategies in Pea Cultivation

1. Organic Nutrient Sources

Application of farmyard manure, compost, or vermicompost improves soil physical properties, enhances microbial activity, and increases soil organic carbon. Organic amendments improve nutrient retention and provide a slow release of nutrients, thereby supporting sustained crop growth.

2. Inorganic Fertilizers

Judicious application of chemical fertilizers ensures immediate nutrient availability. In pea, recommended doses of phosphorus and potassium along with a small quantity of nitrogen at sowing improve early vigor and nodulation efficiency. Integration

with organic sources reduces fertilizer requirement without compromising yield.

3. **Biofertilizers**
   - **Rhizobium inoculation** enhances nitrogen fixation and improves nodulation.
   - **Phosphate-solubilizing bacteria (PSB)** increase phosphorus availability in the rhizosphere.
   - **Arbuscular mycorrhizal fungi (AMF)** improve nutrient and water uptake.

Combined application of biofertilizers with organic and inorganic nutrients significantly enhances nutrient use efficiency and yield.

4. **Integrated Micronutrient Management**

Soil application or foliar spray of zinc, boron, and iron corrects hidden deficiencies and improves reproductive growth. Integrated micronutrient management enhances pod formation, seed weight, and protein content in pea.

5. **Soil Test–Based Nutrient Management**

Site-specific nutrient management based on soil testing ensures precise nutrient application, minimizes losses, and improves fertilizer use efficiency.

Effect of INM on Growth, Yield, and Quality of Pea

Research findings consistently indicate that INM practices improve:

- Plant growth parameters and biomass accumulation
- Number of pods per plant and seeds per pod
- Seed yield and harvest index
- Protein content and nutritional quality

The synergistic effect of different nutrient sources results in improved yield stability and economic returns.

Soil Health and Environmental Implications

INM contributes to sustainable pea production by:

- Enhancing soil organic carbon and microbial diversity
- Improving soil structure and water-holding capacity
- Reducing nutrient leaching and environmental contamination
- Lowering greenhouse gas emissions associated with fertilizer use

These benefits make INM an integral component of climate-resilient agriculture.

Constraints and Future Research Needs

Despite its advantages, adoption of INM is limited by inadequate access to quality biofertilizers, limited awareness among farmers, and lack of soil testing infrastructure. Future research should focus on long-term experiments, region-specific INM modules, and integration of precision nutrient management technologies.

Conclusion

Integrated Nutrient Management is a scientifically validated and sustainable strategy for enhancing pea yield and maintaining soil fertility. By combining organic manures, chemical fertilizers, and biofertilizers, INM ensures balanced nutrient supply, improves nutrient use efficiency, and enhances crop productivity. Adoption of INM practices in pea cultivation is essential for achieving sustainable pulse production and long-term agricultural resilience.

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