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Effects of Rabbit Urine and Urea Fertilizer on the Growth and Yield Performance of Amaranthus (*Amaranthus hybridus* L.)

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Abstract: The high prevalence of lofty demand on lands for other uses aside for agricultural purposes has resulted in unavailability of lands for cultivation and thereby forcing farmers to employ continuous cropping of same farmland at the cost of soil fertility management. The present study aimed at evaluating the effect of rabbit urine and urea fertilizers on the yield performance of Amaranthus (*Amaranthus hybridus*) at two different locations in Akure, Southwest, Nigeria. The experimental design was Randomized Complete Block Design (RCBD) with ten treatments and each replicated three times. The responsive effect of the plant to treatment and location was determined at 2, 4, 6 and 7 weeks respectively. Result showed that *Amaranthus hybridus* performance increased ($P < 0.05$) when exposed individually to different quantity/ration of rabbit urine and urea respectively as well as their mixed ratios. Results also showed that different treatment applied had significant effect ($p \leq 0.05$) on growth parameters such as plant height and leaves numbers, which were all significantly higher when compared with the control. Meanwhile, the improved growth of *Amaranthus hybridus* at FUTA (Federal University of Technology, Akure) location is higher than that at FECA (Federal College of Agriculture, Akure) location. Furthermore, the interaction between location and treatment is significantly different at 95% level of significance at 1-7 weeks after planting. Conclusively, there is positive effect of rabbit urine and urea fertilizer on the performance of *Amaranthus hybridus*.

Keywords: *Amaranthus hybridus*, Rabbit Urine, Urea Fertilizer, Performance, Soil Fertility

1. Introduction

Exploitation of fertile areas for purposes unrelated to agriculture has contributed to a decline in vegetable output. Intensive agricultural practices with little or no fertilization are also a major variable of its production declines [1]. Other variables, including soil type, soil nutrient status, and fertilizer management, are also important drivers of plant growth, production, and nutritional quality [2]. The use of chemical fertilizers such as urea, though beneficial to the plants, may have detrimental consequences on the agricultural ecosystems, therefore the need to exploit other options such as organic fertilizers. Organic fertilizers have been shown to have important chemical functions such as the provision of macro and micro-nutrients (N, P, K, Ca, Zn, Cu and Mo) in relative amounts [3]. Organic fertilizer, such as rabbit urine, which is inexpensive to get through rabbit rearing (cuniculture), are essential to minimizing crop production costs [4]. In general, the application of organic fertilizer improves root system and plant stems better than chemical fertilizers [5]. Comprehensive tests carried out on organic fertilizer such as livestock waste, and chemical fertilizers revealed that the former is environmentally friendly, more efficient and effective. Livestock waste (such as rabbit urine) increases the availability of nutrients in food

crops, thereby increasing yield via unprecedented boost in growth and production of vegetables. [6]

Amaranthus hybridus is a vegetable with great and medicinal function among the Nigerian populace. Its leafy vegetables are typically prepared and eaten as a condiment with starchy staple foods in Nigeria [7]. Because of its rich phyto-nutrients, *A. hybridus* is used in traditional medical practice as an anti-inflammatory agent of the urinary tract; the root juice is used to treat inflammation during urination and constipation. It is also used as an antiviral against human epidermoid carcinoma (HEP-2) cell line [8]. Considering the importance of this vegetable, employing cheap but effective methods that will help improve soil fertility and thereby the plant's production performance and quality is a necessity. Therefore, the present study was undertaken to determine the effect of rabbit urine and urea fertilizer on the Yield performance of Amaranthus (*Amaranthus hybridus* L.).

2. Materials and Methods

2.1. Experimental Site

The experiment was carried out at two different locations: (i) the Teaching and Research Farm of the School of Agriculture and Agricultural Technology of the Federal University of Technology Akure (FUTA) (longitude 5°06' E, to 5°38'E and between latitude 7°07' N, to 7°37' E), mean annual rainfall of 457 mm, Relative humidity of 55 to 65%; mean annual temperature; 33.8°C and 1565m above the sea level) in a tropical rainforest zone of Nigeria; and (ii) the Horticultural field of the Federal College of Agriculture, Akure (FECA) (longitude 5.2684°E and latitude 7.2779°N), mean annual rainfall ranges from 1100mm – 1500 mm per annum, the relative humidity is 85%, the temperature ranges from 25 – 30°C to determine the effect of rabbit urine and urea fertilizer on the performance of Amaranthus (*Amaranthus hybridus*).

2.2. Source of Planting Material

The seeds of *Amaranthus hybridus* were obtained from First Let Farm, Akure, Ondo State, Nigeria.

2.3. Source of Urea and Rabbit Urine

The urea used for the experiment was purchased from a popular agricultural input shop in Akure (First Let Farm) while rabbit urine was obtained from Akure Central Main Market.

