*Technoscience Journal for Community Development in Africa* 4 (2025) 49–58
ISSN 2659-0573

*Research Article*

# Comparative effects of poultry manure and NPK top dress with urea on growth and yield of maize

**Aishat Atinuke Yusuf*, Adebayo Abayomi Olowoake**

Department of Crop Production, Kwara State University, Malete.

**Abstract:** The study aimed at determining the effects of poultry manure and NPK top dress with urea on the growth and yield of maize. The experiment was conducted using soil collected from a home soil and the Teaching and Research Farm of Kwara State University. The treatments included a Control, NPK, NPK 15-15 -15 RD (100% top dressed N with prilled urea), NPK 15-15 -15 RD (100% top dressed N with granular urea), NPK 15-15 -15 RD (100% top dressed N with neem- coated urea) and Poultry manure 10 t/ha. Treatments were laid out in a completely randomized design with three replications. Results show that application of different fertilizers improved soil chemical properties and maize growth and yield in both experimental soils; however, urea fertilizer top- dressed with NPK showed better maize growth than poultry manure. The study demonstrates that application of NPK top-dressed with granular urea and neem-coated urea significantly improved maize growth and kernel weight. This is attributed to the steady release of nutrients, particularly nitrogen, which supports cell division and growth. The effect of NPK top-dressed with nitrogen sources on soil fertility was positive, as it increased soil N, exchangeable K, organic carbon, and clay content after harvest.

**Keywords:** Maize, NPK fertilizer, Poultry manure, Urea

## 1. Introduction

Maize (Zea mays L.) is considered one of the most important crops in Nigeria, mainly because it provides energy. It is one of the most important cultivated cereal crops in Nigeria after sorghum and millet (FAOSTAT, 2022) and most widely grown cereals globally. Each year, it covers well over 33 million hectares. In 2024, global maize production was about 1.215 billion tons of maize grains (FAO, 2024). These grains are highly nutritious and are used to make many different products (Singh et al., 2017). In nutrient management, nitrogen is vital for crop growth and productivity, with balanced use of nitrogen, phosphorus, and potassium application, along with soil conservation and building-up of organic materials such as biomass for soil enrichment, especially due to soil degradation and access to chemical fertilizers. It is difficult, however, because fertilizer use can reduce efficiency in minimizing nutrient loss through leaching, runoff, emissions, and erosion. Nitrogen is the most critical nutrient, but it's lost from the soil as nitrate, with widespread applications using sound agricultural and chemical management (Sati et al., 2018, Rehman et al., 2021).

Nitrogen is the most important nutrient for plant growth and productivity. High and steady crop yields can be achieved by using balanced NPK fertilizers along with adding organic matter (Rehman et al., 2021). Nitrogen in the form of nitrate ions is easily lost from the soil because these ions carry a negative charge and do not stick to the soil particles as well as ammonium ions do. As a result, rain can leach out nitrates from the soil (Bijay-Singh and Craswell, 2021). Early fertilizer application helps boost crop yield, while top-dressing with nitrogen replaces the nitrogen lost from the soil before the roots are fully developed. Urea fertilizers play a key role in important chemical processes in crops such as the production of chlorophyll, and they are often

* Corresponding author
Email: yusufatinukeaishat@gmail.com

KWASU PRESS AND PUBLISHING

not enough in the soil (Adepetu et al., 2014, Chen et al., 2020). This can limit how effectively and profitably crops are grown. A lot of urea fertilizer used in farming is lost through runoff, gas emissions, erosion, and leaching, because nitrogen moves easily in the soil, and this leads to pollution of groundwater and eutrophication (Chen et al., 2020). Coating urea granules with neem oil (oil extracted from Azadirachta indica) to produce neem-coated urea (NCU) has good nitrification inhibitory actions (Ghafoor et al., 2021).

Neem - coated urea helps to slow down the release of nitrogen from urea, so it stays in the soil longer and becomes available to plants over a longer time with less loss. This makes it easier for plants to use nitrogen and helps increase the number of crops grown (Singh et al., 2019; Ghafoor et al., 2021). Ramappa et al. (2022) found that neem- coated urea also stops nitrogen from escaping through processes like volatilization, leaching, runoff, and denitrification. When regular prilled urea is added to soil, it quickly turns into ammoniacal nitrogen and then into nitrite and nitrate forms by bacteria. If this happens too quickly, nitrogen may escape into the air and plants won't be able to use it. Therefore, controlling urea hydrolysis and nitrification is important for better crop production and better use of nitrogen. Prilled urea has a high nitrogen content, about 46%, and dissolves quickly in water, making it a strong source of nitrogen for plants. Different ways to use this fertilizer include spreading it over the field, using it in irrigation, and mixing it into blended fertilizers (Snyder et al., 2017). Granular urea is also widely used in growing crops like cereals and legumes. Its slow release matches the growth needs of these crops, especially cereals, making sure nutrients are available during the entire growing season. It contains about 46% nitrogen and is a solid form of nitrogen fertilizer. It is made from ammonium and carbon dioxide and has the highest nitrogen content of any solid nitrogen fertilizer.

