



Comparative Effect of Coated Urea Inhibitor and Poultry Manure on Soil Chemical Properties, Growth and Yield of Jute Mallow Varieties (*Corchorus olitorius*)

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ABSTRACT

A screen house and field trial was carried out on two varieties of jute mallow (*Oniyaya* and *Amugbadu*) at Araromi Ilorin Kwara State and National Centre for Agricultural Mechanization (NCAM) respectively during 2022 cropping season to compare the effect of coated urea inhibitor and poultry manure on soil chemical properties, growth and yield of jute mallow. Five treatments were used for both field and pot experiments. The treatments comprised of control, urea, NPK, urea inhibitor, poultry manure at 45 kg N/ha each replicated three times and fitted into a completely randomized design (CRD). Field experiment was a randomized complete block design with three replicates. All fertilizers used significantly enhanced the growth and dry matter yield of varieties of jute mallow under screen house investigation. In the field study jute mallow yield values of *Oniyaya* and *Amugbadu* were 3.8 and 3.6 t ha⁻¹ respectively with poultry manure and these were significantly ($p < 0.05$) higher than that of urea inhibitor treatment (2.6 and 3.5 t ha⁻¹) after the first cropping. Residual effect of jute mallow yield values obtained from poultry manure was also significantly ($p < 0.05$) higher than that of urea inhibitor values. Poultry manure at 45 kg N ha⁻¹ had a significant and additive effect on soil nutrients after harvesting of the two varieties of jute mallow when compared with urea inhibitor in first and second cropping. Therefore, it can be deduced that application of poultry manure at 45 kg N ha⁻¹ increased soil productivity and led to higher jute mallow varieties yield than using urea inhibitor.

Keywords: Jute mallow, poultry manure, urea inhibitor, yield

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INTRODUCTION

Vegetable production in Africa is as old as peasant farming though its cultivation is still at the household level with very few farmers producing on a commercial level. This could be due to the fact that crops such as cereals, roots, and tubers and body-building crops like legumes are given much attention. Cereals and tubers form the

bulk of food consumed in the tropics, but they are deficient in minerals and vitamins compared to the body requirement to guarantee good healthy living (Ogunlade *et al.*, 2011). Jute mallow (*Corchorus olitorius* L.) belongs to genus *Corchorus* and classified under the subfamily *Grewioideae* of the family *Tiliaceae* (Khan *et al.*, 2015).

Jute mallow fiber was the most export in the world compared with the synthetic fiber in the 21st century (Faisal, 2016). The leaves have been variously used in folk medicines for ascites, pain, piles, tumors, cystitis, fever, and gonorrhoea while the cold infusion is said to restore appetite and strength (Adediran et al., 2015). Nitrogen is a crucial macronutrient that is needed for crop production and is valued as a valuable resource for agricultural systems (Olowoake et al., 2024). Most Nigerian soils have low nitrogen and the low nitrogen status is usually supplemented with N fertilizer, and the importance of this source has increased over the year. However, the problem with the usage of chemical fertilizer is that while it can lead to high crop yield, it results into pollution of groundwater after crop harvest (Olowoake and Ojo, 2014). Another major limitation to the usage of chemical fertilizers is due to the adverse effects they have on plant quality and disease susceptibility. A continual dependence on chemical fertilizers 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 (Adeoluwa and Adeogun, 2010). However, long term studies have shown that there is a limit to which inorganic fertilizer can sustain the productivity of intensely cultivated soil.

This is because of problem of decrease in yield with time, enhancement of soil acidity, leaching losses and degradation of soil physical and organic matter status. Simple urea fertilizer is widely used as an N fertilizer. however, much N applied into the soil is lost to the environment (denitrification, nitrate leaching, and ammonia volatilization) which leads to soil degradation, emission of greenhouse gases, groundwater pollution, and ultimately reduced N use efficiency (Spiertz, 2009; Zhang et al., 2010). An approach to maximize the absorption of nitrogen from urea is to reduce the rate of nitrogen loss through inhibition of urease activity. The inhibitory process of urease activity may be carried out by coating urea using N- (n-butyl) thiophosphorictriamide (NBPT) (Dewi et al., 2018). N-(n-butyl) thiophosphorictriamide (NBPT) is a urease inhibitor which can reduce nitrogen loss via ammonia volatilization from urea and dicyandiamide. It is used as a fertilizer additive in agricultural applications. Once applied to the soil, NBPT can reduce urease activity, slow down the hydrolysis process of urease decomposition, prolong urease diffusion time and decrease the concentration of ammonia present near the soil surface.

