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Yield Response of Jew's Mallow (*Corchorus olitorius*) to Fertilizer Application and Soil Properties in Ibadan, Southwest Nigeria

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ABSTRACT

Background and Objective: Jew's mallow (*Corchorus olitorius* L.) is a widely consumed leafy vegetable in Nigeria, but its productivity is often limited by poor soil fertility. Farmers rely heavily on inorganic fertilizers, yet the potential of organic alternatives for sustainable production remains underexplored. This study aimed to evaluate the effects of organic and inorganic fertilizers on the growth, yield, and soil chemical properties of Jew's mallow under field conditions. **Materials and Methods:** The experiment was conducted during the 2020 and 2021 cropping seasons at the Agricultural Development Program Center (ADP), Ibadan, Nigeria, using a randomized complete block design (RCBD) with three replications and five treatments: poultry manure (4 t/ha), pig manure (4 t/ha), NPK 20:10:10 (200 kg/ha), Super Gro liquid fertilizer (1 L/ha), and a control. Pre-cropping soil analysis revealed acidic soil (pH 4.52) with low organic matter and nutrient content. Growth, yield, and soil properties were assessed, and data were analyzed using One-way Analysis of Variance (ANOVA) at a $p<0.05$ level of significance. **Results:** Poultry and pig manure significantly ($p<0.05$) increased plant height and leaf number compared to the control. The NPK enhanced edible yield, while Super Gro improved marketable yield. No significant differences were observed in leaf area or total biomass among treatments. All fertilizers improved soil organic carbon, N, P, K, Ca, and Mg levels, with NPK showing the highest nutrient increases, though it lowered soil pH. Poultry manure and Super Gro slightly reduced soil acidity, whereas pig manure increased pH. Conclusion: Both organic and inorganic fertilizers enhanced Jew's mallow growth, yield, and soil fertility. Poultry and pig manure proved effective alternatives to inorganic fertilizers, offering a more sustainable option for improving soil quality and ensuring long-term production.

KEYWORDS

Inorganic fertilizer, *Corchorus olitorius*, organic fertilizer, yield, soil properties

INTRODUCTION

Jew's mallow (*Corchorus olitorius* L.), a popular tropical leafy vegetable in Africa, Asia, the Middle East, and parts of Latin America, belongs to the Malvaceae family[1]. Its leaves and immature fruits are consumed and cooked[2]. Jew's mallow contributes significantly to nutrition and household food security. However, its yield depends on soil fertility status[3]. Traditional farming systems limited fertilizer use, leads to declining soil fertility because of continuous cultivation depleting nutrients without sufficient replenishment, making

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it difficult for the soil to provide adequate nourishment for crops[4]. Adequate fertilizer application is therefore essential to maximize yields. For optimal yield and nutrient uptake, Jew's mallow requires nutrients such as Nitrogen (N), Phosphorus (P), Potassium (K), Magnesium (Mg), Calcium (Ca), and sodium (Na). These nutrients have specific functions and must be supplied at the appropriate time and in the correct amounts. Olaniyi and Ajibola[5] found that N, P, and K application significantly increased plant height, fresh shoot biomass, number of leaves, and dry matter content compared to unfertilized soil. Thus, soil application of N, P, and K fertilizers can significantly enhance crop yields, growth, and soil properties.

While inorganic fertilizers improve crop yield, soil pH, total nutrient content, and availability, their use is limited by scarcity, high cost, nutrient imbalances, and soil acidity[6]. Organic fertilizers have been shown to enhance efficiency, reduce the need for inorganic fertilizers, and improve soil fertility and health[7]. They release nutrients gradually, improving soil fertility by activating soil microbial biomass[8,9]. Therefore, the objective of the study is to evaluate the yield performance of Jew's mallow in response to fertilizers and its soil properties. Both organic and inorganic fertilizers are necessary to increase Jew's mallow yield and nutrient uptake.

MATERIALS AND METHODS

Study area: The study duration was eight months and was carried out at both the Agricultural Development Programme centre (ADP) in Ibadan and the Federal University of Technology, Akure. The study started in August, 2020 and ended in March, 2021. Ibadan, Southwest Nigeria, is located at a Latitude of 7°30'N and a Longitude of 3°54'E. The area has an annual temperature range of 21 to 32°C and a mean monthly relative humidity of 61% to 83%[10].

Land preparation and soil sampling: The experimental site was manually cleared and ridged. Pre-planting soil samples were collected at a depth of 0-20 cm from various points in the field and bulked to determine the initial chemical properties of the soil before treatment application.

Sources of materials: *Corchorus olitorius* seeds were sourced from a farmer in Ogbomoso, Oyo State. The seeds were cleaned and sorted to remove damaged ones before sowing. Inorganic fertilizers were obtained from an agricultural product marketer, while organic fertilizer was sourced from a local livestock farmer in Ibadan.