Poultry manure is a good source of nutrients and is a good alternative to chemical fertilizers. It helps increase soil organic matter, which helps keep the soil productive (Saha et al., 2008, Du et al., 2020). Using manure instead of synthetic fertilizers helps keep the soil productive for a longer time in many crops (Anand et al., 2019). Poultry manure works as a natural fertilizer with high nitrogen and other essential nutrients. It also helps improve the soil by adding organic matter. While synthetic fertilizers are widely used, their chemical composition can harm soil health in the long run. Poultry manure offers a natural alternative, but its nutrient release patterns are unpredictable (Das et al., 2015). The potential of using N sources fertilizer as top dressing to enhance maize growth and yield has not been fully explored. This study aims to compare effects of poultry manure and NPK top dress with urea on growth and yield of maize.

## 2. Materials and methods

### *2.1. Experimental site*

Pot experiment was carried out at the Kwara State University Screenhouse (Latitude 80 71'N and Longitude 40 44'E) Malete. Soil used for the experiment was from Airport home farm, Ilorin, Kwara State University Teaching and Research farm Malete. Ilorin, Nigeria, which lies in the Southern guinea savanna belt of Nigeria. The annual rainfall in the area is about 1200mm and temperature varies between 33O C and 34O C during the year, with a distinct dry season from December to March (Olowoake, 2014). The soils of Ilorin are predominantly derived from ferruginous and crystalline acidic rocks and are predominantly Alfisols (Afe et al., 2024).

### *2.2. Plant and fertilizer materials*

Maize seeds, NPK and Urea fertilizers were sourced from CAN Agro Allied stores in Ilorin, Kwara state, while Poultry manure was sourced from Al farm farms, Adeta, Ilorin.

### *2.3. Soil analysis*

Soil samples from the experimental sites were collected, at a depth of 0–15 cm using a soil auger. The samples were air-dried and sieved with a 2mm sieve, then analysed to determine the physical and chemical properties of the samples before and after the experiment. Soil particle size was determined by the hydrometer method (Bouyoucos, 1962), soil organic carbon was determined by (Nelson et al., 1982), and total nitrogen was evaluated by the (Walkley and Black, 1982) method and the micro Kjeldahl digestion method (Bremner and Mulvancy, 1982), respectively. Available P was extracted using Bray and Kurtz (1945) method and exchangeable bases (Ca, Na, Mg, and K) were extracted with Ammonium Acetate solution (1M NH4OAC). The flame photometer measured K and Na concentrations, while the atomic absorption spectrophotometer determined the concentration of Mg and Ca. The pH of the soil water was determined in 0.01M CaCl2 solution with a glass electrode pH meter and an electrical conductivity of 1:5 (w/v) in the deionizer water suspension. The soil analysis was carried out before and after the experiment.

*2.4. Experimental design and treatment*

The treatments used for the study were; control, NPK 15-15-15, NPK 15-15 -15 RD (recommended dose) (100% top dress N by prilled urea), NPK 15-15 -15 RD (100% top dressed N with granular urea). NPK 15-15 -15 RD (100% top dressed N with neem- coated urea) and Poultry manure at 10 t/ha. The chemical composition of the fertilizers is presented in (Table 1). Thirty-six pots were filled with 30 kg of soil leaving about 5cm from the soil surface to the top of each pot for adequate watering and to prevent the soil from being washed away during watering. The pots were perforated at the bottom to allow free flow of water out of the pot and avoid salt accumulation at the root zone of the plant. Maize was used as a test crop. The experimental design was a completely randomized design (CRD) with three replications. Watering and weeding were done throughout the experimental period. The plants were grown for twelve weeks after which they harvested.

**Table 1:** Chemical composition of poultry manure and Neem coated urea

| | NUTRIENT (%) | | |
|---|---|---|---|
| | Nitrogen (N) | Phosphorus (P) | Potassium (K) |
| Poultry manure | 2.50 | 0.21 | 3.41 |
| Neem coated urea | 37.0 | 0.08 | 0.11 |

*2.5. Data collection and analysis*

Data were collected at 4, 8 and 12 weeks after sowing on the following parameters: Plant height, number of leaves, leaves area, stem girth, number of cobs, cob length and kernel weight. Plant stem girth was determined using vernier caliper. Numbers of leaves was counted. The stem girth was measured using calipers. Leaf area was calculated as Length x breadth x 0.75 (Mananze et al., 2018). Kernel weight was measured using sensitive scale. All data collected were subjected to an analysis of variance using DSAASTAT. 1.101 version software. The treatment means were separated using the Duncan Multiple Range Test at 5% probability.

## 3. Results and discussions

Table 2 shows the results of the physical and chemical analysis of the two experimental soils before planting. Soils of the two experimental soils (NCAM and Malete) were generally low in total N, K and organic carbon. Thus, the soil requires fertilizers or soil amendment to improve its fertility. Although it was observed to be rich in available phosphorous. The available phosphorous of 21 and 22.4 mg/kg was higher than the critical level of 10-16mg kg-1 (Olowoake et al., 2024). The K status of the soil at 0.14 and 0.15 cmol/kg was below the critical level of 0.2 cmol kg-1 (Adeoye, 1986, Olowoake et al., 2024). Exchangeable magnesium values of 1.07 and 1.11 cmol/kg were higher than the critical level of 0.20 - 0.40 cmol/kg-1 (Adeoye and Agboola, 1985, Olowoake et al., 2024). Calcium values of 3.11 and 3.34 cmol/kg were above the critical level of 2.6 cmol/kg (Olowoake et al., 2024). These finding indicates that the soil could be poor in nutrients supply. This inherent low nutrient status of Savannah soil has been reported due to continuous farming and the indiscriminate application of synthetic fertilizers that are common among the farmers in the zone (Olowoake et al., 2024).

