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Effects of sources of nitrogen fertilizers on soil chemical properties, growth and dry matter yield of maize varieties

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ABSTRACT: A pot experiment was conducted in the screen house of Kwara State University, Malete, Nigeria to compare the effect of sources of nitrogen fertilizers on soil chemical properties on two maize varieties (SUSWAM and LNTP-Y), growth and dry matter yield as well as its residual effect. The treatments comprised of control, poultry manure, granular urea, prilled urea and neem coated urea at 100 and 110 kg N/ha respectively, each replicated three times and fitted into a completely randomized design (CRD). Growth and yield parameters taken were; plant height, number of leaves, stem girth and dry matter yield. Moreover, the results showed that application of neem coated urea and poultry manure at 100 and 110 kg N/ha respectively significantly ($p< 0.05$) increased the growth and yield parameters of the both maize varieties when compared with other fertilizer treatments at first and second planting. Application of poultry manure at 110 kg N/ha had a significant and additive effect on soil nutrients after harvesting of SUSWAM and LNTP-Y maize varieties at first and residual planting followed by neem coated urea at 100 kg N/ha. Therefore, neem coated urea at 100 kg N/ha and poultry manure at 110 kg N/ha could serve as a fertilizer for the production of maize variety and soil amendment.

Keywords: Inorganic fertilizer, neem coated urea, organic fertilizer, maize varieties
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INTRODUCTION

Nitrogen (N) input is a crucial element in modern agriculture, with the primary source being the application of N through mineral fertilizers. This practice is essential for providing the necessary nutrients to support the growth and development of crops. The use of mineral fertilizers ensures that the soil has an adequate supply of nitrogen, which is vital for the production of high-quality and high-yielding crops. As such, the application of N through mineral fertilizers plays a significant role in sustaining agricultural productivity and meeting the demands of a growing population. Nitrogen is a crucial macronutrient that is needed for crop production and is valued as a valuable resource for agricultural systems. (Liu *et al*., 2016). In order to meet crop N requirements, urea is an important source of N that is utilized extensively worldwide (Mustafa *et al*., 2022). Following application to the soil, urea N is converted by a series of chemical and biological processes into a variety of different N forms, some of which are loss-prone and therefore lower the amount of N available to crop plants (Olowoake *et al*., 2022). Nonetheless, N applied as urea is primarily lost in soil, creating significant problems for economic and environmental issues (Mustafa *et al*., 2022). As a result, many methods are employed globally to minimize N losses, such as the application of urea coated with various materials. According to Mustafa *et al*. (2022) urea coating is regarded as a crucial strategy for increasing crop yields while lowering the associated nitrogen losses and their environmental impact. Application of granular urea properly can reduce N losses and increase fertilizer-N utilization and grain yields as compared to prilled (Khalil *et al*., 2011). Prilled urea is a nitrogenous fertilizer that releases quickly but is frequently dispersed in splits, resulting in significant losses such as ammonia volatilization, immobilization, denitrification, and surface runoff. Chemical fertilizer application is crucial for raising crop yields, however in Nigeria, its usage is restricted due to high costs, shortages during planting season, acidic soil, and imbalanced nutrient levels (Aruna *et al*., 2020). Due to these, it has been discovered that applying organic manure, such as poultry manure (PM), can help to increase crop productivity. It contains N, P, and K and other essential elements (Farhad *et al*., 2009). Application of poultry manure raises soil N by over 53% and enhances exchangeable cations. Maize (*Zea mays*) is a significant cereal crop cultivated worldwide and serves as a staple food in many impoverished nations. However, its large-scale production is constrained by the substantial quantities of resources required, as highlighted by Adekiya et al. (2019) and Farhad et al. (2009). All plant parts hold significance in Nigeria, where they are grown using the subsistence farming approach (Aruna *et al*., 2020). The fertility of soil in Nigeria has low majorly macro nutrients. According to Ewulo *et al*. (2016), low activity clays, which have low pH, low organic matter content, low nutrient content, and high erosion susceptibility, make up the majority of tropical soils. One of the main obstacles to maintaining agricultural yield and guaranteeing food security is a decline in soil fertility after several years of cropping (Olowoake *et al*., 2022).In order to meet the demands of crop plants and improve nitrogen use efficiency, growth, yield, and grain quality, it is imperative to implement an effective N management strategy, such as the appropriate application of fertilizer. Coated urea fertilizer has a slow-release mechanism and remains in the soil for a longer period to meet the demand of crop plants and increases nitrogen use efficiency, growth, yield, and grain quality (Guoa *et al.,* 2021). It has also been discovered that using organic manure, such as chicken dung, can help increase crop productivity. Poultry manure is inexpensive, always accessible, safe for the environment, and capable of enhancing soil structure. It also leaves a residual effect. However, compared to granular urea, prilled urea releases nutrients more quickly. It is a nitrogenous fertilizer. In Nigeria, research on the effects of poultry manure, neem-coated urea, prilled urea, granular urea on the growth and dry matter yield of two types of maize is either nonexistent or very little. Therefore, an experiment was designed to examine the effects of various nitrogen fertilizers sources, such as poultry manure, granular urea, prilled urea, and neem coated urea fertilizer on the chemical properties of the soil, the growth and dry matter yield of two varieties of maize, and the soil amendment's residual effects.