Manure incorporation is considered as a primary substrate for replenishment of soil organic matter and can be regarded as an alternative way of adding fertilizer to increase soil fertility and crop productivity (Rasool et al., 2007).

The application of poultry manure to soil is considered as a good management practice in any agricultural

production system because it increases microbial biomass and activity, which increases the processing rate of organic N such as proteins, peptides, and amino acid (Ma et al., 2020). Furthermore, the application of manure helps to neutralize soil pH, and leads to higher levels of organic carbon and improved macro and micronutrient availability, physical properties, and microbial activity, thereby increasing crop yields (Olowoake, 2014).

Despite the advantages of poultry manure, its use is limited; it has to decompose before it can release nutrient for plant uptake, thereby making its action slower. Slow release nitrogen fertilizers such as urea inhibitor is assumed to offer a solution by releasing small amounts of nitrogen coinciding with the crop need and increasing the efficiency of nitrogen by minimizing its losses, likewise poultry manure releases nutrient slowly. With the move towards increased jute mallow production, it has become necessary to study how yield of *Corchorus olitorius* is affected by application of poultry manure and urea inhibitor so as to obtain comparison between these fertilizers. Hence, the present research was therefore conducted to study the comparative effect of coated urea inhibitor and poultry manure on soil chemical properties, growth and yield of jute mallow.

The objectives of this study therefore are to:

- (a) Investigate the effect of coated urea inhibitor and poultry manure on the growth and yield of two varieties of Jute mallow.
- (b) Evaluate the residual effect of soil amendment with urea inhibitor and poultry manure on the yield of two varieties of Jute mallow and on soil properties.

MATERIALS AND METHODS

Location of the experimental site

The screen and field studies were carried out during the 2023 planting season at the National Center for Agricultural Mechanization (NCAM), Idofian, and Araromi Ilorin, Ifelodun Local Government, Kwara State. Respectively. NCAM lies between Latitude 8°26' N and Longitudes 4°30' East (Oyedokun et al., 2022), while Araromi is situated at latitude 8° 25' 59" N and longitude 4° 58' 0" E and is about 300 m above sea level. The two locations are in the Southern Guinea Savannah agro-ecological zone of Nigeria, which is characterized by distinct wet and dry seasons.

The on-set of the rainy season is usually in the month of April and cessation is usually in the month of October. The rainfall season is always at its peak within the month of June to September. The dry season also commence from the month of November and ends in March. The mean annual rainfall of Idofian is 1700mm, while the mean monthly maximum and minimum temperatures in

the basin are 31°C and 29°C, respectively, with the highest temperatures recorded in the months of February through April (Oyedokun *et al.*, 2022). The soils of Ilorin are predominantly derived from ferruginous and crystalline acidic rocks and are predominantly Alfisols (Afe *et al.*, 2024).

Soil sampling and analysis

In the screen house, the soil used in the study area was collected from Araromi, Ifelodun local Government, Ilorin, Kwara State. In the field, soil samples were randomly collected at 0–15 cm depth using a soil auger. Collected samples were air-dried and then taken to the laboratory to determine their physical and chemical properties. The 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 (NH₄OAC). The flame photometer measured K and Na concentrations, while the atomic absorption spectrophotometer determined Mg and Ca. The pH of the soil water was determined at 0.01M CaCl₂ with a glass electrode pH meter and an electrical conductivity of 1:5 (w/v) in the deionized water suspension.