**Table 2:** Physical and chemical properties of experimental soils.

| Soil properties | Test Value | |
|---|---|---|
| | Airport | Malete |
| pH | 6.5 | 7.63 |
| Organic carbon (g/kg) | 0.14 | 0.67 |
| Total nitrogen (g/kg) | 0.12 | 0.13 |
| Available phosphorus (mg/kg) | 21 | 22.4 |
| Exchangeable bases (cmol/kg) | | |
| K | 0.14 | 0.15 |
| Na | 0.30 | 0.37 |
| Ca | 3.11 | 3.34 |
| Mg | 1.07 | 1.11 |
| Extractable micronutrients (mg/kg) | | |
| Fe | 68.0 | 71.0 |
| Cu | 1.10 | 1.14 |
| Zn | 1.69 | 1.77 |
| Mn | 29.8 | 34.0 |
| Particle size (%) | | |
| Sand | 78 | 80 |
| Silt | 12 | 11 |
| Clay | 10 | 9 |
| Textural class | Loamy sand | Loamy sand |

**Table 3:** Effect of NPK top-dress with different urea types and poultry manure on plant height of maize at Airport and Malete site.

| Treatment | Plant height (cm) | | | | | |
|---|---|---|---|---|---|---|
| | Airport | | | Malete | | |
| | ------------------ WAP -------------- | | | -------------------WAP ------------ | | |
| | 4 | 8 | 12 | 4 | 8 | 12 |
| Control | 19.0d | 58.3b | 63.7b | 34.2a | 61.9b | 72.0d |
| NPK | 24.3c | 97.0a | 102.8a | 20.0a | 86.3a | 89.0cd |
| NPK/GU | 35.4b | 100.3a | 104.0a | 39.2a | 84.5a | 93.0c |
| NPK/NCU | 39.0ab | 97.3a | 103.4a | 40.3a | 91.9a | 102.0b |
| NPK/PU | 40.7a | 98.0a | 104.7a | 40.2a | 91.8a | 110.0a |
| Poultry manure | 26.7c | 61.2b | 65.3b | 29.5a | 64.6b | 94.0c |

Mean followed by the same letter(s) in a column are not significantly different at ($P<0.05$) by Duncan's Multiple Range Test (DMRT)

Legend:

NPK/PU: NPK 15-15-15, NPK 15-15 -15 RD (100% top dressed N with prilled urea),

NPK/NCU: NPK 15-15 -15 RD (100% top dressed N with neem- coated urea)

NPK/GU: NPK 15-15 -15 RD (100% top dressed N with granular urea)

### *3.1. Growth and yield parameters of maize as influenced by NPK topdressing with urea*

Table 3 presents the response of maize to poultry manure and NPK top-dressing with urea at 4, 8 and 12 weeks after planting in two soils under the pot experiment. The height of maize was significant ($P<0.05$) and increased with the application of NPK 15-15-15 top dress with urea fertilizers in airport experimental site and were significantly higher ($P<0.05$) when compared with the application of Poultry manure 10 t/ha and control treatment. Also, in Malete soil, there was no significant difference among the treatment at 4 weeks after planting. However, at 8 weeks after planting, the top dressing of NPK with neem coated urea fertilizers resulted in higher plant height than poultry manure and control. But 12 weeks after planting, the values of NPK 15-15 -15 RD (100% top-dress N by prilled urea) was significantly different to other treatment at 12 weeks. Control treatment produced the lowest plant height consistently. The significant increase in plant height reflects the effect of fertilizer nutrients, N, P and K. The untreated plants were low in growth as they relied on native soil fertility which chemical analysis showed to be deficient in these nutrients. Plant height is an important growth character directly linked with the productive potential of plants in terms of grains. An optimum plant height is claimed to be positively correlated with plant productivity (Saeed et al., 2001). Similarly, a study by Safdar et al. (2012) and buttress by (Singh, 2016) suggested that the steady increase in height of plants when treated with prilled urea and Neem coated urea could be as a result of steady release pattern to meet plant nutrient requirement which could also boost synthesis of chlorophyll, induced cell division, and cell expansion leading to stimulated cell elongation along the main axis, which increased in number and length of internodes and the resultant increase in plant height (Safdar, 2012).

Results on Airport Home Farm and Malete soils show that the number of leaves differed significantly ($P<0.05$) among the different fertilizer treatments (Table 4). At 4, 8, and 12 weeks after planting, the fertilized maize plant in Airport soil had a higher number of leaves per plant than the control treatment. The application of NPK 15-15 -15 RD (100% top-dressed N with granular urea), produced the highest number of leaves at 4, 8 and 12 weeks after planting consistently. NPK fertilized treatment decreased significantly ($P<0.05$) at 8 and 12 weeks after planting. In Malete Soil, the application of NPK 15-15 -15 RD (100% top-dressed N with prilled urea) produced higher number of leaves than other treatments and was significantly different from all other treatments including control at 4 and 8 weeks after planting. But at 12 weeks after planting, NPK 15-15 -15 RD (100% top-dress N with neem coated urea) produced more leaves than other treatments. However, it was not significantly ($p<0.05$) different from the leaves produced from NPK 15-15-15, NPK 15-15 -15 RD (100% top dress N with prilled urea) and Poultry manure 10 t/ha. Similarly, control treatment produced the lowest number of leaves at both airport and Malete soils; this might be as a result of low nutrients status of the soil especially N and K.