MATERIALS AND METHODS

Description of the study area

The study was conducted in Nigeria's Southern Guinea Savannah agro ecology at the screenhouse of Kwara State University (KWASU), Malete, Kwara State. KWASU is situated in Malete, which is within latitude 08°43'N and longitude 4°28'E of the equator, at an elevation of 316.37 m above sea level. The land area of Kwara State University is a part of the Nigerian basement complex in the southwest, which is a region of plutonism and basement recurrence (Olowoake *et al*., 2023). Kwara state lies within a region described as tropical climate and is characterized by double rainfall maxima and has tropical wet and dry climate (Olanrewaju, 2009)

Soil analysis

Nine soil samples with a loamy sand texture were gathered between 0 and 15 cm below the surface, let to air dry, and then sieved using a 2 mm screen. In the laboratory, characteristics were determined on a chemical and physical level.

The hydrometer method (Bouyoucos, 1951) was utilized to estimate the particle size distribution, and 0.01M $CaCl_2$ was used to determine the pH of the soil. The total N and soil organic carbon were assessed using the micro-Kjeldahl digestion method (Bremmer and Mulvaney, 1982) and the Walkley and Black, (1963) method, respectively. Using Bray and Kurtz (1945) methods, available P was extracted. Exchangeable bases (Ca, Mg, K, and Na) were extracted using neutral 1M NH OAC at a ratio of 1:10 with the soil solution, and their levels were determined by flame photometry. According to A.O.A.C. (1990), magnesium was measured using a Perken-Elemer Atomic Absorption Spectrophotometer Model 305 B. An atomic absorption spectrophotometer was used to measure the micronutrients after they were extracted using 0.1 EDTA.

Experimental design, treatments and planting procedures

Five kilograms soil each from Teaching and Research farm of Faculty of Agriculture, Kwara state University, Malete were placed into fifty-four pots. Two types of maize (*Zea mays*) varieties were utilized for the test crop: SUSWAM and LNTP yellow maize. Medium plant height, yellow, early maturing, high yielding, and excellent responsiveness to nitrogen uptake are the Characteristics of the SUSWAM variety. On the other hand, the maize variety LNTP-Y has better N-use efficiency and produces more grain per unit of available nitrogen in the soil. This variety matures at a medium rate. A completely randomized design (CRD) with three replications was used for the study. The following treatments were administered at different rates: 100 and 110 kgN/ha for poultry manure, granular urea, pelleted urea, and neem coated, including control Two weeks after planting, neem-coated, prilled, and granular urea fertilizers were applied, with the organic sources applied one week prior to planting. The nutrient analysis of the poultry manure is summarized in (Table 1). Each pot was originally filled with four seeds, but after germination, the seedlings were thinned to two. Everyday watering of the plants was done, along with any necessary weeding. Before the plants were harvested, they were observed for eight weeks. Eight weeks after planting, measurements of its height, number of leaves, and stem girth were taken. Dry matter yield was measured after eight weeks of planting (WAP), when maize plants were taken out of the ground and oven dried to a consistent weight at 70^{o}C.