Plant material, experimental design, and treatments

Jute mallow (Oniyaya and Amugbadu) seeds were purchased from a reliable agro-outlet in, Ilorin, Kwara State, Nigeria. Amugbadu variety leaves are oblong in shape while Oniyaya variety is widely branched with broad, deeply serrated leaves. Both varieties is characterized by vigorous growth, and these characteristics make it particularly suitable for growth during the test period of the experiment. The treatments used for the study were: control, urea inhibitor, urea, poultry manure and NPK. The chemical composition of the fertilizers is presented in (Table 1).

Table1: Chemical composition of urea inhibitor and poultry manure

Nutrient (%)	Potassium (K)	Nitrogen (N)	Phosphorus (P)
Poultry manure	1.68	115.72	0.45
Urea inhibitor	42	Nd	Nd

Legend: Nd- not determine

In the screen house, twenty kilogrammes of soil samples already air-dried and sieved through 2 mm sieve was weighed into fifteen (15) pots. The experimental design was completely randomized design. Poultry manure was incorporated into the soil two weeks before planting of

Corchorus olitorius in each pot, the plant were thinned to 2 seedlings after 2 weeks of germination. The treatments except control were applied at 45 kgN/ha (Olowoake and Ojo, 2022). Watering and weeding were done throughout the experimental period. The plants were grown for eight weeks after which they harvested and terminated. The field experiment was set up with the objective to determine the growth and yield of jute mallow to fertilizer types. The field was cleared, ploughed and harrow. The experimental design was laid out in a randomized complete block design (RCBD) with three replications. The size of each sub plot was 1 X 1 (1 m²), with an inter-plot space of 0.5m. The field trials had 5 major treatment combinations. Drilling method was done at an intra-row spacing of 0.25x 4cm and the seedlings were later thinned. Poultry manure was incorporated to the soil 2 weeks before drilling of corchorus seeds. The experimental plots were weeded manually with hoe two (2) times to avoid weed from competing with the plant for nutrient. The second experiment was carried out on both screen house and field in order to investigate the residual effects of fertilizer application.

Data collection and analysis

Data were collected on the following parameters: plant height, number of leaves and stem girth and the weight of fresh and dry weight of corchorus were taken at first and second harvest. The parameters were taken at 4, 6, and 8 WAP. Plant height was measured from the root collar to the growing tip. Plant stem girth was determined using vernier caliper. Numbers of leaves was counted, fresh shoot weight were measured using the sensitive scale, dry weight was taken after air dry using sensitive scale. All data collected were subjected to an analysis of variance using the DSAASTAT. 1.101 version software. The treatments mean where significant differences exist were separated using (Duncan Multiple Range Test) at 5% probability.

RESULTS AND DISCUSSION

Soil analysis

Table 2 shows the results of the physical and chemical analysis of the two experimental soils before cropping. Soils of the two sites (Araromi and NCAM) were generally low in total N, P and organic carbon. Thus, the soil required fertilizers or soil amendment to improve its fertility. The available P of 8.24 and 8.32 mg/kg was below the critical level of 10-16mg kg⁻¹ (Adeoye and Agboola, 1985). The K status of the soil which was 0.74 and 0.51 cmol/kg was higher than the critical level of 0.2 cmol kg⁻¹ (Adeoye, 1986). Exchangeable magnesium values of 1.48 and 0.76 cmol/kg were higher than the critical level of 0.20 - 0.40 cmol/kg⁻¹ (Adeoye and

Table 2: Physico-chemical properties of experimental soils.

Parameters	Soil test value	
	Araromi (Screen house)	NCAM (Field)
pH	6.33	5.85
Org.C(%)	2.77	1.95
Total N(%)	0.31	0.22
P(mgkg ⁻¹)	8.24	8.32
Exchangeable bases (cmolkg⁻¹)		
K (mgkg ⁻¹)	0.34	0.51
Mg (cmolkg ⁻¹)	1.48	0.76
Ca (cmolkg ⁻¹)	2.21	2.06
Na(cmolkg ⁻¹)	0.33	0.23
Exch. Acidity(cmolkg ⁻¹)	3.70	4.15
Extractable micro nutrients (mgkg⁻¹)		
Fe	146.0	124.0
Zn	2.21	1.65
Cu	1.83	1.46
Mn	110	85.0
Mechanical composition (%)		
Sand	79	80
Silt	12	13
Clay	9	7
Textural class	Loamy Sand	Sandy Loam