The higher number of leaves obtained in pot treated with NPK 15-15 -15 RD (100% top dress N with prilled urea) over the poultry manure in the airport soil could be attributed to the immediate availability of nutrients in the chemical fertilizer. Singh et al. (2019) reported

**Table 4:** Effect of NPK top dress with different urea types and poultry manure on number of leaves of maize at Airport and Malete site.

| Treatment | Number of leaves | | | | | |
|---|---|---|---|---|---|---|
| | Airport | | | Malete | | |
| | ------------------ WAP -------------- | | | -------------------WAP ----------- | | |
| | 4 | 8 | 12 | 4 | 8 | 12 |
| Control | 4.0b | 5.7c | 6.8c | 6.0c | 7.5d | 8.5c |
| NPK | 5.0ab | 6.8bc | 7.7bc | 8.2bc | 9.1bc | 10.9ab |
| NPK/GU | 6.3a | 9.0a | 9.7a | 9.2ab | 10.2ab | 10.3b |
| NPK/NCU | 6.0a | 8.5a | 9.5a | 8.3bc | 9.1bc | 11.9a |
| NPK/PU | 6.3a | 7.7ab | 8.8ab | 9.5a | 10.5a | 10.5ab |
| Poultry manure | 5.3a | 8.0ab | 8.8ab | 7.7c | 8.5cd | 1.6ab |

Mean followed by the same letter(s) in a column are not significantly different at (P<0.05) by Duncan's Multiple Range Test (DMRT)

Legend:

NPK/PU: NPK 15-15-15, NPK 15-15 -15 RD (100% top-dressed N by prilled urea),

NPK/NCU: NPK 15-15 -15 RD (100% top dressed N by neem coated urea)

NPK/GU: NPK 15-15 -15 RD (100% top dress N by granular urea)

that a steady increase in the number of leaves in plants treated with prilled urea and neem-coated urea is due to the enhanced and more efficient supply of nitrogen, an essential nutrient for vigorous vegetative growth.

Table 5 shows the results obtained on leaves area of maize at 4, 8 and 12 weeks after planting. It was observed that treatments differed significantly (Table 5). At 4 weeks after planting, leaves area of maize from NPK and NPK top dress with granular urea, neem coated urea and prilled urea treated pot in Airport soils were significantly different from leaves area of maize obtained from poultry manure and control. At 8 weeks after planting, it was observed that the application of NPK 15-15 -15 RD (100% top dressed N by neem-coated urea) resulted in highest leaf area than other treatments. At 12 weeks after planting, leaf area obtained from NPK, NPK/PU, NPK/NCU and NPK/GU did not differ significantly but were significantly different from leaf area from poultry manure and control. Furthermore, treatments differed significantly (P<0.05) in Malete soil for leaf area at 4, 8 and 12 weeks after planting. At 4 weeks after planting, all the fertilized maize pot produced higher leaf area than the control. However, at 8 weeks after planting, the application of NPK 15-15 -15 RD (100% top-dressed N with neem-coated urea) resulted in a higher leaf area than leaf area obtained from all other treatments including control. Also, at 12 WAP, NPK/NCU produced higher leaf area which was

**Table 5:** Effect of NPK top dress with different urea types and poultry manure on Leave area of maize at Airport and Malete site

| Treatment | Leaves area (Cm$^2$) | | | | | |
|---|---|---|---|---|---|---|
| | Airport | | | Malete | | |
| | ------------------ WAP -------------- | | | --------------------WAP ------------- | | |
| | 4 | 8 | 12 | 4 | 8 | 12 |
| Control | 87.7b | 201.0c | 302.4a | 205.9b | 228.1c | 255.0d |
| NPK | 163.0a | 366.3b | 416.7a | 345.8a | 379.0b | 394.4b |
| NPK/GU | 184.8a | 260.4c | 316.0a | 318.0a | 349.4b | 363.3c |
| NPK/NCU | 187.7a | 411.3a | 414.1a | 345.8a | 392.0a | 414.9a |
| NPK/PU | 161.7a | 299.7bc | 313.3a | 319.3a | 346.3b | 371.5c |
| Poultry manure | 100.5b | 222.7c | 347.3a | 306.9a | 341.5b | 393.6b |

Mean followed by the same letter(s) in a column are not significantly different at (P<0.05) by Duncan's Multiple Range Test (DMRT)

Legend:

NPK/PU: NPK 15-15-15, NPK 15-15 -15 RD (100% top dressed N with prilled urea),

NPK/NCU: NPK 15-15 -15 RD (100% top dressed N with neem- coated urea)

NPK/GU: NPK 15-15 -15 RD (100% top dressed N with granular urea) significantly different from all other fertilizer treatments including control. Control treatment consistently produced the lowest leaves area than other treatments. The low performance of the poultry manure on maize leaf area could be due to slow rate of decomposition of organic fertilizer compared with NPK. Generally, from the study, there was an increase in the leaf area of maize from the pot treated with NPK/NCU in both Airport home farm and Malete soils, Mustapha et al. (2022) reported that the increased leaf area in maize treated with NPK/NCU is likely due to the enhanced nitrogen use efficiency (NUE) from the neem coating, which reduce nitrogen release and makes nitrogen available to plant for photosynthesis and vegetative growth. The N,P, and K from the NPK fertilizer also provide essential nutrients for overall growth, directly contributing to a larger leaf area for increased light capture and dry matter production.

