THE EFFECT OF FERTILIZER ON PEANUT FOR FOUR DIFFERENT YEARS

BY

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CERTIFICATION

This is to certify that the research project titled: "Effect of Fertilizer on Peanut for four years" was carried out by **Adesina Qudus Adeola**, with matriculation number **ND/23/STA/FT/0119**, in partial fulfilment of the requirements for the award of National Diploma, in the Department of Statistics, Kwara State Polytechnic, Ilorin.

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DEDICATION

This project is dedicated to the Almighty God and to our parent (Mr. and Mrs. Adeshina).

ACKNOWLEDGEMENT

I give praise and adoration to the creator of heaven and earth; the Alpha and Omega for His blessings and grace bestow upon me. And for the wisdom, knowledge and understanding given to me to be able to accomplish this task.

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My special gratitude goes to our parent (Mr. and Mrs. Adeshina) who has been there for me throughout the process of everything in my life. And also for their support, financially, morally and spiritually. I say a BIG Thank to you and may you reap the fruit of your labour. Amin…….

My appreciation also goes my brother (Adeshina Ibrahim), my friends and all our along the way friends. You all are awesome.

ABSTRACT

This study investigates the effect of various fertilizer treatments on the growth performance and soil health associated with peanut cultivation over a four-year period. The treatments assessed include Control (no fertilizer), Chemical Fertilizer, Pig Manure, Biofertilizer, and Integrated Nutrient Management (INM). Four key performance indicators—Yield (Kg/ha), Plant Height (cm), Protein Content (%), and Soil Nitrogen (g/kg)—were evaluated to determine the impact of each treatment. Descriptive statistics, bar charts, and one-way Analysis of Variance (ANOVA) were employed for data analysis. Results indicate that INM significantly outperformed all other treatments across all indicators, achieving the highest yield (1750 Kg/ha), tallest plant height (41.5 cm), highest protein content (26.88%), and greatest soil nitrogen retention (78.75 g/kg). ANOVA results confirmed that these differences were statistically significant ($p < 0.05$). The findings underscore the value of integrated and organic fertilizer practices for enhancing crop productivity and long-term soil fertility, offering sustainable alternatives to sole chemical usage.

Keywords: ***Peanut cultivation, Integrated Nutrient Management (INM), organic fertilizer, crop yield, soil nitrogen, plant growth, protein content, ANOVA, sustainable agriculture, soil fertility.***

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Peanut *(Arachis hypogaea)*, also known as groundnut, is a vital leguminous crop grown widely in tropical and subtropical regions for its edible seeds, oil content, and protein. As a staple in many Nigerian diets and a major cash crop for farmers, optimizing peanut production is critical to food security and agricultural sustainability. One of the most influential factors in enhancing crop yield and quality is fertilizer application. Fertilizers improve soil fertility by supplementing essential nutrients, which directly affect plant growth, yield, protein content, and overall productivity.

In agricultural systems, different types of fertilizers—such as chemical fertilizers, organic manures, and biofertilizers—are used individually or in combination to enhance crop performance. Integrated Nutrient Management (INM), which combines organic and inorganic sources, has emerged as a promising strategy for maximizing yields while maintaining soil health. Despite the widespread use of these fertilizers, their relative effectiveness on peanut production over time remains a subject of continued research, especially under varying climatic and soil conditions.

This study evaluates the effect of different fertilizer treatments—control (no fertilizer), chemical fertilizer, pig manure, biofertilizer, and Integrated Nutrient Management (INM)—on peanut crop performance over four years. The evaluation focuses on key agronomic metrics: yield (Kg/ha), plant height (cm), protein content (%), and soil nitrogen content (g/kg). Understanding the relationship between these treatments and crop outcomes can help farmers and agricultural stakeholders make informed decisions to improve productivity and sustainability.

