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| RESEARCH ARTICLE

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ASSESSMENT OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES FOR IMPROVING SOIL FERTILITY AND MAIZE (ZEA MAYS L.) PRODUCTIVITY

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| ABSTRACT

Integrated Nutrient Management (INM) has become an important strategy for maintaining soil fertility while increasing crop productivity under sustainable agricultural systems. This study evaluated the influence of different nutrient management practices on maize growth, yield, and selected soil fertility parameters. Four treatments were investigated: control (no fertilizer), chemical fertilizer alone, organic manure alone, and a combination of chemical fertilizer with organic manure. A randomized complete block design with three replications was employed during one cropping season. Growth parameters, grain yield, soil organic carbon, available nitrogen, phosphorus, and potassium were measured.

| KEYWORDS

Integrated nutrient management, maize, soil fertility, sustainable agriculture, organic manure.

|ARTICLE INFORMATION

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Abstract:-

Integrated Nutrient Management (INM) has become an important strategy for maintaining soil fertility while increasing crop productivity under sustainable agricultural systems. This study evaluated the influence of different nutrient management practices on maize growth, yield, and selected soil fertility parameters. Four treatments were investigated: control (no fertilizer), chemical fertilizer alone, organic manure alone, and a combination of chemical fertilizer with organic manure. A randomized complete block design with three replications was employed during one cropping season. Growth parameters, grain yield, soil organic carbon, available nitrogen, phosphorus, and potassium were measured. The combined application of chemical fertilizer and organic manure significantly improved plant height, leaf area, grain yield, and soil fertility compared with the other treatments. Soil organic carbon increased by approximately 18% under integrated nutrient management relative to chemical fertilizer alone. Grain yield was highest (6.45 t ha^{-1}) in the integrated treatment compared with 5.20 t ha^{-1} under chemical fertilizer, 4.12 t ha^{-1} under organic manure, and 2.85 t ha^{-1} in the control. The findings indicate that integrating organic and inorganic nutrient sources enhances nutrient availability, improves soil quality, and promotes sustainable maize production.

Introduction:-

Agriculture plays a crucial role in ensuring food security and supporting rural livelihoods throughout the world. Increasing population growth has intensified the demand for higher agricultural productivity. Excessive dependence on synthetic fertilizers has undoubtedly increased crop yields but has also contributed to declining soil quality, nutrient imbalance, environmental pollution, and reduced biodiversity. Integrated Nutrient Management (INM) combines organic and inorganic nutrient sources to optimize nutrient availability while maintaining soil health. Organic amendments improve soil structure, microbial activity, moisture retention, and long-term fertility, whereas inorganic fertilizers provide readily available nutrients

necessary for rapid crop growth. Maize (Zea mays L.) is among the world's most important cereal crops and serves as food, livestock feed, and industrial raw material. However, declining soil fertility remains a major limitation to maize production in many developing countries. This study aimed to evaluate the effectiveness of integrated nutrient management in improving soil fertility and maize productivity.

Objectives:-

The objectives were to:-

- Evaluate the effect of integrated nutrient management on maize growth.
- Compare grain yield under different fertilizer treatments.
- Assess changes in soil fertility after harvest.
- Recommend sustainable nutrient management practices.

Materials and Methods:-

Study Area:-The experiment was conducted at the Agricultural Research Farm under subtropical climatic conditions during the summer growing season. The soil was sandy loam with moderate fertility.

Experimental Design:-The experiment followed a Randomized Complete Block Design (RCBD) with three replications.

Treatments:-

- T_1 = Control (No fertilizer)
- T_2 = Recommended chemical fertilizer
- T_3 = Farmyard manure (10 t ha^{-1})
- T_4 = Farmyard manure + Recommended chemical fertilizer

Each experimental plot measured 4 × 5 m.

Data Collection:-

Measurements included:-

- Plant height
- Number of leaves
- Leaf area index
- Grain yield
- Soil organic carbon
- Available nitrogen
- Available phosphorus
- Available potassium

Statistical Analysis:-

The collected data were analyzed using one-way Analysis of Variance (ANOVA). Mean comparisons were performed using the Least Significant Difference (LSD) test at a 5% significance level.

Results:-

Table 1. Effect of Nutrient Management on Maize Growth

Treatment	Plant Height (cm)	Leaf Area Index
Control	128.4	2.65
Chemical Fertilizer	175.2	4.12
Organic Manure	162.7	3.85
Integrated (INM)	189.6	4.78

Integrated nutrient management produced the tallest plants and highest leaf area index.

Table 2. Grain Yield

Treatment	Grain Yield (t ha^{-1})
Control	2.85
Chemical Fertilizer	5.20
Organic Manure	4.12

Treatment	Grain Yield (t ha⁻¹)
Integrated (INM)	6.45

The integrated treatment recorded the highest grain yield.

Table 3. Soil Fertility After Harvest

Treatment	Organic Carbon (%)	Available N (kg ha⁻¹)	Available P (kg ha⁻¹)
Control	0.48	168	18
Chemical Fertilizer	0.54	215	27
Organic Manure	0.66	204	25
Integrated (INM)	0.74	232	31

Integrated nutrient management substantially improved soil fertility.

Discussion:-

The findings demonstrate that integrated nutrient management significantly enhanced maize growth and productivity. The combined application of organic manure and chemical fertilizer supplied nutrients continuously throughout the growing season while improving soil physical properties. Organic manure increased microbial activity and soil organic matter, which enhanced nutrient mineralization and improved nutrient use efficiency. In contrast, sole application of chemical fertilizer provided immediate nutrient availability but contributed less to improving soil structure. The improvement in soil organic carbon under integrated nutrient management suggests greater carbon sequestration potential and improved soil resilience. Enhanced nitrogen and phosphorus availability further contributed to vigorous vegetative growth and increased grain production. The results are consistent with previous studies reporting positive effects of integrated nutrient management on cereal crops. The balanced supply of nutrients supports sustainable agricultural production while minimizing environmental degradation associated with excessive chemical fertilizer use.

Conclusion:-

Integrated nutrient management proved to be the most effective fertilizer strategy for improving maize growth, grain yield, and soil fertility. Combining farmyard manure with recommended chemical fertilizers enhanced nutrient availability, increased soil organic carbon, and promoted sustainable crop production. Farmers are encouraged to adopt integrated nutrient management practices to achieve higher productivity while maintaining long-term soil health.

Recommendations:-

- Promote integrated nutrient management among maize farmers.
- Increase awareness regarding balanced fertilizer application.
- Encourage recycling of farm organic wastes.
- Conduct long-term field experiments to evaluate sustainability.
- Develop region-specific nutrient management recommendations.

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