Stem girth of maize at 4, 8 and 12 weeks after planting differed significantly (P<0.05) among the different treatments as presented on (Table 6). At 4 WAP, Airport home farm soil shows that there was no significant difference from the stem girth produced from application of NPK 15-15 -15 RD (100% top dressed N with neem- coated urea), NPK 15-15-15 and NPK 15-15 -15 RD (100% top dress N by granular urea). However, at 8 and 12 weeks after planting, the application of NPK 15-15-15 and NPK 15-15 -15 RD (100% top dressed N with granular urea) produced consistent higher stem girth than other fertilizer types. Furthermore, in Malete soil, stem girth of maize differed significantly (P<0.05) among treatments. The application of NPK and NPK top-dressed with urea, prilled urea and neem- coated urea fertilizers on maize resulted in significantly high stem girth than the stem girth obtained from pot treated with poultry manure and control. Olowoake et al. (2024) reported that the higher maize stem girth from NPK and urea-based fertilizers over poultry manure is due to the faster release and greater availability of essential nutrients, particularly nitrogen, which is crucial for robust vegetative growth in maize. While poultry manure also provides nutrients, its mineralization rate is slower, leading to a delayed and less intense growth response compared to the immediate nutrient supply from inorganic fertilizers.

### *3.2. Yield parameters as influenced by NPK top dress with urea-based fertilizers and poultry manure*

Table 7 shows that there were significant (P<0.05) differences in yield parameters of maize among the fertilizer treatments treated with soils from Airport home farm and Malete. Results from Airport soil showed that there was no significant difference from the cob length of maize produced from NPK 15-15-15 and Poultry manure 10 t/ha, However, the maize cob length from both fertilizers were significantly higher than the cob length obtained from other fertilizer treatments including control Furthermore, there was no significant different (P<0.05) among the number of cobs produced from the pot treated with fertilizers. Kernel weight indicates varied difference (P<0.05) among the different fertilizer applied. The results showed that kernel weight of maize obtained from the fertilized maize treatments were higher than the control. Control produced the lowest cob

**Table 6:** Effect of NPK top dress with different urea types and poultry manure on Stem girth of maize at Airport and Malete site.

| Treatment | Stem girth (cm) | | | | | |
|---|---|---|---|---|---|---|
| | Airport | | | Malete | | |
| | ------------------ WAP -------------- | | | --------------------WAP ----------- | | |
| | 4 | 8 | 12 | 4 | 8 | 12 |
| Control | 5.90d | 3.40c | 3.90d | 2.2c | 3.2c | 5.0c |
| NPK | 15.80ab | 6.70a | 7.00a | 5.2a | 6.6a | 7.8a |
| NPK/GU | 15.46ab | 6.49ab | 7.54ab | 5.0a | 6.4a | 8.1a |
| NPK/NCU | 16.10a | 5.30b | 6.30bc | 5.2a | 6.4a | 7.2ab |
| NPK/PU | 14.81b | 5.23b | 6.80abc | 5.0a | 6.6a | 7.4ab |
| Poultry manure | 11.50c | 5.30b | 5.90c | 3.5b | 5.4b | 6.6b |

Mean followed by the same letter(s) in a column are not significantly different at (P<0.05) by Duncan's Multiple Range Test (DMRT)

Legend

NPK/PU: NPK 15-15-15, NPK 15-15 -15 RD (100% top dressed N with prilled urea),

NPK/NCU: NPK 15-15 -15 RD (100% top dressed N with neem -coated urea)

NPK/GU: NPK 15-15 -15 RD (100% top dressed N with granular urea)

**Table 7:** Yield parameters as influenced by NPK top dress with different urea types and poultry manure on the growth and yield of maize (Airport and Malete site)

| Treatment | Airport | | | Malete | | |
|---|---|---|---|---|---|---|
| | Cob length | No of cobs | kernel wgt | Cob length | No of cobs | Kernel wgt |
| Control | 12.3d | 1.5a | 25.7b | 10.0b | 1.2a | 25.0b |
| NPK | 19.0a | 1.3a | 29.0a | 17.3a | 1.5a | 29.9a |
| NPK/GU | 16.3bc | 1.5a | 30.4a | 16.5a | 1.8a | 29.9a |
| NPK/NCU | 16.7bc | 1.5a | 28.8a | 16.4a | 1.3a | 28.9a |
| NPK/PU | 15.3c | 1.3a | 29.1a | 16.2a | 1.5a | 28.5a |
| Poultry manure | 18ab | 1.5a | 31.3a | 16.8a | 1.3a | 29.8a |

Mean followed by the same letter(s) in a column are not significantly different at (P<0.05) by Duncan's Multiple Range Test (DMRT)

Legend:

NPK/PU: NPK 15-15-15, NPK 15-15 -15 RD (100% top dressed N with prilled urea),

NPK/NCU: NPK 15-15 -15 RD (100% top dressed N with neem- coated urea)

NPK/GU: NPK 15-15 -15 RD (100% top dressed N with granular urea)

length and kernel weight respectively. At Malete soil, there was no significant difference (P<0.05) among the cob length obtained from the pot treated with fertilizers excluding control. All the fertilized maize plants resulted in higher cob length and kernel weight when compared to control treatment. Studies have shown that, when organic and inorganic fertilizers are applied at the same rates especially in terms of macronutrients (N, P, and K), similar effects in crop yields are obtained (Celestina et al., 2019). Although, there was no significant variation between NPK 15-15-15 and poultry manure treatments, the application of NPK 15-15-15 showed better performance attributes than poultry manure in terms of cob length. Chemical fertilizer treatment considerably boosted maize growth, physiological characteristics, and yield component, according to the study by (Chi et al., 2022). It was further observed by Zhang et al. (2022) that using recommended rates of inorganic and organic fertilizers boosted crop growth, yield and supplied adequate NPK and enhanced soil health. This observation could be attributed to improved nutrient availability and uptake in maize plant, which might have resulted in a balanced C/N ratio of plant and boosted plant metabolism.