Experimental design and treatments: The experiment was arranged in a randomized complete block design (RCBD) with three replications and five treatments.

The treatments were poultry manure (4 t/ha), pig manure (4 t/ha), NPK 20:10:10 (200 kg/ha), Super Gro Neolife liquid organic fertilizer (1 L/ha), and Control (no fertilizer applied).

Field experiment and spacing: Poultry and pig manure were applied to the plots two weeks before planting, while NPK (20:10:10) and Super Gro were applied two weeks after sowing. *Corchorus olitorius* seeds were drilled at a spacing of 50×20 cm and thinned to one seedling per stand two weeks after planting. Hand weeding was performed three times to maintain a weed-free field.

Data collection: Agronomic data were collected from five randomly selected plants per plot for the following parameters: Plant height (cm), number of leaves per plant, leaf area (cm^2), edible yield (g/m^2), marketable yield (g/m^2), and total biomass (g/m^2)[11].

Laboratory analysis: Soil samples from treated plots were analyzed at the Soil Laboratory of the Department of Crop, Soil, and Pest Management, Federal University of Technology, Akure, to determine soil chemical properties.

Data analysis: Data were subjected to Analysis of Variance (ANOVA) using Minitab version 17 software. Significant means were separated using Tukey's test at a 5% probability level.

RESULTS

Pre-cropping soil chemical properties: Pre-cropping soil chemical analyses revealed acidic soil with a pH (H_2O) of 4.52 (Table 1). The soil had low organic matter content (1.32 g/kg), available P (4.98 ppm), exchangeable K (0.16 cmoL/kg), and Ca (4.00 cmoL/kg), while Mg content was medium (2.00 cmoL/kg) (Table 1).

Influence of organic and inorganic nutrient sources on growth and yield of Jew's mallow (*Corchorus olitorius*) L.: Table 2 shows the effects of organic and inorganic fertilizers on Jew's mallow plant height. Poultry manure-treated plots produced the highest plant height (32.80 and 15.33 cm), while control plots had the lowest (21.57 and 8.20 cm) in both cropping seasons, respectively. The effects of fertilizer application on the number of leaves are presented in Table 3. Treatments significantly ($p<0.05$) influenced the number of leaves from 4 to 6 weeks after planting (WAP) in both cropping seasons. Plots treated with poultry manure (4 t/ha) and pig manure (4 t/ha) produced the highest number of leaves compared to other treatments, with significant differences ($p<0.05$) from 4 to 6 WAP. The influence of fertilizers on leaf area is shown in Table 3. No significant differences were observed in leaf area among treatments. However, in both cropping seasons, plants receiving fertilizer had the highest mean leaf area, while control plants had the lowest.

Table 1: Pre-cropping soil chemical properties of the locations

Parameter	Nutrient values
pH (H_2O)	4.52
OM g/kg	1.32
OC	0.77
N g/kg	0.8
P (mg/kg)	4.98
K (cmol/kg)	0.16
Ca (cmol/kg)	4.00
Na	0.32
Mg	2.00

Table 2: Effect of organic and inorganic fertilizers on plant heights of *Corchorus olitorius*

	2020			2021		
Treatment	4 WAP	5 WAP	6 WAP	4 WAP	5 WAP	6 WAP
Poultry manure	14.33^{a}	23.67^{a}	32.80^{a}	8.60^{a}	11.90^{a}	15.33^{a}
Pig manure	12.80^{ab}	21.90^{ab}	30.53^{a}	6.37^{ab}	9.40^{ab}	12.43^{ab}
N.P.K.	11.57^{b}	21.20^{b}	30.17^{a}	6.83^{a}	10.00^{ab}	12.97^{a}
Super Gro	11.47^{b}	20.93^{b}	30.30^{a}	6.80^{a}	9.90^{ab}	12.97^{a}
Control	8.47^{c}	15.33^{c}	21.57^{b}	4.03^{b}	6.03^{b}	8.20^{b}

Means in the same column with different superscripts are significantly different using Tukey's at ($p<0.05$) and WAP: Weeks after planting

Table 3: Effect of organic and inorganic fertilizers on the number of leaves and leaf area of *Corchorus olitorius*