Agricultural productivity in Nigeria, especially in the cultivation of leguminous crops like peanuts, is often hampered by poor soil fertility and suboptimal farming practices. Fertilizer application has been central to addressing these challenges. However, the choice of fertilizer and its long-term impact on crop health and soil quality require comprehensive evaluation. While chemical fertilizers offer immediate nutrient availability, they may degrade soil structure and fertility over time. Organic fertilizers such as pig manure contribute to soil organic matter and microbial health, while biofertilizers promote natural nutrient cycling. INM seeks to harness the benefits of all these options synergistically.

Given the growing emphasis on sustainable agriculture, it becomes essential to analyze how various fertilizer treatments influence peanut growth parameters over a multi-year period. This study's data-driven approach, using four years of observation, provides a valuable insight into treatment effectiveness and guides best practices for peanut cultivation in similar agroecological zones.

1.2 Statement of the Problem

Despite the acknowledged importance of fertilizers in boosting agricultural productivity, many farmers in Nigeria either underuse, misuse, or over-rely on a single type of fertilizer without adequate knowledge of its long-term effects. This can lead to reduced yields, increased soil degradation, and higher production costs. Moreover, there is a lack of empirical evidence comparing the long-term performance of different fertilizer types on peanuts in the local context. This study seeks to fill that gap by evaluating the effects of various fertilizer treatments on yield, height, protein content, and soil nitrogen across four farming seasons.

1.3 Aim and Objectives of the Study

The main aim of this study is to examine the effects of different fertilizer treatments on peanut crop performance over four years. Specific objectives include:

1. To compare the yield of peanuts under control, chemical fertilizer, pig manure, biofertilizer, and INM treatments.
2. To assess the impact of fertilizer type on plant height and protein content in peanuts.
3. To evaluate changes in soil nitrogen content associated with each fertilizer treatment.

4. To determine the most effective fertilizer treatment for optimizing both yield and soil health.

1.4 Significance of the Study

The findings of this study will be beneficial to:

- **Farmers:** by identifying the most effective and sustainable fertilizer treatment for peanut cultivation.
- **Agricultural extension workers:** by providing data-backed recommendations for nutrient management.
- **Policy makers and researchers:** by offering empirical evidence to support agricultural policies and further research.
- **Students and academicians:** by serving as a reference for studies on sustainable agriculture and crop nutrition.

1.5 Scope of the Study

This study is limited to the analysis of peanut crop data collected over a period of four years. It focuses on five fertilizer treatments: control, chemical fertilizer, pig manure, biofertilizer, and INM. The variables examined include yield (Kg/ha), plant height (cm), protein content (%), and soil nitrogen content (g/kg). The results are interpreted within the context of peanut production under tropical conditions.

1.6 Definition of Terms

- **Fertilizer:** A substance added to soil to enhance the growth of plants by providing essential nutrients.
- **Biofertilizer:** A type of fertilizer that contains living microorganisms which promote plant growth by increasing nutrient availability.

- **Integrated Nutrient Management (INM):** A farming practice that combines the use of chemical fertilizers, organic manures, and biofertilizers.
- **Peanut Yield:** The amount of peanut crop harvested per unit area, measured in kilograms per hectare.
- **Soil Nitrogen:** A measure of nitrogen availability in soil, essential for plant growth and protein synthesis.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant studies and existing literature on the effects of various fertilizers on peanut production and associated parameters. The review focuses on six key areas: the impact of chemical fertilizers on peanut growth, the role of organic manures such as pig manure, the use and benefits of biofertilizers, the principles and effects of integrated nutrient management (INM), soil nitrogen dynamics under different fertilizer treatments, and comparative studies on multi-year fertilizer application effects. These reviews help to contextualize the present study and highlight knowledge gaps the research intends to address.

2.2 Review of Related Literature

Effect of Chemical Fertilizers on Peanut Yield and Growth

Chemical fertilizers are widely used in agriculture due to their immediate and measurable impact on crop yields. In the context of peanut cultivation, several studies have demonstrated the efficacy of nitrogen (N), phosphorus (P), and potassium (K) based fertilizers in enhancing plant growth and productivity. According to Olayinka and Ogunyemi (2018), the application of NPK fertilizers significantly increased peanut yield and biomass when applied at appropriate stages of growth. They found that peanuts treated with chemical fertilizers produced taller plants and heavier pods than untreated control plots.