Agboola, 1985). Calcium value of 2.21 and 2.06 cmol/kg was below the critical level of 2.6 cmol/kg (Agboola and Corey 1972). Therefore, indicating that the soil may be poor in nutrients. The study showed that the application of soil amendments enhanced the growth and yield components of *Corchorus olitorus* irrespective of fertilizer types. This implies that the soil in the zone is relatively low in both micro and macro elements and cannot support Jews mallow growth and yield without external amendments. This inherent low nutrient status of Savannah soils has been reported by Afe *et al.* (2024) due to continuous farming and the indiscriminate application of synthetic fertilizers that are common among the farmers in the zone.

Growth and yield parameters of Jews mallow varieties in the screen house and the field

Table 3 shows the response of jute mallow varieties (Oniyaya and Amugbadu) to application of fertilizer types at 4, 6, and 8 weeks after planting during the first and second planting in the screen house and field respectively. The plant height of Oniyaya variety at 4, 6 and 8 WAP were significantly ($P<0.05$) increased with the application of NPK in both screen house and field during first planting (Table 3) and were significantly higher ($P<0.05$) when compared with other fertilizers types and control. Also at the screen house and field, the plant height of Amugbadu variety with the application of urea inhibitor during first planting in screen house and field were significantly higher compared to other fertilizers treatments. At the second planting, the plant height of Oniyaya and Amugbadu varieties with the application of poultry manure in both screen house and field differed

significantly ($P<0.05$) at all weeks after planting among the fertilizer treatments. Higher significant plant heights observed at the second trials were obtained from application of poultry manure. In the first planting, the number of leaves of Oniyaya and Amugbadu varieties per plant at both screen house and field differed significantly ($P<0.05$) among the different fertilizer treatments (Table 4). At 4, 6 and 8 weeks after planting, there were significant difference among the fertilizers treatments. All the fertilized jute mallow varieties had higher number of leaves per plant both on the screen house and field than the control treatment. NPK fertilizer had more number of leaves at 4, 6 and 8 WAP on Oniyaya and Amugbadu varieties than other fertilizer treatments both in the screen house and field. In the second trial, all the fertilized Jews mallow varieties had higher number of leaves per plant than the control treatment. At 4, 6 and 8WAP, poultry manure fertilizer produced more leaves than NPK, urea inhibitor and urea fertilizer on both varieties at the screen house and on the field. Stem girth of Jews mallow varieties at 4, 6 and 8 WAP differed significantly (Table 5) among the different fertilizer treatments. In first planting, stem girth of Oniyaya and Amugbadu in the NPK treatments at screen house and field was bigger than in other treatments. The lowest stem girth of the Jews mallow varieties was produced by the control treatment. During second planting, Oniyaya and Amugbadu stem girth differed significantly ($P<0.05$) among fertilizer treatments. At 4, 6 and 8 weeks after planting, the application of poultry manure resulted in significantly higher stem girth of Oniyaya and Amugbadu varieties than NPK, urea and urea inhibitor while the control consistently had the smallest stem girth respectively. Table 6 shows that there was significant ($P<0.05$).

Table 3: Response of Jews mallow varieties to fertilizer types on the plant height (cm) during the first and second planting in the screen house and field