	2020				2021			
Treatment	4 WAP	5 WAP	6 WAP	Leaf area (cm^2)	4 WAP	5 WAP	6 WAP	Leaf area (cm^2)
Poultry manure	16.00^{a}	20.00^{a}	24.00^{a}	17.97^{a}	10.00^{a}	13.33^{a}	17.33^{a}	8.49^{a}
Pig manure	16.00^{a}	20.00^{a}	24.00^{a}	16.63^{a}	8.00^{ab}	12.00^{a}	16.00^{a}	7.30^{a}
N.P.K.	13.00^{b}	17.00^{b}	21.00^{b}	19.26^{a}	9.00^{ab}	13.00^{a}	17.00^{a}	8.27^{a}
Super Gro	14.00^{b}	18.00^{b}	22.00^{b}	17.15^{a}	8.00^{ab}	12.00^{a}	16.00^{a}	7.53^{a}
Control	10.00^{c}	14.00^{c}	18.00^{c}	12.80^{a}	6.00^{b}	8.00^{b}	10.00^{b}	4.38^{a}

Means in the same column with different superscripts are significantly different using Tukey's at ($p<0.05$) and WAP: Weeks after planting

Table 4: Effect of organic and inorganic fertilizers on the yield of *Corchorus olitorius*

Treatment	2020			2021		
	Edible yield (g/m^2)	Marketable yield (g/m^2)	Total biomass (g/m^2)	Edible yield (g/m^2)	Marketable yield (g/m^2)	Total biomass (g/m^2)
Poultry manure	230.00^{a}	496.67^{a}	610.00^{a}	180.00^{a}	303.33^{a}	350.00^{a}
Pig manure	143.33^{a}	390.00^{a}	470.00^{a}	143.33^{ab}	223.33^{a}	256.67^{a}
N.P.K.	246.67^{a}	426.67^{a}	440.00^{a}	170.00^{ab}	286.67^{a}	316.67^{a}
Super Gro	196.67^{a}	530.00^{a}	616.67^{a}	146.67^{ab}	236.67^{a}	266.67^{a}
Control	96.67^{a}	233.33^{a}	283.33^{a}	83.33^{b}	110.00^{a}	120.00^{a}

Means in the same column with different superscripts are significantly different using Tukey's at ($p<0.05$)

Table 5: Effect of organic and inorganic fertilizer on soil chemical properties in the 2020 cropping season

Treatment	pH	OC	OM	N	P	K	Na	Ca	Mg
P. manure	4.26^{b}	0.90^{a}	1.55^{a}	0.10^{c}	3.11^{cd}	0.17^{b}	0.26^{b}	6.60^{b}	2.70^{c}
Pig manure	5.54^{a}	0.71^{bc}	1.22^{bc}	0.10^{c}	3.89^{b}	0.17^{b}	0.26^{b}	5.90^{bc}	3.40^{b}
NPK	4.12^{b}	0.86^{a}	1.49^{a}	0.14^{a}	4.67^{a}	0.20^{a}	0.36^{a}	8.00^{a}	4.00^{a}
Super gro	4.49^{b}	0.79^{ab}	1.35^{ab}	0.12^{b}	3.58^{bc}	0.17^{b}	0.21^{c}	6.5^{b}	3.10^{bc}
Control	5.40^{a}	0.63^{c}	1.05^{c}	0.88^{d}	2.72^{d}	0.14^{c}	0.32^{a}	5.00^{c}	2.00^{d}

Means in the same column with different superscripts are significantly different using the Tukey's test at ($p<0.05$), OC: Organic carbon and OM: Organic matter

Table 6: Effect of organic and inorganic fertilizer on soil chemical properties in the 2021 cropping season

Treatment	pH	OC	OM	N	P	K	Na	Ca	Mg
P. manure	4.23^{a}	1.26^{ab}	2.18^{a}	0.26^{b}	4.67^{ab}	0.17^{ab}	0.33^{a}	7.60^{ab}	4.20^{a}
Pig manure	4.76^{a}	1.26^{ab}	2.18^{a}	0.22^{bc}	3.58^{ab}	0.18^{ab}	0.26^{a}	6.20^{ab}	3.20^{a}
NPK	4.14^{a}	1.61^{a}	2.77^{a}	0.36^{a}	5.13^{a}	0.22^{a}	0.29^{a}	7.80^{a}	3.80^{a}
Super gro	4.27^{a}	1.13^{ab}	1.95^{a}	0.16^{c}	3.58^{ab}	0.20^{ab}	0.36^{a}	8.20^{a}	4.00^{a}
Control	4.86^{a}	1.11^{b}	1.92^{a}	0.16^{c}	3.11^{b}	0.12^{b}	0.21^{a}	4.20^{b}	3.10^{a}

Means in the same column with different superscripts are significantly different using Tukey's at ($p<0.05$), OC: Organic carbon and OM: organic matter