2.4. Experimental Design and Application Rate of Treatment

Ten (10) treatment combinations: (i) 100RB+200kg/ha, (ii) 75RB+200kg/ha, (iii) 50RB+200kg/ha, (iv) 25RB+200kg/ha, (v) 100RB, (vi) 75RB, (vii) 50RB, (viii) 25RB, (ix) 100U and (x) CTRL (control) were evaluated. Each treatment was replicated three (3) times in the two study locations. The experiment was laid out in a Randomized Complete Block Design (RCBD). The volume of rabbit urine used were: 1000ml, 750ml, 500ml and 250ml, and were diluted with 0ml, 250ml, 500ml and 750ml distilled water respectively while urea fertilizer at 200kg/ha was used as standard check.

2.5. Data Collection and Data Analysis

Plant vine length was measured from the stem base to the apical bud using meter rule while stem girth was measured using a digital vernier caliper (model 0-200 mm) at the 5cm point from the base of the stem. The leaves were counted manually. Fresh and dry mass of plant parts were measured. Harvestable yield, consumable yield, and commercial yield were also determined accordingly.

2.6. Soil Analyses

Soil pH, was determined using Metro pH meter model E250. Determination of soil particle size was done using hydrometer method. Cation Exchange Capacity (CEC) was determined by ammonium saturation method. Organic matter was determined by Walkley-Black Wet oxidation method. K and Na determination were determined by flame photometry. Ca and Mg were determined by versenate or (EDTA) method. Soil available phosphorus was also determined.

Data were subjected to Analysis of variance, ANOVA using the MINITAB 17th Edition Statistical Package and means were separated using Tukey's Honest Significant Difference at 5% level of probability.

3. Results and Discussion

Preliminary investigations were carried out on the soil samples of the experimental locations coded FUTA and FECA prior to further analysis. The soil pH at both locations was slightly acidic with FECA soil pH at 5.39 and FUTA 5.45 respectively. The soil organic matter of the two locations was observed with FECA at 1.65% and that of FUTA 2.38%. The mineral analysis of the soil of both locations revealed a moderately available nitrogen content of FECA 0.1% and FUTA 0.16% respectively. Overall the mineral analysis showed that both locations were fertile and can be used for further study.

Table 1. *Chemical properties of soil at the two study locations.*

Soil chemical properties	FUTA	FECA
PH 1:2 (H_2O)	5.45	5.39
OC (%)	1.38	0.96
OM (%)	2.38	1.65
N (Mg/Kg)	0.16	0.1
P (Mg/Kg)	16.92	12.44
K (Mg/Kg)	0.25	0.23
Na (mol/kg)	0.28	0.26
M (mol/kg)	1.4	1.0
C (mol/kg)	3.1	2.1

Table 2. *Physical properties of the soil used for the experiment.*

Physical analysis	FUTA	FECA
Sand	5.45	5.39
Silt	1.38	0.96
Clay	2.38	1.65
Bulk Density (g/cm^3)	0.16	0.1
Moisture content (%)	16.92	12.44

Table 3 revealed the nutrient composition of rabbit urine used for this experiment. The pH of the urine was 7.55. Furthermore, the elemental composition of the urine revealed that calcium was 3.11 and potassium content of 3.11 while magnesium, phosphorus and nitrogen content were 2.15, 2.11 and 1.63 respectively. The organic matter was 2.32.

Table 3. *Rabbit Urine Analysis.*

Parameter	Value
PH	7.55
Calcium	3.11
Potassium	3.11
Organic Matter	2.32
Magnesium	2.15
Phosphorus	2.11
Nitrogen	1.63
Sodium	1.32

Figure 1 showed the interaction effects of treatment combinations and locations on the number of leaves of *Amaranthus hybridus*. It was observed that as the number of weeks of exposure to various treatments increased, the number of leaves of *A. hybridus* also increased. Furthermore, there was a general trend across the treatment groups which showed an increase in the number of leaves as the percentage of rabbit urine used in the treatment increased. Makinde *et al.* [9] reported an increase in the number of leaves per plant of maize when cattle manure was incorporated into the soil. Although inorganic fertilizers alone can be used to replenish soil nutrients and increase crop yields. Similarly, Toungos *et al* [10] reported that nitrogen fertilizer rates positively influenced growth and yield parameters of vegetable amaranth. The combination of the two treatment (rabbit urine and urea) at 100RB+200kg/ha at 4 weeks recorded the highest number of leaves. Stephen Oyedeji *et al* [11] reported that inorganic (NPK) and organic fertilizer (PM) generally increased the growth of *Amaranthus*. However, the number of leaves of *Amaranthus hybridus* at FUTA is higher than that of FECA. The interaction between location and treatment is significantly different at 95 % level of significance at 1-7 weeks after planting.

