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Comparative Assessment of Organic and Inorganic Fertilizers on the Performance of African Egg Plant (*Solanum macrocarpon* L.) in Ekiti State, Nigeria

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ABSTRACT
Studies were carried out to assess the influence of organic and inorganic fertilizers on the performance of *Solanum macrocarpon* L. (African egg plant) in Ado Ekiti, Ekiti State Nigeria. Organic fertilizers (Poultry manure and cow dung) were applied at the rate of 150g per pot and the inorganic (NPK 20:15:15 and Urea) at 6g per pot to make a field equivalent of 8t ha^{-1} and 200kg ha^{-1} respectively. Poultry manure gave the best performance in terms of height, number of leaves, leaf area, shoot biomass, relative growth rate and fruit weight. The relative growth rate, number of leaves and plant height were similar in NPK and Urea applied pots but lower than those of poultry manure. The results obtained from this study indicate that poultry manure could be an alternative source of fertilizer to *S. macrocarpon* production in place of the inorganic NPK and Urea fertilizers. The study further suggests that poultry manure used for crop improvement is a means of turning waste to wealth in crop production. The leaves and fruits produced from poultry manure fertilized soil supports the current global campaigns for organic food production.

Introduction

Solanum macrocarpon otherwise known as the African Egg plant is a plant of the Solanaceae family. It originated from West Africa, but is now widely distributed in central and East Africa to Nigeria and known as a good source of vitamins and minerals [1]. The consumption of *Solanum macrocarpon* fruit spreads throughout the African continent. The fruit is served during ceremonies alongside with kola or sometimes in place of kola. The fruit and the leafy part of parent plant are used in the preparation of delicacy such as African salad, Yam and stew [2]. It is of great importance for medicinal purposes and has potential for the vegetable industry. Medicinally, the fruit or the leafy part of the plant are effective against constipation, ulcers, tooth ache and the leafy part is sometimes used as snake bite remedy [3]. The leafy part of *Solanum macrocarpon* is also applied to areas of skin disease, infections and sores [4].

Solanum macrocarpon is one of the most important vegetable commonly used in Southern Nigeria. It contribute substantially to the people diet as source of soup and widely grown for both consumption and for sales due to its potential leaf production [5]. Despite the significance of *Solanum macrocarpon* in the traditional farming systems and its dietary importance in terms of nutritional quantity and qualities [6, 5], its cultivation and productivity like other leafy vegetables is limited by declined soil fertility [7]. The present study therefore aims at assessing the comparative effect of organic and inorganic fertilizers on improved performance of *Solanum macrocarpon*.

Materials and Methods

This experiment was carried out at the experimental site of the Department of Plant Science, Faculty of Science, Ekiti State University, Ado Ekiti (7° 40'N, 5° 15'E). Ado-Ekiti is located in the South Western Nigeria. The location has a bimodal rainfall pattern with an annual mean of 1,400mm. Poultry manure and cow dung were collected from poultry and cow farm of Ekiti State University, Ado-Ekiti. Two trials were carried out between June and November 2014; and March and August 2015 NPK and urea fertilizers were purchased from Agricultural Supply Input Agency in Ado-Ekiti. Twenty two horticultural pots used were obtained from Plant Science Laboratory, Ekiti State University. Seeds of *S. macrocarpon* used in the experiment were purchased from Oba Market in Ado Ekiti.

Soil samples were collected from a piece of land at the Teaching and Research Farm of Faculty of Agricultural Sciences in Ekiti State University Ado Ekiti where maize has just been harvested. Each of the pots was filled with collected soil sample from a newly harvested yam plot. The collected soil samples were subjected to routine soil analysis and found to be a sandy clay loam with an organic matter content of 4.28; 0.28%N; 11.70mg/kg P; 580mg/kg K; and a pH of 5.77 The poultry manure and cow dung were analysed to contain 2.50%N; 5.13mg/kg P; 5856.64mg/kg K; and a pH of 7.52: and 2.19%N; 4.27mg/kg P; 8366.53mg/kg K; and a pH of 8.20 respectively. *S. macrocarpon* was transplanted to the pots at four week after sowing in the nursery. Either urea or NPK fertilizer was applied at 2 weeks after transplanting (2WAT), while the organic had earlier been applied at 2 weeks before transplanting.

The organic manures were applied at the rate of 150g per pot to make 8t ha^{-1} field equivalent either at the nursery or in the transplanted pots. The following growth and yield factors were assessed: Initial seedling height and girth;

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seedling height and stem girth at 4, 8, and 12 weeks after transplanting (WAT); number of leaves at 4, 8, and 12 WAT; leaf area; shoot and root biomass; number of fruits per plant; fruit weight per plant; and relative growth rate. The leaf area was calculated using a formulae determined by Kayode and Otoide [8], while the relative growth rate was determined according to Kayode and Tedela [9].