Table 8 shows the physical and chemical properties of Malete and Airport farm soil after harvest. Soil chemical properties show significant difference (P<0.05) among different fertilizers. Malete soil at harvest stage of maize shows that pH ranges from 6.53 in control pot to 7.43 in NPK/NCU pot. The application of poultry manure 10 t/ha produced higher value of available P (23.0 mg/kg) when compared to 20.0 mg/kg in NPK treated pot. Also, the K content of soil ranges from 0.10 cmol/kg in control to 0.17 cmol/kg in NPK/PU. This agrees with Swify et al. (2024) who reported that urea hydrolysis (e.g. from prilled urea application) can raise the soil pH temporarily, this shift in pH may reduce potassium fixation and enhance K availability in the soil.

Poultry manure 10 t/ha had the highest organic carbon content of 1.14 compared to 1.12 in NPK 15-15-15 treated plant. These findings supported the report of Javed and Khan (2019) that the nutrients in poultry manure are released slowly as the organic matter decomposes. This process of decomposition is what makes organic carbon available to soil microbes and plants. NPK fertilizer provides a rapid release of nutrients in a readily available form, which is beneficial for immediate plant uptake but does not build the long-term carbon reservoir of the soil.

Total nitrogen varied significantly (P<0.05) and ranged from 0.09 g/kg in control to 0.21 g/kg in NPK 15-15 -15 RD (100% top dress N by granular urea). Hence applying granular urea as top-dressing increases soil nitrogen because it is a highly concentrated nitrogen source. This is in line with the work of Trenkel (2010). The soil physical properties also varied significantly (P<0.05) among different fertilizer treatments.

Furthermore, the mean value of the soil pH for the Airport farm experimental soil ranged from 7.36 in control to 7.72 in NPK 15-15 -15 RD (100% top dressed N with prilled urea. Soil available P varied significantly and ranged from 16.4 mg/kg in control to 24.3 mg/kg in poultry manure. Abubakar and Aruku (2019) reported that poultry manure increased phosphorus (P) in the soil than inorganic fertilizers due to a combination of factors related to its organic nature. While inorganic fertilizers provided P in a readily available, but often short-lived form, poultry manure offers a more stable and complex P

**Table 8:** Physicochemical properties of soil after planting

| Treatment | $pH(H_20)$ | P (mg/kg) | K | OrgC | N (g/kg) | Clay | Silt | Sand |
|---|---|---|---|---|---|---|---|---|
| | | | ------- (cmol/kg)---- | | | ---------------% -------------------- | | |
| | | | Malete | | | | | |
| Control | 6.53d | 18.0d | 0.10c | 0.12c | 0.009d | 10.3a | 11.6ab | 78.0b |
| NPK | 7.36a | 20.0c | 0.16a | 1.12a | 0.18b | 9.0c | 13.0a | 78.0b |
| NPK/GU | 7.03c | 21.0b | 0.11c | 0.90b | 0.21a | 9.6abc | 10.0b | 80.3a |
| NPK/NCU | 7.20bc | 21.5b | 0.11c | 0.89b | 0.12c | 8.6c | 11.3ab | 80.0a |
| NPK/PU | 7.43 | 23.0a | 0.17a | 0.14c | 0.16b | 9.3ac | 10.6b | 80.0a |
| Poultry manure | 7.13d | 23.0a | 14.0b | 1.14a | 0.18b | 10.3ab | 11.0b | 79.0ab |
| | | | Airport Farm | | | | | |
| Control | 7.36c | 16.4f | 0.15b | 0.38d | 0.13bc | 8.6bc | 10.6a | 80.3ab |
| NPK | 7.60b | 18.7e | 0.23ab | 0.67c | 0.2ab | 8.3c | 11.3a | 80.0ab |
| NPK/GU | 7.65ab | 21.1c | 0.22ab | 0.86b | 0.22a | 9.6ab | 10.6a | 81.0ab |
| NPK/NCU | 7.65ab | 22.4b | 0.22ab | 1.12a | 0.08c | 10.3a | 9.3a | 81.0ab |
| NPK/PU | 7.72a | 20.4d | 0.23ab | 1.13a | 0.25a | 8.3c | 9.3a | 80.3ab |
| Poultry manure | 7.73b | 24.3b | 0.26a | 1.12a | 0.17ab | 9.0bc | 9.6a | 82.0a |

Mean followed by the same letter(s) in a column are not significantly different at ($P<0.05$) by Duncan's Multiple Range Test (DMRT)

Legend:

NPK/PU: NPK 15-15-15, NPK 15-15 -15 RD (100% top dressed N with prilled urea),

NPK/NCU: NPK 15-15 -15 RD (100% top dressed N with neem coated urea)

NPK/GU: NPK 15-15 -15 RD (100% top dressed N with granular urea)

source that improves soil health and nutrient availability over time.

