IMPACT OF ORGANIC SOIL AMENDMENTS ON SOIL FERTILITY AND YIELD PERFORMANCE OF MAIZE (ZEA MAYS L.) UNDER SUSTAINABLE FARMING SYSTEMS.

Abstract:-

Sustainable agriculture has become increasingly important as excessive dependence on chemical fertilizers has contributed to soil degradation, nutrient imbalance, and environmental pollution. Organic soil amendments provide an environmentally friendly alternative capable of improving soil fertility while maintaining crop productivity. The present study evaluated the effects of different organic amendments on soil physicochemical properties and maize yield. Four treatments comprising farmyard manure, vermicompost, poultry manure, and a control were arranged in a randomized complete block design with three replications. Soil samples were analyzed before planting and after harvest for pH, organic carbon, nitrogen, phosphorus, potassium, and microbial biomass. Growth parameters including plant height, leaf number, biomass accumulation, and grain yield were recorded. Results demonstrated that vermicompost significantly enhanced soil organic carbon, nitrogen availability, microbial biomass, and grain yield compared with the control. Poultry manure produced comparable improvements, while farmyard manure showed moderate effects. The findings indicate that organic amendments can substantially improve soil fertility and crop productivity while reducing dependence on synthetic fertilizers. Adoption of organic nutrient management practices contributes to sustainable agricultural production and environmental conservation.

Keywords: Organic manure, Soil fertility, Sustainable agriculture, Vermicompost, Maize production, Crop yield

Introduction:-

Agriculture plays a vital role in ensuring global food security and economic development. The increasing demand for food has encouraged intensive farming practices characterized by excessive application of chemical fertilizers and pesticides. Although these practices have increased crop production, they have also resulted in declining soil fertility, groundwater contamination, reduced biodiversity, and environmental degradation.

Organic soil amendments have gained considerable attention as sustainable alternatives capable of restoring soil health while maintaining agricultural productivity. Organic materials improve soil structure, enhance water-holding capacity, increase microbial activity, and supply essential plant nutrients through gradual mineralization.

Among various cereal crops, maize (Zea mays L.) occupies an important position due to its extensive use for food, feed, and industrial applications. High nutrient demand makes maize an ideal crop for evaluating the effectiveness of organic nutrient management practices.

This study investigated the influence of different organic soil amendments on soil fertility and maize yield under field conditions.

2. Objectives

The objectives of this study were:

- To evaluate the effect of organic amendments on soil fertility.
- To determine their influence on maize growth.
- To compare grain yield under different nutrient management practices.
- To identify suitable organic fertilizer sources for sustainable agriculture.

3. Materials and Methods

3.1 Study Area

The experiment was conducted during the summer growing season at an agricultural research field characterized by sandy loam soil and moderate climatic conditions.

3.2 Experimental Design

The study followed a Randomized Complete Block Design (RCBD) with three replications.

Treatments included:

- T_1 – Control (No fertilizer)
- T_2 – Farmyard manure (10 t/ha)
- T_3 – Vermicompost (6 t/ha)
- T_4 – Poultry manure (5 t/ha)

Each experimental plot measured 4 m × 5 m.

3.3 Soil Analysis

Composite soil samples were collected before sowing and after harvesting.

The following parameters were analyzed:

- Soil pH
- Organic carbon
- Total nitrogen
- Available phosphorus
- Exchangeable potassium
- Microbial biomass carbon

3.4 Crop Management

Certified maize seeds were planted at recommended spacing.
Uniform irrigation, weed control, and pest management practices were maintained throughout the experiment.

3.5 Data Collection

The following parameters were recorded:

- Germination percentage
- Plant height
- Number of leaves
- Stem diameter
- Dry biomass
- Grain yield
- Harvest index

3.6 Statistical Analysis

Experimental data were subjected to Analysis of Variance (ANOVA). Treatment means were compared using Duncan's Multiple Range Test at $P < 0.05$.

4. Results

Table 1. Soil Properties after Harvest

Parameter	Control	Farmyard Manure	Vermicompost	Poultry Manure
Soil pH	6.2	6.5	6.7	6.6
Organic Carbon (%)	0.81	1.28	1.64	1.47
Nitrogen (%)	0.08	0.13	0.18	0.16
Available P (mg/kg)	13.5	19.6	25.8	23.9
Available K (mg/kg)	145	181	205	198

Organic amendments significantly improved all measured soil properties compared with the untreated control.

Table 2. Growth Parameters of Maize

Treatment	Plant Height (cm)	Leaves/Plant	Biomass (g)
Control	132.4	11	165
Farmyard Manure	157.6	13	228
Vermicompost	178.3	15	274
Poultry Manure	170.9	14	259

Plants receiving vermicompost exhibited superior vegetative growth.

Table 3. Grain Yield

Treatment	Yield (t/ha)
Control	3.45
Farmyard Manure	5.26
Vermicompost	6.82
Poultry Manure	6.31

The highest grain yield was observed under vermicompost application.

5. Discussion

Organic amendments significantly enhanced soil fertility through increased organic matter accumulation and nutrient availability. Vermicompost produced the highest improvements because it contains stabilized organic matter, readily available nutrients, humic substances, and beneficial microorganisms.

Enhanced microbial activity promoted nutrient mineralization and improved nutrient uptake by maize plants. Improved soil structure also increased moisture retention, supporting better root development during crop growth.

Farmyard manure improved soil fertility but released nutrients more slowly due to incomplete decomposition. Poultry manure provided rapid nutrient release because of its relatively low carbon-to-nitrogen ratio, resulting in substantial improvements in plant growth and yield.

The findings agree with previous studies reporting that organic nutrient sources improve soil biological activity, increase nutrient-use efficiency, and enhance sustainable crop production. Reduced dependence on synthetic fertilizers also minimizes nutrient leaching and greenhouse gas emissions.

6. Environmental Significance

Organic farming practices contribute to environmental sustainability by:

- Improving soil biodiversity.
- Reducing chemical fertilizer dependence.
- Increasing carbon sequestration.
- Enhancing water retention.
- Reducing nutrient runoff.
- Lowering environmental pollution.

These benefits support climate-smart agriculture and sustainable food production systems.

7. Limitations of the Study

The study was conducted for one cropping season only. Long-term experiments are necessary to determine cumulative effects of organic amendments on soil fertility and crop productivity. Future studies should also evaluate integrated nutrient management combining organic and inorganic fertilizer sources.

8. Conclusion

The application of organic soil amendments significantly improved soil fertility, maize growth, and grain yield compared with untreated soil. Vermicompost proved to be the most effective amendment, followed by poultry manure and farmyard manure. Organic nutrient management enhances soil quality while reducing environmental impacts associated with intensive chemical fertilizer use. Adoption of organic amendments offers a practical strategy for achieving sustainable agricultural production and improving long-term soil health.

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