# Growth Response of Potato (Solanum tuberosum) to Poultry Droppings in Ilorin Southern Guinea Savanna Zone of Nigeria.


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# CHAPTER ONE

## INTRODUCTION

### Background Information

Potato (Solanum tuberosum) is one of the most widely grown root crops in the world, valued for its high yield, versatility in culinary uses, and nutritional content. In Nigeria, potatoes are an important crop for both local consumption and economic development. However, the cultivation of potatoes is often constrained by soil fertility issues, among other factors. Nitrogen, as one of the essential macronutrients, plays a crucial role in promoting plant growth and increasing yields. It is primarily involved in key biological processes such as photosynthesis, protein synthesis, and cell division, making it indispensable for optimal crop production. The Southern Guinea Savanna zone, which encompasses Ilorin in central Nigeria, presents unique agricultural challenges. This region is characterized by a tropical climate with a distinct wet and dry season, along with soils that are often deficient in key nutrients such as nitrogen. Given the critical importance of nitrogen for potato cultivation, it is essential to explore effective sources of nitrogen that can support high yields while maintaining soil health in this particular agro-ecological zone.

### Nitrogen Fertilization and Sources

The use of nitrogen fertilizers is a common agricultural practice to boost crop productivity. These fertilizers can be categorized into two main types: organic and inorganic. Organic nitrogen sources, such as animal manure, compost, and leguminous cover crops, provide a slow-release form of nitrogen and improve soil structure over time. They are also considered more sustainable, as they contribute to enhanced soil organic matter, microbial activity, and long-term soil health.

In contrast, inorganic nitrogen fertilizers, including urea and ammonium nitrate, are widely used due to their rapid nutrient release and ability to meet immediate crop nutrient demands. However, the excessive or improper use of inorganic fertilizers has raised concerns regarding environmental pollution, soil acidification, and nutrient leaching. While they tend to result in quick growth and higher short-term yields, inorganic fertilizers may lead to long-term degradation of soil quality if not managed carefully.

Given these contrasting benefits and challenges of organic and inorganic fertilizers, it is crucial to evaluate their respective effects on crop growth, yield, and soil health, especially in regions like Ilorin where soil fertility management is a key concern.

## Research Problem

Despite the critical role of nitrogen in potato cultivation, the most effective and sustainable nitrogen sources for potato production in the Southern Guinea Savanna zone of Nigeria remain unclear. While many studies have focused on the impact of nitrogen fertilization on potato growth in other regions, there is a lack of specific research on how organic versus inorganic nitrogen sources affect potato yields and soil quality in the unique climatic and soil conditions of Ilorin. This research aims to address this gap by evaluating the response of potatoes to varying nitrogen rates from organic source. It will assess how each nitrogen source affects potato growth with a focus on determining the most suitable nitrogen management practices for sustainable potato farming in the Southern Guinea Savanna zone.

## Justification of the Study

This research is important for several reasons. First, it provides valuable information to farmers in the Southern Guinea Savanna zone on how to optimize nitrogen fertilization for potatoes. With rising concerns about environmental sustainability, understanding the trade-offs between organic and inorganic fertilizers is essential for promoting sustainable agricultural practices. Second, the findings could contribute to improving the productivity of potato farming in the region, supporting food security and enhancing the livelihoods of smallholder farmers. Lastly, the study offers insights into soil fertility management, which is critical in the context of increasingly erratic climatic conditions and the need for resilient farming systems

## Objectives of the Study

The objectives of this study involve the following:

i. Evaluate the effect of poultry droppings on sprouting percentage of Potato

ii. Effect of poultry droppings on growth parameters of Potato.