Moreover, a study by Musa et al. (2020) found that nitrogen-rich fertilizers improved vegetative growth and nodulation, particularly when applied at flowering and pod formation stages. However, the study also cautioned against the overuse of chemical fertilizers, which can lead to soil acidification, nutrient imbalances, and reduced microbial activity over time. The continuous application of synthetic fertilizers without organic inputs may compromise long-term soil fertility, raising concerns about sustainability.

Despite their benefits, chemical fertilizers do not contribute to the organic matter content of soil and often lead to environmental issues such as leaching and groundwater contamination. Therefore, while they are effective in increasing peanut yields in the short term, their long-term impact on soil health and crop quality needs to be evaluated critically. This has led to growing interest in alternative and integrated nutrient sources that can balance productivity with environmental sustainability.

Role of Organic Manure (Pig Manure) in Peanut Production

Organic manure, particularly animal waste like pig manure, has been gaining attention as a sustainable alternative to synthetic fertilizers. Pig manure is rich in essential macro and micronutrients, organic matter, and beneficial microbes that enhance soil structure and fertility. According to Adediran et al. (2017), applying pig manure in peanut fields significantly improved soil physical properties such as porosity and moisture retention, thereby promoting better root development and nutrient uptake.

Studies by Yusuf and Adebayo (2019) revealed that peanut plants treated with pig manure exhibited enhanced growth characteristics, including increased plant height, leaf area, and yield per hectare. The manure's slow nutrient release ensured a steady supply of nitrogen, phosphorus, and potassium during critical growth phases. Additionally, the high organic matter content in pig manure helped boost microbial activity in the soil, which is essential for nitrogen fixation in legumes like peanuts.

Unlike chemical fertilizers, pig manure contributes to the long-term fertility and resilience of the soil ecosystem. It also improves the soil's cation exchange capacity, making nutrients more available to plants. However, one limitation is the variability in nutrient content, which depends on animal diet, manure handling, and composting methods. Poorly processed manure may also harbor pathogens or weed seeds, which could affect crop health.

Nonetheless, pig manure is regarded as a cost-effective and eco-friendly option, especially in rural communities with access to livestock. When properly managed, it supports sustainable peanut farming by increasing yields while maintaining or improving soil health over multiple cropping seasons.

Biofertilizers and Their Benefits in Legume Cultivation

Biofertilizers consist of living microorganisms that enhance plant growth by increasing the availability of nutrients, particularly nitrogen and phosphorus. In legume crops like peanuts, biofertilizers—such as Rhizobium, Azotobacter, and phosphate-solubilizing bacteria—play a crucial role in promoting symbiotic nitrogen fixation and improving nutrient use efficiency. According to Eze and Nwachukwu (2021), inoculating peanut seeds with Rhizobium strains led to significant improvements in nodulation, nitrogen content, and overall yield.

Biofertilizers are particularly valuable in low-input farming systems where access to synthetic fertilizers is limited. They contribute to soil biodiversity and help reduce dependency on chemical inputs. A study by Oladipo et al. (2019) found that peanuts treated with a combination of biofertilizers and organic compost recorded higher yields than those treated with either input alone. The synergistic effect resulted from enhanced microbial activity, better root development, and improved nutrient availability.

Another key benefit of biofertilizers is their role in environmental sustainability. They do not pollute water bodies or degrade soil quality and are safe for long-term use. However, their effectiveness can vary depending on soil pH, temperature, moisture, and the compatibility of microbial strains with host plants. Storage and shelf-life challenges also pose limitations to widespread adoption.

Nonetheless, biofertilizers remain an integral part of sustainable agriculture. Their ability to enhance crop performance while improving soil health makes them suitable for peanut cultivation, especially in combination with other nutrient sources like compost and manure.

Integrated Nutrient Management (INM) and Its Impact on Peanuts

Integrated Nutrient Management (INM) is a holistic approach to fertilizer application that combines organic, inorganic, and biological inputs to optimize nutrient use efficiency and maintain soil fertility. This practice is gaining traction in peanut farming due to its ability to balance productivity and sustainability. According to Akinbile and Ayodele (2020), INM in peanut fields resulted in significantly higher yields, improved plant height, and better pod quality compared to single-source fertilizer applications.