The second experiment was designed to investigate the residual effects on growth and dry matter yield of fertilizers coated with neem, granular urea, prilled urea, and poultry manure. LNTP and SUSWAM, two varieties of maize, were reseeded. On the second planting, the experiment was conducted again without the use of fertilizer. Throughout the trial, watering and weeding were done. The end point of the experiment. To ascertain the soil's nutritional quality, a pre-cropping chemical analysis of the experimental soil utilized in the screen house was conducted prior to the experiment and again at the conclusion of the first and second harvests. Pre-cropping chemical analysis of the experimental soil used in the screen house was carried out before experiment and repeated at the end of first and second harvest to determine the nutrient status of the soil.

Table 1: Chemical composition of poultry manure.

Nutrient (%)	Nitrogen (N)	Phosphorus (P)	Potassium (K)
Poultry manure	2.34	1.24	0.90

Statistical analysis

An analysis of variance (ANOVA) was performed on the obtained data, and a 5 % probability level Duncan's Multiple Range Test (DMRT) was used to assess significant differences between the treatment means.

RESULTS AND DISCUSSION

The physico-chemical properties of the experimental soil revealed that the soil was slightly acid and of loamy sand texture (Table 2). According to the critical levels by Adeoye and Agboola (1985), Adeoye (1986), Agboola and Corey (1972), the established critical level for total N is 4.3 g/kg, available P is 10-16 mg/kg$^-$, K is 0.20 cmol/kg, and exchangeable Ca is 2.6 cmol/kg. At the beginning of the trial, the soil had appropriate levels of P and K but deficiencies in N and Ca. It is anticipated that adding soil amendments will improve the low soil N condition.

Table 2: Physical and chemical properties of the experimental soil.

Soil Properties	Soil Test Value
pH	6.4
Organic carbon (g/kg)	1.03
Total nitrogen (g/kg)	0.12
Available phosphorus (mg/kg)	45.38
Exchangeable bases (cmol/kg)	
K	0.27
Na	0.25
Ca	2.53
Mg	3.88
Extractable micronutrients (mg/kg)	
Fe	122.25
Cu	1.13
Zn	1.96
Mn	108.50
Particle size (%)	
Sand	79.5
Silt	14.0
Clay	6.5
Textural class	Loamy sand

Plant height and number of leaves of maize varieties as affected by urea, neem coated urea and poultry manure

The plant height and number of leaves of the maize plants' varieties were significantly (P<0.05) increased with the application of prilled urea, granular urea, neem coated urea and poultry manure in both cropping cycles (Table 3) and were significantly higher (P<0.05) when compared with the control. At first planting, application of neem coated urea and poultry manure at 100 and 110 kg N/ha respectively enhanced plant height of maize varieties (SUSWAM and LNTP-Y) than those of other treatments. The maize plant height of the two varieties produced from neem coated urea and poultry manure were significantly different from other treatments. The control treatment produced the shortest maize plant height. At the residual planting, maize varieties plant height also differed significantly (P<0.05) among the fertilizer treatments (Table 3). Higher significant (P<0.05) maize plant varieties heights observed at the second trials were obtained from application of neem coated urea and poultry manure at 100 and 110 kgN/ha respectively. In first trial the number of leaves per plant among the varieties differed significantly (P<0.05) among the

Table 3: Plant height and number of leaves of maize varieties as influenced by the application of different fertilizer types during the first and second planting in the screenhouse.