All data collected were subjected to statistical analysis of variance and means compared using the Duncan's multiple range Test.

Results

Table 1 shows the initial height of seedlings and stem girth of seedlings at transplanting. Identical seedling heights and stem girths were observed in both trials showing uniform seedlings growth at transplanting.

Table 1. Effects of organic and inorganic fertilizers on the height and stem girth of seedlings of *S. macrocarpon* at transplanting.

Treatments	Seedling height (cm)		Stem girth of seedlings (cm)	
	Trial 1	Trial 2	Trial 1	Trial 2
Control	2.6a	2.3a	4.1a	4.5a
Poultry manure	2.4a	2.5a	4.9a	4.2a
Cow dung	2.4a	2.6a	4.2a	4.1a
NPK	2.7a	2.3a	4.0a	4.4a
Urea	2.6a	2.5a	4.9a	4.0a

Means followed by the same letter(s) within columns are not significantly different (P=0.05).

The tallest plants were observed in the poultry manure applied pots at 4 WAT but not significantly different from those of NPK and urea in Trial 1. In Trial 2, urea produced shorter plants than either poultry manure or NPK fertilizer applied pots. The shortest plants were produced in the control experiment. Cow dung and urea were also similar.

Table 2. Effects of organic and inorganic fertilizer on *S. macrocarpon* height (cm) at 4, 8 and 12 weeks after transplanting.

Treatments	4 WAT (cm)		8 WAT (cm)		12 WAT (cm)	
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Control	4.3c	4.5c	6.7c	6.0d	11.5c	10.3c
Poultry manure	6.8a	7.4a	14.8a	15.2a	27.8a	28.1a
Cow dung	5.9b	6.1b	12.2b	12.9c	23.8b	20.5b
NPK	6.7a	7.5a	14.4a	15.5a	28.5a	27.9a
Urea	6.6ab	6.5b	12.8b	13.6b	24.4b	22.8b

Means followed by the same letter(s) within columns are not significantly different (P=0.05).

Table 3 shows the effect of organic and inorganic fertilizer on number of green leaves at 4WAT, 8WAT and 12WAT. The highest number of leaves was produced in the poultry manure applied pots at 4WAT but not significantly different from NPK fertilizer application, while the control had the lowest number of leaves. While the number of leaves was higher in cow-dung applied pots than those of urea in Trial 1, they were similar in Trial 2 (this could arise probably because of different soil nutrient compositions in the soils of both trials). At 8 WAT and 12 WAT, the highest number of the leaves was produced in the poultry manure which was identical to those observed in the NPK applied pots. The lowest number of leaves was also observed in the control experiment. Cow-dung applied pots produced higher number of leaves than urea applied pots at 8 and 12 WAT in both Trials. Urea produced similar number of leaves with NKP at 12 WAT in both Trials.

Table 3. Effect of organic and inorganic fertilizers on number of green leaves of *S. macrocarpon* at 4, 8 and 12 weeks after transplanting.

Treatments	4 WAT		8 WAT		12 WAT	
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Control	3.5d	4.6c	11.6d	8.5d	12.0d	11.6d
Poultry manure	7.8a	10.3a	16.9a	18.6a	22.3a	23.5a
Cow dung	6.8b	6.9b	13.3c	14.4c	18.0c	18.6c
NPK	7.1ab	11.1a	16.5a	18.2a	21.4ab	22.8ab
Urea	5.6c	6.6b	15.3b	17.0b	20.5b	21.0b

Means followed by the same letter(s) within columns are not significantly different (P=0.05).

Table 4. Effects of organic and inorganic fertilizers on the stem girth *S. macrocarpon* at 4, 8 and 12 weeks after transplanting.

Treatments	4 WAT (cm)		8 WAT (cm)		12 WAT (cm)	
	Trial1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Control	6.1c	6.5c	8.30c	10.40c	13.40c	13.40d
Poultry manure	10.9a	11.2a	14.34a	14.93a	20.93a	19.74a
Cow dung	9.2b	9.1b	11.97b	13.00b	18.00b	17.50b
NPK	10.6a	10.81a	13.95a	14.20a	20.70a	19.46a
Urea	8.9b	9.0b	12.10b	13.33b	18.33b	16.18c

Means followed by the same letter(s) within columns are not significantly different (P=0.05).