	Screen house						Field					
	Oniyaya WAP			Amugbadu WAP			Oniyaya WAP			Amugbadu WAP		
First planting	4	6	8	4	6	8	4	6	8	4	6	8
Control	5.6e	12.1e	14.2e	5.3e	15.2e	18.3d	6.1e	11.3e	21.2e	12.6d	23.5e	29.0d
NPK	14.7a	35.7a	27.6a	12.4d	20.8d	28.7a	11d	42.37a	43.6a	18.75a	54.1a	55.8a
Poultry manure	13.9b	22.4b	25.2b	13.3c	22.7b	23.5c	11.47c	31.88c	34.1b	18.6a	44.1d	48.0c
Urea	7.6d	14.6d	16.6d	17.4a	21.4c	22.8c	12.2b	32.27b	33.7c	13.4c	45.4c	47.7c
Urea inhibitor	10.7c	18.5c	22.4c	15.6b	23.4a	25.9b	14.3a	25.17d	27.29d	14.9b	47.8b	51.8b
Second Planting	4	6	8	4	6	8	4	6	8	4	6	8
Control	5.5e	9.8e	14.4e	5.5e	9.8e	14.4e	5.1c	12.4e	15.3e	8.3e	16.6e	19.5d
NPK	7.7c	11.3d	17.7d	12.4c	24.6b	30.7b	10.6b	20.5c	24.4c	17.5d	20.9c	24.1c
Poultry manure	14.6a	22.6a	28.9a	19.4a	27.3a	34.6a	15.2a	26.8a	35.6a	18.8a	26.9a	36.9a
Urea	10.9b	13.9c	18.6c	10.5d	13.2c	15.4d	9.3b	18.4d	22.4d	18.3c	19.2d	23.5c
Urea inhibitor	6.6d	17.4b	25.3b	16.3b	24.6b	20.4c	10.8b	21.6b	29.2b	19.9b	22.2b	28.9b

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level

Table 4: Response of Jews mallow varieties to fertilizer types on the number of leaves during the first and second planting in the screen house and field.

	Screen house						Field					
	Oniyaya WAP			Amugbadu WAP			Oniyaya WAP			Amugbadu WAP		
First planting	4	6	8	4	6	8	4	6	8	4	6	8
Control	6.3d	11.7e	14.5e	6.5e	15.2e	10.3e	8.2d	14.3e	18.47e	10.6e	14.6d	20.7c
NPK	11.7a	25.9a	33.4a	8.2d	20.8d	35.8a	17.8a	32.1a	33.7a	21.8a	30.8a	34.7a
Poultry manure	9.1b	20.4b	22.1c	9.9a	22.7b	15.7d	15.3b	23.4c	24.33c	19.8b	27.1b	29.7b
Urea	8.7c	14.5d	28.4b	9.3b	21.4c	25.7c	14.5b	21.33d	23.7d	14.9d	28.7b	30.5b
Urea inhibitor	7.3c	16.3c	17.6d	9.3b	23.4a	30.8b	12.8c	25.3b	26.9b	18.2c	26.7c	30.3b
Second Planting	4	6	8	4	6	8	4	6	8	4	6	8
Control	5.1e	7.7d	8.4e	4.53e	10.9d	10.4e	5.6d	7.4e	9.6d	6.6d	9.5e	11.1d
NPK	6.1c	9.6cd	10.8d	10.5d	13.2c	15.4d	6.5c	10.5d	13.8c	10.5c	14.2c	16.7b
Poultry manure	9.5a	18.6a	20.7a	19.7a	27.9a	36.6a	9.8a	14.7a	19.5a	15.2a	17.3a	22.2a
Urea	6.9bc	15.3b	19.8b	16.3b	24.6b	20.4c	9.9a	14.5b	16.3b	13b	11.7d	14.9c
Urea inhibitor	7.6b	11.5c	12.8c	12.4c	24.6b	33.7b	8.8b	12.5c	13.9c	10.9c	16.4b	17.5b

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level.

differences in fresh shoot, dry shoot weight and yield of the Jews mallow varieties among the fertilizer treatments in first trial at the screen house and on field. The fresh shoot and dry shoot weight of Oniyaya and Amugbadu varieties in the NPK was larger than other fertilizer treatments followed by urea inhibitor in the screen house. The same trend was observed on the yield of the two varieties on the field. Amugbadu variety yield in NPK at both screen house and field produced higher yield than Oniyaya variety. Fresh shoot weight, dry shoot weight and yield of Jews mallow varieties from screen house and field were significantly ($P < 0.05$) influenced by fertilizer treatments in second planting. Poultry manure produced the highest fresh shoot weight, dry shoot weight and yield of Jews mallow varieties in the screen house and field. Amugbadu variety treatment produced the highest yield (2.8 t/ha) than Oniyaya variety (2.7 t/ha)