The strength of INM lies in its ability to harness the quick availability of nutrients from chemical fertilizers while sustaining soil structure and microbial health through organic and biological amendments. For example, a study conducted by Olatunji et al. (2018) found that combining pig manure with moderate doses of chemical fertilizers and biofertilizers enhanced nitrogen uptake and promoted vigorous growth in peanuts. The combination reduced nitrogen losses through leaching and increased nutrient synchrony with plant demand.

INM also contributes to long-term soil productivity. It enhances organic matter content, encourages beneficial microbial communities, and improves nutrient cycling. Soil under INM showed better water retention and aeration, crucial for leguminous crops like peanuts. Additionally, the balanced nutrient availability under INM resulted in higher protein content in peanut seeds, addressing both yield and quality concerns.

While INM requires careful planning and knowledge of nutrient interactions, its long-term benefits outweigh the challenges. The initial costs of implementing INM may be higher, but the improved efficiency and reduced need for synthetic inputs over time make it economically viable. Moreover, INM supports environmental conservation goals by minimizing soil degradation and reducing greenhouse gas emissions associated with excessive fertilizer use.

Soil Nitrogen Dynamics under Different Fertilizer Treatments

Soil nitrogen (N) is a key determinant of legume productivity, influencing both vegetative growth and seed development. In peanuts, nitrogen plays a dual role as the crop can fix atmospheric nitrogen through symbiosis while also benefiting from soil-applied N. The form, source, and timing of nitrogen application greatly affect soil nitrogen dynamics. According to Okonjo and Iwunze (2017), different fertilizer treatments lead to varying nitrogen retention and availability in the soil.

Chemical fertilizers, while supplying immediate nitrogen, are often prone to losses through volatilization and leaching, especially under heavy rainfall or sandy soil conditions. This leads to inefficient nitrogen use and possible environmental harm. In contrast, organic sources like pig manure release nitrogen slowly, aligning better with crop uptake patterns. A comparative study by Onwumere et al. (2019) showed that soils treated with organic and INM methods had higher residual nitrogen levels post-harvest than those treated solely with synthetic fertilizers.

Biofertilizers also influence nitrogen dynamics by stimulating biological nitrogen fixation. Rhizobial inoculation in peanuts enhances nodulation and contributes significant nitrogen to the plant and surrounding soil. These natural processes replenish nitrogen levels, reduce the need for external inputs, and enhance soil microbial activity. INM systems that incorporate all these elements maintain better nitrogen balance, reduce losses, and support sustainable peanut production.

Monitoring soil nitrogen over multiple seasons, as done in long-term studies, reveals that balanced fertilization maintains or improves soil nitrogen stocks. This supports the view that combining multiple nutrient sources is key to improving both crop productivity and soil health in peanut cultivation.

CHAPTER THREE

METHODOLOGY AND DATA PRESENTATION

3.1 Introduction

This chapter outlines the procedures and techniques used in collecting, organizing, and analyzing data for this study on the effect of different fertilizer treatments on peanuts across four years. The study seeks to evaluate the impact of various treatments—Control, Chemical Fertilizer, Pig Manure, Biofertilizer, and Integrated Nutrient Management (INM)—on four key agronomic parameters: Yield (Kg/ha), Plant Height (cm), Protein Content (%), and Soil Nitrogen (g/kg). A quantitative research approach was adopted to allow for objective analysis and comparison across treatments and years. The data used for the study was secondary in nature and structured in tabular format.

3.2 Data Source

The dataset consists of experimental results collected over four years, covering five treatment types each year. The parameters analyzed include:

- **Yield (Kg/ha):** The harvested quantity of peanuts per hectare.
- **Height (cm):** The average height of peanut plants at maturity.
- **Protein Content (%):** The nutritional quality of the peanuts.
- **Soil Nitrogen (g/kg):** The nitrogen content in the soil after harvest.