Table 5 shows the effect of organic and inorganic fertilizers on leaf area at harvest, shoot biomass and root biomass of *S. macroarpon*. Poultry manure applied pots produced the highest leaf area similar to that of NPK while the lowest was observed in the control experiment. Cow dung and urea were not significantly different. The highest shoot weights were observed in the Poultry manure but were not significantly different from the NPK applied pots. The shoot weight in the cow dung application was not significantly different from those of urea applied pots. The lowest was recorded in the control experiment. Root biomass recorded in urea and NPK were not significantly different but highest. Poultry manure and cow dung were not significantly different but higher than the control in terms of root biomass assessment.

Table 5. Effect of organic and inorganic fertilizers on the leaf area shoot and root biomass of *S. macrocarpon*.

Treatments	Leaf area at harvest (cm^2)		Shoot biomass (g)		Root biomass (g)	
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Control	122.2c	106.7c	10.8c	11.2c	2.6c	2.6c
Poultry manure	297.6a	300.2a	25.5a	27.3a	3.6a	3.8b
Cow dung	249.5b	245.5b	19.2b	20.4b	3.5b	3.9b
NPK	288.6a	298.5a	24.9a	26.8a	4.4a	4.6a
Urea	242.8b	265.7b	20.5b	21.9b	4.7a	4.8a

Means followed by the same letter(s) within columns are not significantly different (P=0.05).

The effect of treatments on the relative growth rate, number of fruits per plant and fruit weight at harvest is presented in Table 6. The relative growth rate observed in the poultry manure was highest but not significantly different from cow dung application. Also the NPK and urea were not significantly different but higher than the control. The highest number of fruits per plant at harvest was identical in poultry manure and NPK applied plots. Cow dung and urea were similar while the control experiment had the lowest number of fruits per plant.

The fruit weights observed in the poultry manure, NPK and urea applied pots were identical in Trial 1but urea produced lower fruit weight than either poultry manure or

NPK. The fruit weight observed in the cow dung application is lower but higher than those of the control experiment which recorded the lowest fruit weight.

Table 6. Effect of organic and inorganic fertilizers on the relative growth rate, number of fruits per plant and fruit weight per plant of *S. macrocarpon*.

Treatments	Relative growth rate		Number of fruits plant^{-2}		Fruit weight plant^{-2} (g)	
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Control	11.40d	10.64d	1.3b	1.0c	8.07c	10.5c
Poultry manure	18.07a	18.61a	2.7a	3.1a	29.30a	35.8a
Cow dung	17.02ab	17.90a	1.5b	1.9b	19.70b	28.5b
NPK	16.10bc	16.5b	2.3a	2.8a	28.80a	34.6a
Urea	15.09c	15.00c	1.5b	2.1b	23.34a	28.3b

Means followed by the same letter(s) within columns are not significantly different (P=0.05).

Discussion

The result of this research work showed that the application of organic manure substantially increase the growth and yield parameters of *Solanum macrocarpon* more than the inorganic fertilizers. This could be due to enhancement of decomposition of organic material and mineralization of nutrients especially N and P. poultry manure enhanced the vegetative growth of *Solanum macrocarpon*, this is in line with an earlier research work where poultry manure was found to increase growth and yield of *Corchorus olitorius* [10].

It had also been reported that plant height, number of leaves, leaf area as well as N, P and K of soil content were increased with increase in the level of poultry manure [11]. The importance of use of inorganic and organic manure in tropical agriculture and increasing world food production had also been reported [12]. Their roles are to improve the yield and quality and also for quick maturity of vegetables. Apart from the role organic manure plays as a store house for plant nutrient, it also acts as a major contributor to cation exchange capacity and as buffering agent against undesired pH fluctuation [13].

Reports have also shown that application of fertilizer gave vigorous development in plant vegetative parts due to the release of considerable amount of nutrients for plant use, which is essential for the formation of plant essential molecules such as chlorophyll and protoplasm [14]. The observed increase performance of *Solanum macrocarpon* in trems of shoot, leaves and fruit yield in poultry manure applied pots in this experiment is attributed its ability to released nutrient elements quickly for plant improvement.

Significant part of the total weight of plants are made up of nitrogenous compounds, similarly increase in nitrogen supply for utilization of carbohydrate to form protoplasm and more cells enhance plant growth [15, 16]. The positive response of *Solanum macrocarpon* to poultry manure in this work indicates that this manure served as good source of nitrogen, which increased the growth and yield potentials of *Solanum macrocarpon* [17].

Conclusion

In conclusion, the present work shows that all the four types of fertilizer used were found to increase the growth and yield of *Solanum macrocarpon*. However, the effect of poultry manure were prominent in the production of green leaves, vine length, stem girth, number of fruits and fruit weight per pot.

Therefore, the use of poultry manure as organic fertilizer, has shown promising potential for improving soil fertility, growth and yield performance of *Solanum macrocarpon* in Ado-Ekiti.

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