from application of poultry manure. The control treatment had the smallest yield of Jews mallow varieties in both screen house and field. Generally, all the fertilizer treatments produced higher yield parameters of Jew mallow varieties than the control without soil amendment in the screen house and field. The high values of growth parameters of Jews mallow varieties grown in the pot and field treated with mineral fertilizer (NPK and urea inhibitor) over poultry manure during the first Planting might be as a result of the quicker release of N, P and K which are the major nutrients required by crop for vegetative growth, seed and root development. This observation is in line with the findings of Olowoake (2014) that mineral fertilizers quickly release their nutrients to the soil than organic wastes. The performance of urea inhibitor on the growth and yield of Jews mallow varieties after NPK fertilizer during the first planting in the screen

Table 5: Response of Jews mallow varieties to fertilizer types on the stem girth (cm) during the first and second planting in the screen house and field

	Screen house						Field					
	Oniyaya WAP			Amugbadu WAP			Oniyaya WAP			Amugbadu WAP		
	4	6	8	4	6	8	4	6	8	4	6	8
First planting												
Control	0.45d	1.12c	1.11c	0.3c	0.97c	1.71c	0.33c	1.87c	2.01c	0.23c	1.42c	2.02d
NPK	0.93a	2.01a	2.35a	0.95a	2.16a	3.17a	1.05a	2.48a	3.23a	1.08a	2.53a	3.60a
Poultry manure	0.83b	1.79b	2.04b	0.65b	1.17b	2.06b	0.72b	2.26c	2.55b	0.76b	2.17b	3.06b
Urea	0.53c	1.85b	1.41c	0.67b	1.15b	2.17b	0.69b	2.23c	2.58b	0.77b	2.13b	2.73c
Urea inhibitor	0.97a	1.86b	2.02b	0.68b	1.17b	2.12b	0.73b	2.36b	2.66b	0.72b	2.17b	2.77c
Second Planting												
Control	0.13c	1.42d	1.90d	0.21c	0.43d	1.32c	0.15d	1.04d	1.7c	0.5d	1.8c	1.95d
NPK	0.23b	1.56c	2.02c	0.51b	1.15c	2.31b	0.34c	1.93c	2.21b	0.58c	2.10b	2.32c
Poultry manure	1.14a	2.28a	2.97a	1.45a	2.27a	2.79a	0.94a	2.41a	3.12a	0.98a	2.42a	3.31a
Urea	0.25b	1.91b	2.12b	0.52b	1.18c	2.32b	0.33c	2.01c	2.21b	0.65b	2.12b	2.32c
Urea inhibitor	0.35b	1.89b	2.16b	0.54b	1.51b	2.37b	0.62b	2.12b	2.25b	0.68b	2.14b	2.54b

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level.

Table 6: Response of Jews mallow varieties to fertilizer types on the yield parameters during the first and second planting in the screen house and field.

Treatment	Screen house				Field	
	Oniyaya		Amugbadu		Oniyaya	Amugbadu
First planting	Fresh shoot Weight (g)	Dry shoot Weight (g)	Fresh shoot Weight (g)	Dry shoot Weight (g)	Yield (t/ha)	Yield (t/ha)
Control	12.5d	1.7e	11.6c	1.7c	1.1c	1.5e
NPK	39.9a	7.3a	85.3a	14.7a	3.8a	3.7a
Poultry manure	17.1d	3.3d	62.8b	12.3b	2.5b	2.8c
Urea	39.9c	4.7c	62.9b	12.6b	2.6b	2.0d
Urea inhibitor	34.3b	6.7b	63.2b	12.9b	2.7b	3.2b
Second planting						
Control	7.2e	2.0e	7.3d	2.3d	0.7d	1.1d
NPK	21.5c	5.7c	25.7c	6.0c	1.1c	1.8c
Poultry manure	28.9a	9.8a	68.8a	10.9a	2.7a	2.8a
Urea	13.4d	3.4d	25.4c	5.0c	1.1c	1.7c
Urea inhibitor	25.3b	7.0b	40.7b	8.0b	2.1b	2.0b