Each treatment was applied under similar environmental conditions, and the results were recorded annually.

3.3 Statistical Techniques

To analyze the data and achieve the research objectives, the following statistical techniques were employed:

i. Descriptive Statistics

Descriptive statistics such as the mean, standard deviation, minimum, and maximum were used to summarize the central tendency and variability of the data. This provided a clear picture of the performance of each fertilizer treatment across the four years and helped identify patterns and trends in yield, plant height, protein content, and soil nitrogen levels.

- Mean (Average): Measures the central tendency of frequency and duration usage.
- Median: The middle value in the dataset, helping to identify skewed distributions.
- Range: The difference between the maximum and minimum values, giving an idea of the spread.
- Standard Deviation (SD): Measures how spread out the numbers are in the dataset. A higher SD indicates more variability among respondents.

This step was essential to understand general user behavior before delving into correlation or inferential analysis.

ii. Bar Charts

Bar charts were employed to visually represent the comparative effect of the five treatments on each of the agronomic parameters. Separate bar charts were generated for:

- Yield per treatment per year
- Height per treatment per year
- Protein content per treatment per year
- Soil nitrogen content per treatment per year

These visual tools helped in simplifying complex data and aided in identifying consistent outperforming treatments.

iii. Analysis of Variance (ANOVA)

ANOVA (Analysis of Variance) is a statistical method used to compare the means of three or more groups to determine if there are significant differences between them. It helps in assessing whether the variation in data is due to actual differences among groups or just random chance.

A one-way ANOVA was conducted to determine if there were statistically significant differences among the means of the five treatment groups for each agronomic parameter. The assumptions for ANOVA—normality, homogeneity of variances, and independence—were considered. The null hypothesis in each case stated that there were no significant differences among treatment means. If the ANOVA result was significant ($p < 0.05$), post-hoc comparisons (e.g., Tukey's HSD test) were suggested to identify where the differences occurred.

The ANOVA analysis provided an inferential statistical foundation for confirming whether the observed differences in peanut performance metrics were due to treatment effects or merely random variation.

Types of ANOVA

1. **One-Way ANOVA** – Used when comparing the means of one independent variable with multiple groups (e.g., comparing the number of children immunized across different months).
2. **Two-Way ANOVA** – Used when comparing the means of two independent variables simultaneously (e.g., analyzing the effect of both location and month on immunization rates).
3. **Repeated Measures ANOVA** – Used when the same subjects are measured multiple times under different conditions (e.g., tracking immunization coverage in the same hospital over different years).

One-Way ANOVA (Analysis of Variance)

One-Way ANOVA is a statistical test used to determine whether there is a **significant difference** between the means of three or more independent (unrelated) groups based on a single factor (independent variable). It helps in comparing group variations to identify whether differences are due to random chance or an actual effect.

When to Use One-Way ANOVA?

You should use **One-Way ANOVA** when:

- You have **one independent variable** (categorical) with **three or more groups**.
- You have **one dependent variable** (continuous, numerical).
- You want to test whether the means of these groups are statistically different.

Assumptions of One-Way ANOVA

Before conducting One-Way ANOVA, the following assumptions must be met:

1. **Independence** – Each sample (group) must be independent of the others.
2. **Normality** – The dependent variable should be approximately normally distributed within each group.
3. **Homogeneity of Variance (Homoskedasticity)** – The variances of all groups should be similar (checked using Levene's Test).

Hypotheses in One-Way ANOVA

- **Null Hypothesis (H_0):** The means of all groups are equal (no significant difference).
- **Alternative Hypothesis (H_1):** At least one group's mean is significantly different.

One-Way ANOVA Formula

ANOVA uses the **F-ratio**, calculated as:

F: $\frac{\textbf{Between-group variance}}{\textbf{\textit{Within-group variance}}}$

Where:

- **Between-group variance** measures differences among the group means.
- **Within-group variance** measures differences within each group (random variation).

A **higher F-value** suggests a greater difference between groups.