# CHAPTER TWO

# 2.0 LITERATURE REVIEW

## 2.1 Importance of Potato (Solanum tuberosum) in Agriculture

Potato (Solanum tuberosum) is a major staple crop, particularly in temperate and tropical regions. In Nigeria, potatoes are grown mainly in the highland areas, including parts of the Southern Guinea Savanna zone, and are valued for their high productivity per unit area. Potatoes are rich in carbohydrates, vitamins, and minerals, making them an important part of the diet for many communities. However, the production of potatoes is often hindered by low soil fertility, especially nitrogen deficiency, which is a critical limiting factor for growth and yield in many tropical soils. According to Okonkwo et al. (2014), potatoes require adequate nitrogen supply for optimum growth and tuber development. Nitrogen influences several key physiological processes in potatoes, including photosynthesis, protein synthesis, and the formation of chlorophyll, which are essential for plant development and productivity. The Southern Guinea Savanna zone, characterized by a tropical climate with distinct wet and dry seasons, presents unique challenges for potato cultivation, as the soil is often acidic and deficient in nitrogen, making the management of soil fertility crucial for successful cultivation.

## 2.2 Role of Nitrogen in Plant Growth and Yield

Nitrogen is an essential nutrient for plants, as it is a major component of amino acids, proteins, and chlorophyll, all of which are crucial for plant growth. Nitrogen is a mobile nutrient within the plant, and its availability directly impacts vegetative growth, tuber formation, and yield (Zhao et al., 2020). In potatoes, adequate nitrogen leads to increased leaf area, enhanced photosynthesis, and improved tuber bulking, all of which contribute to higher yields. However, nitrogen also plays a complex role in plant growth, as both nitrogen deficiency and excess can negatively affect crop performance. Inadequate nitrogen can result in stunted growth, yellowing of leaves (chlorosis), and reduced tuber size and yield, while excessive nitrogen can lead to excessive vegetative growth, delayed tuberization, and increased susceptibility to diseases (Marschner, 2012). Therefore, optimizing nitrogen application is key to achieving balanced growth and maximizing yields.

### 2.3 Nitrogen Fertilization: Organic

Organic nitrogen sources, such as farmyard manure, compost, and green manures, are derived from biological materials and are considered environmentally friendly alternatives to synthetic fertilizers. Organic fertilizers release nitrogen slowly, providing a steady supply of nutrients over time. Additionally, they improve soil structure, increase microbial activity, and enhance soil organic matter content, all of which contribute to long-term soil fertility and sustainability (Giller et al., 2017). In a study conducted by Sanz et al. (2019), the use of organic fertilizers was found to enhance soil microbial diversity and activity, which, in turn, improved nitrogen cycling and soil health. Organic sources of nitrogen have the added benefit of increasing soil organic matter, which helps improve soil water retention, aeration, and drainage, critical factors for potato cultivation in tropical regions. However, organic fertilizers are generally slow-acting, and their nutrient content can be variable, making them less reliable in meeting the immediate nitrogen demands of crops. For example, research by Adeyemi and Adediran (2015) found that potatoes fertilized with organic nitrogen sources showed moderate yield improvement compared to inorganic sources, but the results were less consistent across different seasons.

Most farmers in the tropics have adopted the use of mineral fertilisers, but the intensive use of this over time could constitute a setback to soil fertility (Phicot, et al., 1981, Isherwood, 2000). Another major limitation to the usage of chemical fertilisers is due to the adverse effects they have on plant quality and disease susceptibility. A continual dependence on chemical fertilisers may be accompanied by a fall in organic matter content, increased soil acidity, degradation of soil physical properties and increased rate of erosion due to instability of soil aggregates (Olowoake&Ojo, 2014).

However, the supply of inorganic fertiliser is inadequate and the farmers lack sufficient money to procure the fertiliser and, when supplied, the supply is often late. Inorganic fertilizer costs and the other constraints deter farmers from using them in the recommended quantities and in balanced proportions (Babatola et al., 2002). Unlike inorganic fertiliser, some organic fertilisers are cheap, easy to come-by, generally safe to use, are not poisonous and may be environmentally friendly. However, they must be applied to the crop in large quantities because the nutrient concentration is very low compared with inorganic fertiliser which would definitely result to high transportation cost of manure materials.

The prospect of obtaining enough chemical fertiliser to meet the requirements of the increasing population in the tropics is remote (Law-Ogbomo 2013). The current price of fertiliser calls for its economic utilisation to meet specific requirements of crops. The current world-wide shortage of fertiliser and its anticipated adverse effect on food production has made many countries to explore the value of organic manure to reduce pressure on the demand for mineral fertiliser as complementary use.