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level.

house and field could be due to the fact that urea inhibitor slows down the urea hydrolysis and prolongs nitrogen (N) stay in soil, resulting in an increased N uptake by plants (Rana et al., 2022) The residual fertilizer treatments from poultry manure treatment having better plant height in Oniyaya and Amugbadu varieties across the weeks in both screen house and field compared to other treatments in this investigation could be as a result of better nutrient mineralization with time of application. This is in line with the report of several authors Ayanfeoluwa et al., (2015) and Olowoake, (2017) that organic fertilizers are characterized with slow release of nutrients, which leads to reduction in soil nutrient loss. Suleiman, (2021) also reported that high content of nutrients (both macro nutrients and micro nutrients) in the poultry manure and also due to its low C: N ratio leads to faster decomposition and subsequent release of nutrient most especially nitrogen which leafy vegetable like *C. olerivus* needs.

Effects of fertilizer types on some soil chemical and physical properties at harvest

Table 7 shows the physical and chemical properties of soil on Oniyaya and Amugbadu in the screen house after harvesting. The mean value of harvest stage of Jews mallows variety Oniyaya, pH value ranged from 5.7 in control pot to 6.9 in poultry manure pot. There was no much change in soil pH of the pots treated with urea and NPK. Soil available P content ranged from 1.8 mg kg⁻¹ in control pots to 14.9 mg/ kg in poultry manure pot. Ca varied between mg kg⁻¹ in control pot and 2.83 mg kg⁻¹ in poultry manure Soil treated with poultry manure had the highest exchangeable K value of 0.35 c mol kg⁻¹. This value was 71 and 23 % higher than control and NPK respectively. Soil organic carbon ranged from 0.18 % in control pot to 1.37 % in pot that received poultry manure. Total N varied between 0.03 % in control pot and 0.17% in poultry manure. These values indicate a general

Table 7: Physical and chemical properties of soil on Oniyaya and Amugbadu in the screen house after harvesting.

Oniyaya									
Treatment	pH	P mg kg ⁻¹	Ca mg kg ⁻¹	K c mol kg ⁻¹	Org C %	N %	Clay %	Silt %	Sand %
Control	5.7c	1.8d	1.36d	0.1c	0.18d	0.03e	12.0a	13.0a	75.0d
NPK	6.6b	10.9b	2.76a	0.27b	1.19c	0.08d	11.0b	12.0ab	77c
PM	6.9a	14.9a	2.83a	0.35a	1.37a	0.17a	12.0a	10.0cd	78bc
Urea	6.6b	5.5c	2.21c	0.1c	1.24b	0.15b	10.0a	11.0b	79ab
Urea Inhibitor	6.7b	5.5c	2.61b	0.1c	1.38a	0.12c	11.0b	9.0d	80a
Amugbadu									
Control	6.0c	1.1c	1.27d	0.21d	0.62e	0.02e	15.0a	13.0a	72.0e
NPK	6.8b	27.48a	2.74a	0.41b	1.35b	0.15c	9.0b	12.0a	79c
PM	6.9a	27.4a	2.6bc	0.55a	3.36a	0.09d	13.0a	12.0a	75d
Urea	6.7c	6.56b	2.5c	0.31c	1.07d	0.37b	7.0c	11.0b	82b
Urea Inhibitor	6.7c	6.41b	2.66ab	0.34c	1.26c	0.41a	7.0c	11.0b	82a

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level.

Table 8: Physical and chemical properties of soil on Oniyaya and Amugbadu on the field after at harvesting.