Treatment		Plant height (cm)		Number of leaves	
		Maize varieties		Maize varieties	
First planting	FR (kg N/ha)	SUSWAM	LNTP-Y	SUSWAM	LNTP-Y
Control	0	53.00d	64.67d	6.56d	7.17b
Prilled urea	100	78.75bc	77.83bc	8.83c	7.25b
Prilled urea	110	70.67bc	70.98c	8.33c	9.50a
Granular Urea	100	81.67b	77.45bc	8.50c	9.67a
Granular Urea	110	67.85c	79.60b	9.00b	9.17a
Neem coated urea	100	81.90b	81.07a	10.33a	9.83a
Neem coated urea	110	86.02a	82.38a	10.17a	9.50a
Poultry manure	100	81.92b	82.42a	10.12a	9.00 a
Poultry manure	110	84.75a	83.17a	10.19a	9.50a
Residual planting					
Control	0	42.33d	62.00e	6.57b	7.17b
Prilled urea	100	49.43b	77.83bc	7.00a	8.50a
Prilled urea	110	47.33c	76.33c	7.00a	8.83a
Granular Urea	100	48.43b	64.67d	6.83a	9.00a
Granular Urea	110	48.50b	77.47bc	7.00a	9.17a
Neem coated urea	100	52.90a	79.60a	6.83a	9.83a
Neem coated urea	110	52.27a	82.43a	6.83a	9.50a
Poultry manure	100	50.20a	81.14a	6.77a	9.50a
Poultry manure	110	51.70a	81.10a	6.87a	9.67a

Mean having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level. FR- Fertilizer rate

different fertilizer treatments (Table 3). There was significant difference among the fertilizer's treatments. All the fertilized pots had higher number of leaves per plant than the control treatment.

In the second trial all the fertilized pots had higher number of leaves per plant than the control treatment. There was no significant difference among the number of leaves of maize varieties among the fertilizer treatments applied.

The control treatment produced the least number of leaves per plant in the two varieties of maize. Poultry manure provides a continual supply of nutrients, which may explain the increased plant height and number of leaves of both species of maize when applied in comparison to conventional fertilizers. Kareem et al. (2017) uncovered similar results to the present study, demonstrating consistency and reliability in their findings.

This similarity supports the validity of the methodologies and the significance of the reported results.

In addition, a greater availability and consistent supply of nutrients in the treatment may have contributed to the increased plant height and number of leaves that resulted from applying neem coated urea. These findings are agreed with the findings of Shilpha *et al*. (2017), who observed that the rise in maize growth parameters was linked to the availability of nutrients, particularly nitrogen, through neem-coated urea.

This helped to reduce leaching and volatilization losses, hence speeding up the availability.

Stem girth and dry matter yield of maize varieties as affected by urea, neem coated urea and poultry manure

Stem girth were not significantly (Table 4) different among the fertilizer treatments. During first planting, stem girth of SUSWAM in neem coated fertilizer at 100 kgN/ha pot was bigger than all other fertilizer treatments. However, all the fertilizer applied were significantly different from the control. The control treatment resulted in the lowest stem girth. In the second trial, there were no significant differences ($P<0.05$) in the stem girth of the SUSWAM maize variety among the fertilizer treatments.

The application of neem coated urea at 100 kgN/ha resulted in higher stem girth than all other fertilizer treatments while the control had the smallest stem girth. The stem girth of LNTP-Y produced from application of Neem coated urea fertilizer and other fertilizer treatments were not significantly different from one another during first planting. The same trend was observed at residual planting on stem girth of LNTP-Y. Table 4 shows that there were significant ($P<0.05$) difference in the dry matter weight of SUSWAM maize plants among the fertilizer treatments in first trial. The dry matter weight of SUSWAM in the poultry manure and neem coated urea at 100 and 110 kg N/ha respectively were significantly different from other fertilizers including control. The control treatment produced the smallest dry matter weight. The dry matter weight of SUSWAM maize variety was significantly ($P<0.05$) influenced by the fertilizer

Table 4: Stem girth and dry matter yield of maize varieties as influenced by the application of different fertilizer types during the first and second planting in the screenhouse.