Research studies have shown that the use of inorganic fertiliser in combination with organic materials is able to give the desired higher and sustainable crop yields than the sole use of inorganic fertiliser or animal manure. (Ogunlade et al., 2011).

Total reliance on inorganic fertiliser or organic materials alone as fertiliser may not be realistic, use of organic fertiliser should be employed so as to sustain soil fertility management strategy for okra production. Several sources of organic materials and residues abound in Nigeria which can be processed, packaged and made available as branded organic fertiliser at a cheap rate for home gardening, horticulture and farming as a whole (Olowoake&Adeoye, 2010). Hence, the prospect of jatropha cake and organomineral as organic fertilisers needs to be further evaluated in greater details. jatropha cake contained up to 58% of crude protein by weight (Achtena et al., 2008). The percentages of nitrogen (N), phosphorous (P), and potassium (K) were 3.2-4.5%, 1.4-2.1%, and 1.2-1.7%, respectively. The presences of these elements were recognised as the organic nutrients sources that are even higher than that of chicken or cow manure (Srinophakun et al., 2012).

Some studies showed that organomineralfertiliser gave significant increases in yield of okra (Akanbi et al., 2004) and watermelon (Ojo et al., 2014). There is little or no information on the usage of jatropha cake and organomineralfertiliser for the production of okra in Ilorin, North-central Nigeria. The objective of this work is to investigate the growth and yield of okra as influenced by NPK, jatropha cake and a commercially available organomineralfertiliser on an Alfisol in Ilorin, Southern Guinea Savanna of Nigeria.

# CHAPTER 3

## 3.0 MATERIALS AND METHODS

### 3.1 Effect of Poultry Manure on growth and yield of Okra.

**3.1.2 Site Description** experiment was carried out in the nursery garden of the Department of Agricultural Technology, Institute of Applied Science, Kwara State Polytechnic Ilorin, Ilorin, Nigeria. Ilorin is in the Southern Guinea Savanna agro ecological zone of Nigeria.

### 3.1.3 Preparation of Planting Materials

The seeds were obtained from a reputable source at the department of Agronomy Faculty of Agriculture University of Ilorin, Ilorin. These seeds were subjecte to germination test, before planted.

### 3.1.4 Experimental Design and Plot layout

The potted experiment was laid out in completely randomized design (C R D) with three treatments replicated three times. These treatments include: 20g, 40g, 60g and Control making 12 experimental units were involved.

### 3.1.5 Planting

Planting was carried out in March/ April, 2025 during the later part of early rainy season. Seeds were sown at the rate of one seed per hole at 2cm deep; a total of three seeds per polythene bags were planted to give three stands. Five litres buckets capacity were used, properly perforated to allow drainage. They were filled with soil ¾ size of the buckets size.

### 3.1.6 Agronomic practices

Weeding was done manually by hand pulling weed, plants were irrigated using watering can once in a day for the first week and later followed by every two (2) days interval to avoid water logging.

### 3.1.7 Data Collection

Data were collected on the following parameters: number of seedlings sprout, percentage sprout, plant height, stem girth, number of leaves per plant.

i. Mean Plant height: This was taken on the plants from each polythene bag at four weeks after planting using a meter tape. The measurement was taken on each of the plant from the base to the upper most shoot/leaves.

ii. Number of leaves per plant: This was done by counting the leaves on each plant

iii. Stem Girth: This was determined by vernier caliper.OR, stem diameter was measured five centimeters above ground level using micrometer screw gauge and converted to girth using the following formula:

where, G is the stem girth, D is the stem diameter and π is a constant (π = 22/7).

### 3.1.8 DATA ANALYSIS

All data collected were subjected to Analysis of Variance (ANOVA). The analysis was done according to the completely randomized block design using SPSS analytical Software. OR All data collected were subjected to analysis of variance using the procedure GLM of SAS (SAS Institute, 2010). Where there was significant F-test, treatment means were separated using the Least Significant Difference (LSD) test at 5% probability level.