Oniyaya									
Treatment	pH	P mg kg ⁻¹	Ca mg kg ⁻¹	K c mol kg ⁻¹	Org C %	N %	Clay %	Silt %	Sand %
Control	6.1c	0.3d	1.36d	0.16c	0.05d	0.1b	6c	18aa	76c
NPK	6.7a	45.64b	0.21e	0.24b	0.63b	0.44a	17a	11cd	72d
PM	6.7a	54.68a	1.98a	0.36a	1.2a	0.16b	9b	13b	78b
Urea	6.5b	6.68c	1.73c	0.1d	0.54c	0.4a	10b	10d	80a
Urea Inhibitor	6.7a	6.56c	1.78b	0.1d	0.59bc	0.44a	12b	15b	73d
Amugbadu									
Control	5.9 c	0.21d	0.18c	0.16c	0.72b	0.03e	10b	16aa	74b
NPK	6.7a	11.6b	0.92b	0.24b	0.7bc	0.54c	12b	13b	75b
PM	6.6a	27.4a	2.94a	0.42a	1.3a	0.12d	11b	15a	74b
Urea	6.4b	6.65c	0.01d	0.01d	0.58c	0.72b	13a	10c	77a
Urea Inhibitor	6.4b	6.72c	0.01d	0.01d	0.65bc	0.79a	10b	15a	75b

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level.

increase in pH, P and K in soil treated with poultry manure compared with control and before pre-cropping. At mean value of harvest stage of Amugbadu, pH value ranged from 6.0 in control pots to 6.9 in poultry manure. Soil available P content in Amugbadu pot ranged from 1.10 mg kg⁻¹ in control pots to 27.48 mg kg⁻¹ in poultry manure pots. Poultry manure pots had Ca content of 2.74 mg kg⁻¹ which was higher than the pot treated with NPK and control. Control pots had available K content of 0.21 mg kg⁻¹ while soil from pot treated with urea inhibitor and poultry manure increased soil available K from 0.34 to 0.55 c mol kg⁻¹ respectively. Soil organic carbon ranged from 0.62 % in control pot to 3.36 % in poultry manure. Table 8 shows the physical and chemical properties of soil on Oniyaya and Amugbadu on the field after at harvesting. The mean value of soil pH after harvest stage of Jews mallows variety Oniyaya ranged from 6.1 in control pots to 6.7 in NPK and poultry manure. Soil available P content in Oniyaya pot ranged from 0.3 mg kg⁻¹ in control pots to 54.68 mg kg⁻¹ in poultry manure pots. Poultry manure pots had available P content of 54.68 mg kg⁻¹ which was higher than the pot treated with NPK. Poultry manure pots had Ca content of 1.98 mg kg⁻¹

which was higher than the pot treated with NPK, urea inhibitor, urea and control. Control pots had available K content of 0.16c mol kg⁻¹ while soil from pot treated with poultry manure increased soil available K values. Soil organic carbon ranged from 0.05 in control pot to 1.2 % in poultry manure. At harvesting stage of Jews mallow variety Amugbadu, pH value ranged from 6.2 in control pot to 6.7 in NPK. Soil available P content ranged from 0.21 mg kg⁻¹ in control pots to 27.4 mg kg⁻¹ in poultry manure pot. Poultry manure pots had Ca content of 2.94 mg kg⁻¹ which was higher than the pot treated with NPK, urea inhibitor, urea and control. Pot treated with poultry manure had the highest exchangeable K value of 0.42C mol kg⁻¹. This value was 95 % higher than control. Soil organic carbon ranged from 0.12 in control pot to 1.37 % in pot that received poultry manure. Total N varied between 0.03% in control pot and 0.79% in poultry manure. The organic matter component of poultry manure decomposed and nutrients were released to soil. Hence the finding that poultry manure increased soil pH, N, P, K and, organic carbon significantly. The increases in soil fertility is consistent with findings of previous studies that amendment of soil using poultry manure

improved soil OM, N, P, K, Ca and organic carbon (Adeniyani and Ojeniyi, 2005; Adenawoola and Adejoro, 2005). The significance increase in soil nutrients especially N, P, K and organic carbon in organic amendments compared with NPK fertilizer may be due to leaching in NPK fertilizer treated plots (Adekiya et al., 2020).

Conclusion

In general, at first planting Jews mallow varieties (Oniyaya and Amugbadu) growth and yield were improved by applying NPK fertilizers. However, poultry manure were also found to have better residual effects on soil nutrients than coated urea inhibitor and NPK fertilizer. Thus, the poultry manure demonstrated encouraging potential for enhancing soil fertility and Jews mallow varieties growth and production performance.

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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