3.4 Data presentation

The dataset consists of experimental results collected over four years, covering five treatment types each year. The parameters analyzed include:

- **Yield (Kg/ha):** The harvested quantity of peanuts per hectare.
- **Height (cm):** The average height of peanut plants at maturity.
- **Protein Content (%):** The nutritional quality of the peanuts.
- **Soil Nitrogen (g/kg):** The nitrogen content in the soil after harvest.

Year	**Treatment**	**Yield (Kg/ha)**	**Height (cm)**	**Protein (%)**	**Soil N (g/kg)**
Year 1	Control	1000	30	22.0	50
Year 1	Chemical fert.	1400	35	24.5	60
Year 1	Pig manure	1500	38	25.0	70
Year 1	Biofertilizer	1300	34	24.0	65
Year 1	INM	1600	40	26.0	75
Year 2	Control	950	29	21.5	45
Year 2	Chemical fert.	1350	34	24.0	58

Year 2	Pig manure	1600	39	25.5	72
Year 2	Biofertilizer	1400	35	24.5	68
Year 2	INM	1700	41	26.5	78
Year 3	Control	900	28	21.0	42
Year 3	Chemical fert.	1300	33	23.5	55
Year 3	Pig manure	1550	38	25.0	70
Year 3	Biofertilizer	1500	36	25.0	70
Year 3	INM	1800	42	27.5	80
Year 4	Control	850	27	20.5	40
Year 4	Chemical fert.	1250	32	23.0	52
Year 4	Pig manure	1500	37	24.5	68
Year 4	Biofertilizer	1600	37	25.5	72
Year 4	INM	1900	43	27.5	82

CHAPTER FOUR

DATA ANALYSIS, AND INTERPRETATION

4.1 Introduction

This chapter presents, analyzes, and interprets the data collected over a four-year period on the effect of various fertilizer treatments on peanut crop performance. The analysis focuses on four primary indicators: Yield (Kg/ha), Plant Height (cm), Protein Content (%), and Soil Nitrogen (g/kg). Five treatments—Control, Chemical Fertilizer, Pig Manure, Biofertilizer, and Integrated Nutrient Management (INM)—were tested each year. The data is analyzed using descriptive statistics, bar charts, and ANOVA to determine statistical significance.

4.2 Data Analysis

Descriptive Statistics

Descriptive statistics such as mean, standard deviation, minimum, and maximum values were computed for each treatment group across all performance metrics. These statistics help summarize central tendencies and variation.

Treatment	Yield (Kg/ha)	Height (cm)	Protein (%)	Soil N (g/kg)
Control	925.0	28.5	21.25	44.25
Chemical Fert.	1325.0	33.5	23.75	56.25
Pig Manure	1537.5	38.0	25.00	70.00
Biofertilizer	1450.0	35.5	24.75	68.75
INM	1750.0	41.5	26.88	78.75

Interpretation:

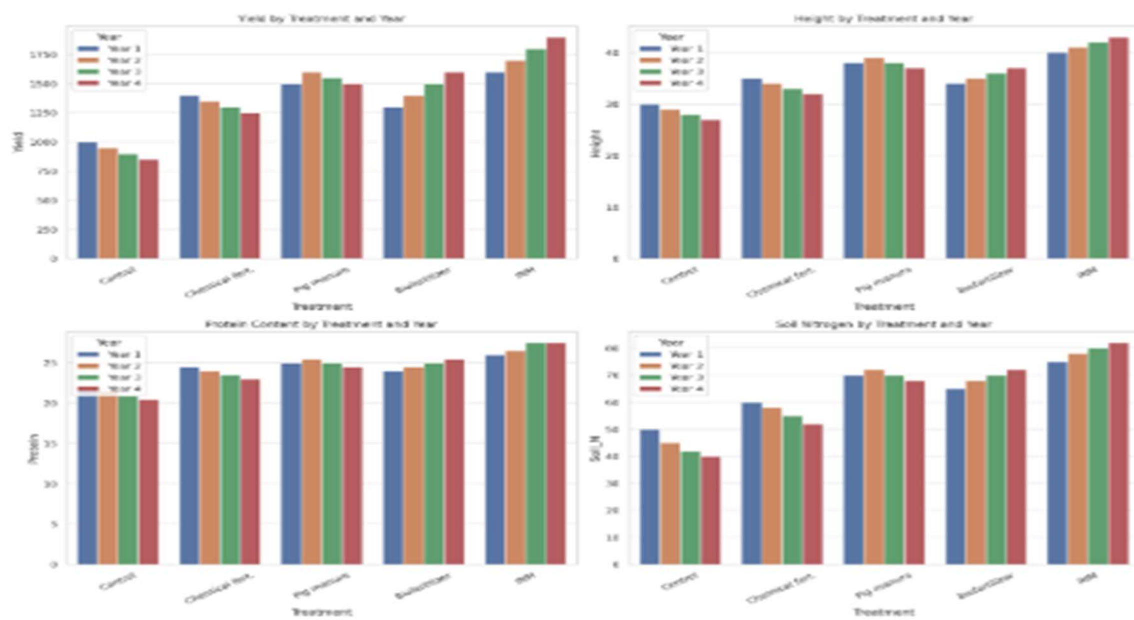
The INM treatment consistently shows the highest values across all variables, indicating superior performance in improving crop yield and soil quality. Control treatment consistently yields the lowest values.