# CHAPTER FOUR

## 4.0 Results and Discussion

### 4.1 Results

Effects of poultry droppings on potato (Solanum tuberosum) in Southern Guinea Savanna of Nigeria.

4.2 Analysis of data

Table 1: Effect of poultry droppings on Potato Sprouting Percentage.

| Treatments | Emergence Percentage at 4 Weeks After Sowing ( WAS) |
|---|---|
| poultry droppings (g) | |
| 0 | 54.67a |
| 10 | 63.33c |
| 20 | 74.33b |
| 30 | 82.33d |
| se±0.05 | 8.381 |

Means followed by the same letter within a treatment group are not significantly different at 0.05 level of probability

Table 2: Effect of poultry droppings on Potato plant height (cm).

| treatments | Weeks After Sowing (WAS) | |
|---|---|---|
| | 4 | 6 |
| poultry droppings (g) | | |
| 0 | 3.83a | 6.67a |
| 10 | 4.50b | 7.17c |
| 20 | 5.83b | 8.67b |
| 30 | 6.83c | 9.67d |

| | | |
|---|---|---|
| se±0.05 | 0.489 | 1.000 |

Means followed by the same letter within a treatment group are not significantly different at 0.05 level of probability

Table 3. Poultry droppings on Potato leaf numbers.

| treatments | weeks after sowing (was)<br><br>4 | <br><br>6 |
|---|---|---|
| poultry droppings (g)<br><br>0 | <br><br>3.33 | <br><br>5.00 |
| 10 | 4.67 | 6.67 |

| | | |
|---|---|---|
| 20 | 5.00 | 7.33 |
| 30 | 6.33 | 8.00 |
| se$\pm_{0.05}$ | 2.830 | 0.774 |

Means followed by the same letter within a treatment group are not significantly different at 0.05 level of probability

Table 4. Poultry droppings on Potato Stem Girth.

| Treatments | Weeks After Sowing (WAS) | |
|---|---|---|
| | 4 | 6 |
| poultry droppings (g) | | |
| 0 | 0.50 | 1.00 |
| 10 | 0.60 | 1.50 |

| | | |
|---|---|---|
| 20<br><br><br>30 | 0.60<br><br><br>0.60 | 1.50<br><br><br>1.50 |
| se$\pm_{0.05}$ | 0.000 | 0.000 |

Means followed by the same letter within a treatment group are not significantly different at 0.05 level of probability

From the results above at Table 1 to 4, all the growth parameters collected for all other treatments were higher to that of control and at both week 4 and 6 of the sprouting percentage.

## DISCUSSION

### 4.2 Response of Potato Growth Characters to Poultry Manure Rates.

From the results above the sprouting percentage, plant height, number of leaves as well as stem girth shows there are significant differences between the control and the remaining treatments treated with poultry manure. Conventionally, poultry manure has been reported to be rich in nitrogen which supports vigorous vegetative growth in crops. Dademol *et al.* (2004) reported that nitrogen content in organic fertilizers enhanced leaf area production. Also, decomposition of manure increases macro and micro nutrients as well as enhancement of physico-chemical properties of the soil which helps to boost morphological growth. Perhaps another possibility for increased yield is mineralization of some compounds present in the poultry manure used which increased uptake of nitrogen, phosphorous and potassium which are essential for plant growth and development (Sendurkunaran *et al*., 1998). This study is agreed with the findings of Aliyu, (2002) who observed increase in plant height, number of leaves and branches with increase in stand density. Efficient utilization of applied nutrients probably induced optimum morphological growth that caused the increase in growth characters of the crop.

Also, this is in agreement with the work done by Senjobi *et al*. (2010) who reported that the use of organic manure (poultry, cow, goat, pig) improved all the growth parameters of leaf vegetables. They also help in better nutrient recycling (Elshakweer *et al*., 1998). This positive performance might have due to the better mineralization of the applied manure, and efficient use of the nutrients by the crop as well as pests and diseases attacked controlled.

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