Soil potassium content (K) also varied among different fertilizer applications. The K value ranged from 0.15 cmol/kg in control to 0.26 cmol/kg when treated with poultry manure. The organic content of the soil ranged from 0.38 g/kg in control to 1.13 g/kg in NPK 15-15 -15 RD (100% top dressed N by prilled urea) treated plant. Total nitrogen of the soil ranged from 0.08 g/kg in control to 0.25 g/kg in the pot treated with poultry manure. Poultry manure had higher soil N post-harvest, which agrees with Abubakar and Aruku (2019) that reported that poultry manure not only provides potassium but also a host of other macro- and micronutrients and, critically, organic matter. This organic matter improves soil structure, water retention, and microbial activity. The combination of these factors creates a healthier soil environment where all nutrients, including potassium, are used more efficiently by the plants. Furthermore, the physical properties of the soil varied significantly among different fertilizer treatments.

## 4. Conclusion

Among the treatments, poultry manure at 10 t/ha was found to be a highly effective soil amendment, greatly increasing both vegetative growth and kernel weight. This result can be due to the dual benefits of organic manure, which not only offers critical macro- and micronutrients but also enhances the soil's physical properties, such as water retention and structure, to ensure plant health. The application of NPK 15-15-15 RD (100% top dressed N by granular urea) and NPK 15-15-15 RD (100% top-dressed N with neem coated urea) resulted in the most significant increase in maize growth and kernel weight in potted soil from Airport farm and Malete Teaching and Research farm, making these the most agronomically effective treatments. However, poultry manure treatment has emerged as a viable option, providing long-term soil health benefits not afforded by synthetic fertilizers.

## References

Abubakar, M. M. and Aruku, O. B. (2019) Different organic manure sources and NPK fertilizer on soil chemical properties, growth, yield and quality of okra. *Scientific Reports, 9(1),* 1-11.

Adeoye, G. O. and Agboola, A. A. (1985) Critical levels for soil pH, available P, K, Zn and Mn and maize ear leaf content of P, Cu and Mn on sedimentary soils of southwestern Nigeria. *Fertilizer Research, 6(1),* 65-67

Adeoye, G.O. (1986) Comparative studies of some extractants for sedimentary soil of South Western Nigeria. Ph.D. Thesis, University of Ibadan, Ibadan. 201pp

Adepetu, J.A., Adetunji, M.T. and Ige, D.V. (2014) Soil and Fertilizer Nitrogen. In: Soil Fertility and Crop Nutrition. Jumak Publishers, Ringroad Ibadan, 202-215

Afe, A. I., Olowoake A. A., Akure, C. O. and Babatunde, M. R. (2024) Comparative study of cucumber (Cucumis sativus L.) cultivars under organic fertilizer treatments in the Southern Guinea Savanna, Nigeria. *Int. J. Recycling and Organic Waste Agriculture, 13(3),* 1- 10.

Anand M R, Kumar H D S, Kommireddy P and Murthy K N K (2019). Secondary and micronutrient management practices in organic farming- An Overview. *Curr Agri Res 7*, 4-18

Bijay-Singh and Craswell, E. (2021) Fertilizers and nitrate pollution of surface and ground water: an increasingly pervasive global problem. *SN Applied Science 3*,518. https://doi.org/10.1007/s42452-021-04521-8.

Bouyoucos, G.J. (1962). Hydrometer method improved for making particle size analysis of soil.

Bray, R.H. and Kurtz, L.T. (1945) Determination of total organic and available forms of phosphorus in soils. *Soil Science, 59,* 39-45

Bremner, J. M. and Mulvaney, C. S. (1982) Nitrogen total. In: Methods of Soil Analysis Part 2. (eds. A.L. Page, R.H. Miller and D.R. Kenney). SSSA. Madison. USA. pp. 595-624.

Celestina, C.; Hunt, J.R.; Sale, P.W.; Franks, A.E. (2019) Attribution of crop yield responses to application of organic amendments: A critical review. *Soil Tillage Res. 186,* 135–145.

Chen Z, Wang Q, Ma J, Zou P, Jiang L. (2020) Impact of controlled-release urea on rice yield, nitrogen use efficiency and soil fertility in a single rice cropping system. *Scientific reports, 10(1)*,1-10.

Chi, Y. X., Gao, F., Muhammad, I., Huang, J. H., and Zhou, X. B. (2022) Effect of water conditions and nitrogen application on maize growth, carbon accumulation and metabolism of maize plant in subtropical regions. *Archives of Agronomy and Soil Science,* 1-15

Das, S. K. and Jana, K. (2015) Effect of foliar spray of watersoluble fertilizer at pre flowering stage on yield of pulses. *Agricultural Science Digest-A Research Journal, 35(4),* 275-279

Du, S., Bai, G., Yu, J., Li, P., Yang, L., and Yang, T., (2020) Manure application accumulates more antiobiotcs in soil than fertilization in the long term. *Agriculture, Ecosystems and Environment, 302,* 107071

FAO (2024) Cereal supply and demand brief. faostat.fao.org

FAO. (2022) FAOSTAT database results. Food and Agriculture Organization (FAO) 2022. Retrieved from http://faostat.fao.org

Ghafoor I, Habib-ur-Rahman M, Ali M, Afzal M, Ahmed W, Gaiser T, Ghaffar A. (2021) Slow-release nitrogen fertilizers enhance growth, yield, NUE in wheat crop and reduce nitrogen losses under an arid environment. *Environmental Science and Pollution Research, 28(32),* 43528-43543

Javed, S. A., and Khan, H. A. (2019) Managing organic manures for carbon sequestration to improve soil health and sustained vegetable yield. *Pakistan Journal of Analytical and Environmental Chemistry, 20(1),*58-69.