Table 4 indicates no significant differences ($p<0.05$) among treatments for edible yield, marketable yield, and total biomass in the 2020 cropping season. However, NPK-treated plots had the highest mean edible yield, while Super Gro-treated plots had the highest marketable yield (530 g/m^2) compared to the control (233.33 g/m^2). For total biomass, Super Gro-treated plots had the highest mean (616.67 g/m^2), followed by poultry manure (610 g/m^2), with the control having the lowest (283.33 g/m^2). Moreover, in the 2021 growing season, there were significant differences among the treatments with respect to the yield components determined in edible yield, where poultry manure was significantly different from other treatments. While in marketable yield, total biomass, there were no significant differences among the treatments. Poultry manure had the highest mean in marketable yield and total biomass, while the control treatment had the lowest mean. The effects of treatments on soil chemical properties post-harvest are presented in Table 5 and 6. All treatments significantly ($p<0.05$) increased soil organic carbon (OC), N, P, K, Ca, and Mg in 2020 and 2021 cropping seasons. NPK recorded the highest mean in N, P, K, Na, CA and Mg content respectively which are higher among the treatments used. Whereas significant differences were observed among the treatments with respect to their influences on the soil nutrient status in 2021 cropping season. NPK treated plots had the highest mean values for N, P, K, Na, Ca, and Mg, followed closely by organic manure treatments, with the control showing the lowest values. In both years, application of NPK, poultry manure, and liquid fertilizer reduced soil pH compared to the pre-treatment value, while pig manure increased soil pH.

DISCUSSION

This study demonstrates that the tested soil amendments improved the growth and yield of Jew's mallow. The high growth and yield in poultry and pig plots align with previous findings[11-16], which reported that poultry manure enhances crop growth and yield. Manure provides organic matter and nitrogen, acting

as an effective soil amendment[17]. The improved nitrogen supply throughout the growth period likely contributed to enhanced vegetative growth and shoot yield in both organic and inorganic fertilizer-treated plants. Nitrogen stimulates leaf formation, increasing plant size and height, which contributed to higher yields in treated plants.

The lack of significant differences in yield among poultry manure, pig manure, Super Gro, and NPK treatments suggests that both organic and inorganic fertilizers are effective for Jew's mallow cultivation. Organic fertilizers, such as poultry manure, pig manure, and Super Gro, are preferable for vegetable production where available, as supported by Makinde *et al.*[18] for *Corchorus olitorius* and Celosia argentea and James *et al.*[16] for Sesamum radiatum. The positive effects of fertilizers on Jew's mallow growth and yield are likely due to improved soil fertility. Decomposed manure increases macro and micro nutrients and enhances soil physico-chemical properties, supporting crop growth, as reported by Adekiya *et al.*[19] for okra. Organic manures (poultry and pig) and inorganic fertilizers increased soil organic matter, N, P, K, Ca, and Mg compared to the control, attributed to nutrient release during decomposition[20,21]. Organic matter improves soil structure and aeration[22]. The slightly lower pH in organic-amended soils may result from organic acids released during microbial decomposition, neutralizing alkalinity and reducing soil pH[23]. NPK fertilizer resulted in the lowest pH, possibly due to nutrient leaching. Poor soil conditions, like low nutrient status, restricted plant growth, and reduced crop yield. Farmers should apply poultry manure (4 t/ha), pig manure (4 t/ha), NPK 20:10:10 (200 kg/ha), and Super Gro liquid organic fertilizer (1 L/ha) to enhance Jew's mallow growth and yield. Poultry and pig manure are particularly recommended for their significant improvements in plant height and leaf number, offering cost-effective and sustainable alternatives to inorganic fertilizers.

CONCLUSION

This study evaluated the influence of organic and inorganic fertilizers on the growth, yield, and soil properties of Jew's mallow. Poultry manure, pig manure, NPK, and Super Gro significantly increased growth and yield while improving soil chemical properties, demonstrating their efficacy in enhancing *Corchorus olitorius* production. Farmers should apply poultry manure (4 t/ha), pig manure (4 t/ha), NPK 20:10:10 (200 kg/ha), and Super Gro liquid organic fertilizer (1 L/ha) to enhance Jew's mallow growth and yield. Poultry and pig manure are particularly recommended for their significant improvements in plant height and leaf number, offering cost-effective and sustainable alternatives to inorganic fertilizers. To address the low nutrient content and acidity of soils similar to those in the study area (pH 4.52), regular application of organic manure is advised to improve soil organic matter, nutrient availability, and chemical properties. Pig manure is recommended where slight pH increases are desired to counteract soil acidity.

SIGNIFICANCE STATEMENT

The study demonstrates that both organic (poultry manure, pig manure, Super Gro) and inorganic (NPK) fertilizers significantly improve the growth and yield of Jew's mallow, a nutritious leafy vegetable critical for food security in tropical regions. This information supports farmers in optimizing production to meet market demands. Also, highlighting the positive effects of organic fertilizers on soil organic matter, nutrient content, and chemical properties, the study underscores their role in sustainable agriculture.

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