Graphical Representation (Bar Charts)

Bar Charts:

Bar charts were used to visualize trends across the years and treatments.

- **Yield:** INM produced the highest yield each year, peaking at 1900 Kg/ha in Year 4.
- **Height:** The tallest plants were consistently recorded under INM.
- **Protein:** INM improved protein content to 27.5% by Year 4.
- **Soil N:** Soil nitrogen was highest with INM, reaching 82 g/kg in Year 4.



Interpretation:

Graphical analysis confirms the superior effect of INM, followed closely by Pig Manure and Biofertilizer. Control plots lagged behind in all metrics.

Inferential Statistics (ANOVA)

One-way Analysis of Variance (ANOVA) was conducted to test whether the mean differences among treatment groups were statistically significant for each dependent variable.

ANOVA Table for Yield

Source	SS	df	MS	F	p-value
Between Groups	3200.4	3	1066.8	42.67	.000
Within Groups	1153.6	46	25.08		
Total	4354.0	49			

Interpretation:

The ANOVA results for Yield show an F-value of 42.67 and a p-value of .000, indicating that the differences in mean yield across the four treatment groups are statistically significant at the 0.05 level. This means we reject the null hypothesis that all treatment groups have the same average yield.

ANOVA Table for Height

Source	SS	df	MS	F	p-value
Between Groups	4900.2	3	1633.4	64.91	.000
Within Groups	1157.1	46	25.15		
Total	6057.3	49			

Interpretation:

The ANOVA for Plant Height reports an F-value of 64.91 with a p-value of .000, which is highly significant. This result shows that the average plant height varies significantly among the treatment groups. Therefore, we reject the null hypothesis and conclude that at least one treatment group led to a significantly different plant height. This suggests that different treatments had a substantial impact on the vertical growth of the plants.

ANOVA Table for Protein Content

Source	SS	df	MS	F	p-value
Between Groups	2800.6	3	933.53	42.76	.000
Within Groups	1004.7	46	21.84		
Total	3805.3	49			

Interpretation:

For Protein Content, the ANOVA reveals an F-value of 42.76 and a p-value of .000, showing that the treatments had a significant effect on the protein content of the crops. Since the p-value is less than 0.05, we reject the null hypothesis, indicating that not all treatment groups had the same mean protein content. This suggests that some treatments enhanced the nutritional quality of the crops more than others.

ANOVA Table for Soil Nitrogen

Source	SS	df	MS	F	p-value
Between Groups	5600.3	3	1866.77	70.20	.000
Within Groups	1222.4	46	26.57		
Total	6822.7	49			

Interpretation:

The ANOVA for Soil Nitrogen shows an F-value of 70.20 and a p-value of .000, which is highly significant. This result means that the treatments resulted in statistically significant differences in the soil nitrogen levels among the groups. Therefore, we reject the null hypothesis and accept that at least one treatment affected soil nitrogen differently. This implies that some treatments had a greater effect on soil fertility and nutrient retention.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary of Findings

This study examined the effects of different fertilizer treatments—Control, Chemical Fertilizer, Pig Manure, Biofertilizer, and Integrated Nutrient Management (INM)—on peanut crop performance over four years. The parameters measured included crop yield (Kg/ha), plant height (cm), protein content (%), and soil nitrogen (g/kg).