Treatment	FR (kg N/ha)	Stem girth (cm) Maize varieties		Dry matter weight (g) Maize varieties	
		SUSWAM	LNTP-Y	SUSWAM	LNTP-Y
First planting					
Control	0	7.47b	7.34b	1.78c	1.64c
Prilled urea	100	9.13a	8.60 a	1.93c	2.48b
Prilled urea	110	9.27a	8.80a	2.38b	2.14b
Granular Urea	100	9.56a	8.86a	2.83b	2.35b
Granular Urea	110	9.31a	8.80a	2.70b	2.14b
Neem coated urea	100	9.90a	9.49a	4.07a	3.77a
Neem coated urea	110	9.50a	9.21a	3.60a	3.30a
Poultry manure	100	9.88a	9.32a	3.32a	3.22a
Poultry manure	110	9.23a	9.09a	3.88a	3.45a
Residual planting					
Control	0	5.93b	7.60b	0.6c	0.93c
Prilled urea	100	8.22a	8.70a	1.0b	1.13b
Prilled urea	110	8.97a	9.07a	1.0b	1.07b
Granular Urea	100	7.82a	8.80a	1.0b	1.33b
Granular Urea	110	8.20a	9.20a	1.0b	1.17b
Neem coated urea	100	8.82a	9.47a	2.0a	2.23a
Neem coated urea	110	8.21a	9.10 a	1.87a	1.93a
Poultry manure	100	7.81a	8.87a	1.86a	1.94a
Poultry manure	110	7.95a	9.33a	1.92a	1.97a

Mean having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level. FR- Fertilizer rate

treatments in second trial (Table 5). The observed trend in the dry matter yield of SUSWAM maize during the first planting was also evident in the residual planting. Notably, the application of poultry manure and neem coated urea at 100 and 110 kg N/ha respectively resulted in significantly higher dry matter weight of LNTP-Y compared to other fertilizer treatments, including the control. Conversely, the control treatment exhibited the lowest dry matter yield. This trend persisted during the residual planting, with all fertilizer treatments demonstrating higher dry matter weight of LNTP-Y compared to the control. These findings suggest that the soil, lacking essential nutrients, was not adequately supplemented with fertilizer. According to Olowoake, (2022), low growth and yield are caused by insufficient main nutrient availability, particularly N, P, and K, which impair the plant's ability to photosynthesize and have an impact on the amount of dry matter generated. Granular urea outperformed prilled urea when applied as fertilizer treatments, according to a comparison of the two types of urea's effectiveness on maize growth parameters. This result is consistent with Olowoake *et al*. (2022) finding that, as a slow-releasing nitrogenous fertilizer, granular urea provided higher grain and straw yields than prilled urea in the pearl millet-wheat cropping sequence.

Applications of poultry manure and neem-coated urea kept the dry matter weight of the SUSWAM and LNTP-Y varieties statistically at par. This investigation demonstrated that increased levels of nutrient (nitrogen) provided to the plants resulted in superior vegetative development, as seen by the increase in dry matter weight of maize varieties following the treatment of 110 kgN/ha through poultry manure. The reason for this is that soil fertility is increased by adding vital nutrients and soil organic matter, which increases soil moisture and nutrient retention. Poultry manure has long been acknowledged as the most ideal organic fertilizer (Farhad *et al*., 2009). Similarly, the increase in dry matter weight of the neem-coated urea-treated maize varieties may have resulted from greater plant growth-promoting nitrogen uptake and a steady supply of nitrogen. Zhao *et al*. (2013) published similar results. Applying neem coated urea to maize varieties' dry matter yield outperformed conventional urea; this could be because of an adequate nitrogen supply that increased leaf area, which in turn produced more photo-assimilates and a larger accumulation of dry matter (Guoa *et al*., 2021). Ankita *et al*. (2019), who also observed comparable observations, corroborate these findings.