Mananze, S. E., PÃ´Ã§as, I., and Cunha, M. (2018) Maize leaf area estimation in different growth stages based on allometric descriptors. *African Journal of Agricultural Research, 13(4),* 202-209.

Mustapha, M., Dzomeku, I. K. and Abdulai, Y. (2022) Nitrogen uptake and grain yield of maize (Zea mays L.) as influenced by soil amendments of neem (Azadirachta indica L.) cake and oil extracts and NPK fertilizer in Guinea savannah zone of Ghana. *GSC Advanced Engineering and Technology, 04(02),* 032–041. https://doi.org/10.30574/gscaet.2022.4.2.0056

Nelson, D. W., and Sommers, L.E. (1982) *Total carbon, organic content and organic matter*. In A. L Page, R. H., Miller, and D. R. Keeney (Eds.) Methods of soil Analysis, part 2: chemical and microbiological properties (2nd ed., pp. 539-579). American society of Agronomy and soil science society of America

Olowoake A. A., Ojo, J. A., and Afe A. I. (2024) Effects of sources of nitrogen fertilizers on soil chemical properties, growth and dry matter yield of maize varieties. *Direct Res. J. Agric. Food Sci., 12(2)*,208-215. https://doi.org/10.26765/DRJAFS17058073I

Olowoake, A. A. and Ojo, J.A. (2014) Effect of fertilizer types on the growth and yield of Amaranthus caudatus in Ilorin, Southern Guinea Savanna Zone of Nigeria. *Advances in Agriculture 3(4),* 121-125

Ramappa, K. B., Shruthi, H. R., and Shankar, A. G. (2022) Neem coated urea- A key driver for enhancing crop productivity and nutrient use efficiency: A review. *International journal of environment and climate change, 12 (11),* 2580-2587

Rehman A, Nawaz M, Chattha MU, Khan I, Chattha MB, Hussain F, Hassan MU. (2021). Neem Coated Urea Improves the Productivity, Nitrogen Use Efficiency and Economic Return of Wheat Crop. *Int. J. Agric. Biol, 26,* 450-460.

Saeed, I. M., R. Abbasi and M. Kazim (2001) Response of maize (Zea mays) to nitrogen and phosphorus fertilization under agro-climatic condition of Rawalokol, Azad Jammu and Kaslim and Kashmir. *Pak. J. Biological Sci., 4*,949-952

Safdar A, Sahiba M, Malik A, Hassam F, Ansar M, (2012) Growth of rainfed fodder maize under different levels of nitrogen and phosphorus. *Pakistan J. Agril. Res., 25 (3),*196- 205.

Saha S, Mina B L, Gopinath K A, Kundu S and Gupta H. S. (2008) Organic amendments affect biochemical properties of a subtemperate soil of the Indian Himalayas. *Nutr Cycl Agroecosyst* 80, 233–242 (2008). https://doi.org/10.1007/s10705-007-9139-x

Sati U C, Raghav M, Singh D K, Singh S, Singh D K and Singh D K (2018) Integrated nitrogen management in okra under tarai conditions of Uttarakhand. *Int J Chem Stud. 6*, 1118-22.

Singh A, Jaswal A, Singh, M. (2019) Impact of neem coated urea on rice yield and nutrient use efficiency (NUE). *Agricultural Reviews, 40(1)*, 70-74

Singh B (2016) Agronomic benefits of neem coated urea – A Review. *International Fertilizer Association, Paris, France*, pp. 1-21. DOI: 10.13140/RG.2.2.10647.98722

Singh, A., Jaswal, A. and Singh, M. (2019). Impact of neem coated urea on rice yield and nutrient use efficiency (NUE). *Agricultural Reviews*, *40(1)*, 70-74.

Singh, P., Singh, R. P., and Prasad, P.V. V (2017) Nutritional composition and versatile uses of maize: a comprehensive review. *Journal of food science and technology, 54 (10),* 3015-3025

Snyder, C.S. (2017). Enhanced nitrogen fertiliser technologies support the '4R' oncept to optimize crop production and minimize environmental losses. *Soil Research,* 55, 463–472. https://doi.org/10.1071/SR16335

Swify, S., Mažeika, R., Baltrusaitis, J., Drapanauskaitė, D. and Barčauskaitė, K. (2024) Review: Modified Urea Fertilizers and Their Effects on Improving Nitrogen Use Efficiency (NUE). *Sustainability, 16(1),* 188. https://doi.org/10.3390/su16010188

Trenkel, M. E. (2010). Controlled-Release and Stabilized Fertilizers in Agriculture. *International Fertilizer Association (IFA)* pp156

Walkley, A. and Black, I. A. (1982). An examination of the digestion method for the determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Sci 37*,29–38. https://doi.org/10.1097/00010694-193401000-00003

Zhang, Y.; Ye, C.; Su, Y.; Peng, W.; Lu, R.; Liu, Y.; Huang, H.; He, X.; Yang, M.; Zhu, S. (2022) Soil Acidification caused by excessive application of nitrogen fertilizer aggravates soil-borne diseases: Evidence from literature review and field trials. *Agric. Ecosyst. Environ*. 340, 108176.