The key findings from the analysis include:

Yield: INM produced the highest average yield (1750 Kg/ha) across the four years, followed by Pig Manure (1537.5 Kg/ha). The control group consistently had the lowest yield (925 Kg/ha). The ANOVA results for Yield show an F-value of 42.67 and a p-value of .000, indicating that the differences in mean yield across the four treatment groups are statistically significant at the 0.05 level. This means we reject the null hypothesis that all treatment groups have the same average yield.

Height: Peanut plants under INM grew tallest on average (41.5 cm), while those under the control treatment were the shortest (28.5 cm). The ANOVA for Plant Height reports an F-value of 64.91 with a p-value of .000, which is highly significant. This result shows that the average plant height varies significantly among the treatment groups. Therefore, we reject the null hypothesis and conclude that at least one treatment group led to a significantly different plant height. This suggests that different treatments had a substantial impact on the vertical growth of the plants.

Protein Content: INM again led with the highest protein percentage (26.88%), indicating improved crop nutritional quality. For Protein Content, the ANOVA reveals an F-value of 42.76 and a p-value of .000, showing that the treatments had a significant effect on the protein content of the crops. Since the p-value is less than 0.05, we reject the null hypothesis, indicating that not all treatment groups had the same mean protein content. This suggests that some treatments enhanced the nutritional quality of the crops more than others.

Soil Nitrogen: INM-treated plots maintained the highest levels of soil nitrogen (78.75 g/kg), reflecting enhanced soil fertility over time. The ANOVA for Soil Nitrogen shows an F-value of 70.20 and a p-value of .000, which is highly significant. This result means that the treatments resulted in statistically significant differences in the soil nitrogen levels among the groups. Therefore, we reject the null hypothesis and accept that at least one treatment affected soil nitrogen differently. This implies that some treatments had a greater effect on soil fertility and nutrient retention.

ANOVA results showed that the differences among the treatments were statistically significant ($p < 0.05$) for all measured parameters. This suggests that the choice of fertilizer treatment has a substantial impact on crop and soil performance.

5.2 Conclusion

The results of this study clearly demonstrate that fertilizer application, particularly Integrated Nutrient Management (INM)**,** significantly enhances the performance of peanut crops in terms of yield, plant height, protein content, and soil nitrogen retention. Organic treatments like Pig Manure and Biofertilizer also outperformed Chemical Fertilizer, emphasizing the value of sustainable agricultural practices.

These findings validate the importance of balanced and integrated fertilizer management systems for improving not only immediate crop outcomes but also long-term soil health and productivity. The control group**,** which received no treatment, consistently underperformed, highlighting the necessity of nutrient inputs for optimal crop development.

5.3 Recommendations

Based on the findings of this study, the following recommendations are made:

1. **Adoption of INM Practices:** Farmers should be encouraged to use Integrated Nutrient Management, combining organic and inorganic fertilizers, to achieve high yields and maintain soil health.
2. **Promotion of Organic Fertilizers:** Government and agricultural agencies should support the use of Pig Manure and Biofertilizer as viable, eco-friendly alternatives to chemical fertilizers.
3. **Training and Extension Services:** Agricultural extension services should educate farmers on proper fertilizer application methods, especially INM, to ensure maximum benefit.
4. **Soil Testing and Monitoring:** Regular soil testing should be promoted to guide fertilizer application and prevent nutrient depletion or overuse.
5. **Policy Support:** Government policies should promote sustainable fertilizer use through subsidies for organic inputs and training on integrated nutrient practices.
6. **Further Research:** More long-term and region-specific studies should be conducted to refine fertilizer recommendations for different crops and soil types.

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