Table 5 shows the results of fertilizer types on some soil chemical properties at harvest during the first and second cropping. At first harvest stage of maize variety SUSWAM, pH value ranged from 6.58 in control pot to 7.21 in poultry manure at 110 kg N/ha pot. There was no much change in soil pH of the pots treated with Neem coated urea and Poultry manure at 100 and 110 kg N/ha.

Table 5: Effects of fertilizer types on some soil chemical at harvest during the first and second planting in the screenhouse.

Treatment	Rate (Kg N/ha)	pH (H_2O)		Org C (g/Kg)		N (%)		P (mg/kg)		K (cmol/kg)	
First Harvest		**V1**	**V2**	**V1**	**V2**	**V1**	**V2**	**V1**	**V2**	**V1**	**V2**
Control	0	6.58c	6.06c	2.34c	1.47d	0.20c	0.08c	48.64e	20.48h	0.20c	0.19c
Prilled Urea	100	6.85bc	6.91b	2.91b	1.66c	0.32a	0.18b	50.96c	23.04e	0.26b	0.21b
Prilled Urea	110	6.94ab	6.63b	2.76b	1.66c	0.32a	0.18b	50.72c	22.36f	0.24b	0.21b
Granular Urea	100	6.95ab	6.21b	2.78b	1.86b	0.23b	0.16b	49.64d	22.04g	0.23b	0.20b
Granular Urea	110	6.84bc	6.40b	2.74c	1.79b	0.24b	0.18b	50.80c	22.04g	0.24b	0.20b
Neem coated Urea	100	7.01a	8.00a	3.26a	2.40a	0.33a	0.26a	50.80c	23.76c	0.26b	0.24a
Neem coated Urea	110	7.21a	8.03a	2.97a	2.34a	0.31a	0.20b	48.34e	23.12d	0.30b	0.25a
Poultry manure	100	7.10a	8.62a	2.98a	2.40a	0.36a	0.20b	59.52b	37.04b	0.30b	0.26a
Poultry manure	110	7.20a	8.87a	3.30a	2.43a	0.36a	0.27a	60.08a	37.88a	0.40 a	0.28 a
Residual Harvest											
Control	0	6.57c	6.05c	1.15d	0.74e	0.12e	0.08c	21.80f	20.49h	0.20c	0.14b
Prilled Urea	100	6.8cb	6.92b	1.73c	1.79c	0.23c	0.18b	22.92e	23.04e	0.26b	0.21b
Prilled Urea	110	6.62b	6.87b	1.57c	1.86c	0.26c	0.16b	23.08d	22.36f	0.25b	0.20b
Granular Urea	100	6.77b	6.63b	1.28c	1.60d	0.16d	0.18b	21.52g	22.04g	0.24b	0.21b
Granular Urea	110	6.79b	6.61b	1.38c	1.47d	0.17d	0.17b	21.44h	22.04g	0.26b	0.20b
Neem coated Urea	100	7.86a	8.03a	2.34a	2.40a	0.29b	0.20b	23.32c	23.76c	0.27b	0.24a
Neem coated Urea	110	7.81a	8.04a	2.09b	1.95b	0.24c	0.20b	23.28c	23.12d	0.27b	0.25a
Poultry manure	100	7.87a	8.03a	2.08b	1.96b	0.31a	0.25a	33.92b	37.04b	0.28b	0.26a
Poultry manure	110	7.91a	8.09a	2.78a	2.43a	0.34a	0.27a	34.04a	37.88a	0.30a	0.27a

Mean having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level. Legend V1 = SUSWAM; V2- LNTP-Y

The same trend occurs with soil grown with SUSWAM maize variety residual harvest.

The increase in value of soil pH through application of poultry manure may probably cause by ion exchange reactions, which happen when organic anions such as malate, citrate, and tartrate replace the terminal OH^- of Al_3^+ or Fe^{2+} hydroxyl oxides. Additionally, following the first and residual cropping of the maize varieties, the pH of the soil was raised using neem-coated urea fertilizer at 100 and 110 kgN/ha. This outcome is consistent with Cantarella *et al*. (2018), who found that applying neem-coated urea increased soil pH from 6.5 to 8.8. They attributed this increase to urea hydrolysis, which uses protons (H^+).

There was significance difference among the value of soil organic carbon obtained from the pot planted with SUSWAM and LNTP-Y maize varieties with fertilizer types used at harvest and residual harvest. There was no significance difference among the value of soil organic carbon obtained from the pot planted with SUSWAM and LNTP-Y maize varieties with neem coated urea and Poultry manure at 100 and 110 kg N/ha respectively. However, at residual harvest poultry manure at 110 kg N/ha produced highest soil organic carbon values from pot grown with SUSWAM and LNTP-Y followed by neem coated urea at 100 kgN/ha. The highest nitrogen content in the soil was recorded in poultry manure at 110 kg N/ha which was not significantly different from poultry manure at 100 kgN/ha and neem coated urea at 100 and 110kg N/ha from pot grown with SUSWAM and LNTP-Y respectively at first planting. Minimum N content in soil was recorded in control at first harvest. At residual harvest, poultry manure at 110 kgN/ha had the highest N content of 0.34 % and 0.27 % from pot grown with SUSWAM and LNTP-Y respectively. Available P increased in all the pot grown with the two varieties of maize when different fertilizer types were applied at both planting. During first planting, soil available P content ranged from 48.64 to 60.08 mg/kg in pot planted with SUSWAM and 20.48 to 37.88 mg/kg in pot planted with LNTP-Y. There was significant difference among the fertilizer treatments including control. Pot treated with poultry manure at 110 kg N/ha had the maximum available P value of 60.08 and 37.88 mg/kg in pot planted with SUSWAM and LNTP-Y maize variety respectively. The same trend occurs with soil grown with SUSWAM and LNTP-Y maize variety at residual harvest. At residual harvest of maize, there was significance difference among the value of available P obtained from the pot planted with SUSWAM and LNTP-Y maize varieties with different types of fertilizer respectively. Pot treated with poultry manure at 110 kg N/ha had the highest available P value of 34.04 and 37.88 mg/kg in pot planted with SUSWAM and LNTP-Y maize varieties respectively.

Also, pot treated with poultry manure at 110 kg N/ha had the highest exchangeable K value of 0.40 and 0.28 c mol/kg in pot planted with both maize varieties respectively after first harvest. At residual harvest of maize varieties, K contents from poultry manure at 110 kg N/ha was significant different from all other fertilizer treatments including control respectively. In accordance with the analysis of the poultry manure that was recorded, there was a notable increase in the soil's pH, N, P, K, and organic carbon values after 110 kgN/ha of poultry manure was applied (Table 1). As a result of the solubilization effect of organic matter during decomposition processes, the application of poultry manure in this experiment led to relatively large increases in soil nutrient concentrations (organic carbon, total nitrogen, phosphorus, and potassium). This agrees with Olowoake, (2014) report.

Conclusion

Application of poultry manure at 110 kg N/ha and neem coated urea at 100 kg N/ha increased plant height, number of leaves, stem girth and dry matter weight on SUSWAM and LNTP-Y varieties in both first and residual planting due to slow-release of N. However, poultry manure at 110 kg N/ha had a significant and additive effect on soil chemical properties after harvesting of SUSWAM and LNTP-Y maize varieties which increased plant nutrient especially nitrogen, phosphorus, potassium and organic carbon. Therefore, neem coated urea at 100 kg N/ha and poultry manure at 110 kg N/ha could serve as alternative to mineral fertilizer for the production of maize variety and soil amendment, respectively. There is a need to validate this finding on the field for recommendation to farmers

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Authors' Declaration

We declare that this study is an original research by our research team and we agree to publish it in the journal.

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