Figure 1: Interaction effects of treatment and location on the number of leaves (cm) of *Amaranthus hybridus.*

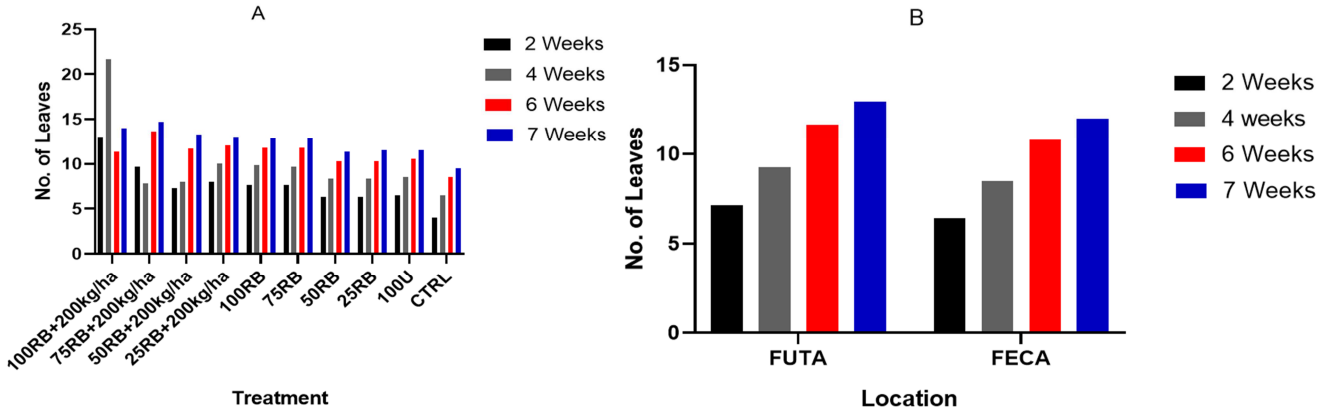

Figure 1. *Interaction effects of treatment and location on the number of leaves of Amaranthus hybridus after 2, 4, 6 and 7 weeks of planting (A) effect of treatment (B) effect of location.*

Figure 2 showed the interaction effects of treatment and location on plant height of *Amaranthus hybridus*. The plant height varied significantly as the number of weeks increased from 2 to 7 weeks, there was a significant increase in the plant height for all treatment, the plant height increased as the quantity of rabbit urine increased in the treatment groups. This is similar to the findings of Amos *et al*. [12] who reported that application of cattle manure increased plant growth. Although increased level of production can be achieved by increased use of inorganic fertilizers alone. This is consistent with earlier findings of Olaniyi *et al* [13] who reported the effects of N fertilizer application on the plant height were significantly different ($P \leq 0.05$) at various levels of N. The combination of the two treatment (rabbit urine and urea) at 100RB+200kg/ha at 7 weeks produced the highest plant height. This is in accordance with the findings of Lim *et al.* [14] who reported highest yield in vegetables treated with the combination of 30 t/ha PM (poultry manure) + IF (inorganic fertilizer). At FUTA and FECA location, the plant height was the same across the weeks (week 1 – 7). The interaction between location and treatment is significantly difference at 95% level of significance at 1-6 weeks after planting while there were significant differences ($p \leq 0.05$) at 7 weeks after planting.

Figure 2: Interaction effects of treatment and location on the plant height (cm) of *Amaranthus hybridus.*

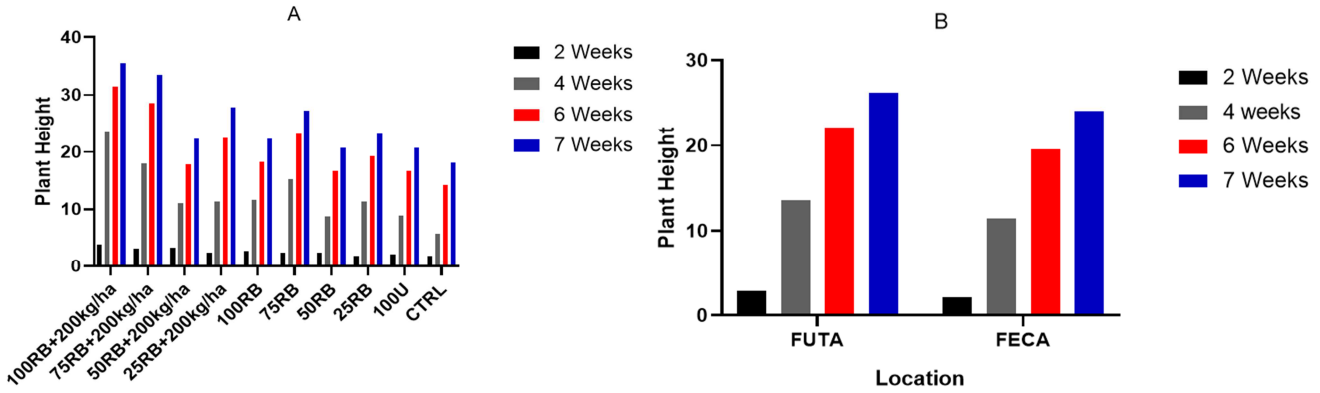

Figure 2. *Interaction effects of treatment and location on the plant height of Amaranthus hybridus after 2, 4, 6 and 7 weeks of planting (A) effect of treatment (B) effect of location.*

4. Conclusion

The present study established that sole application of either organic or inorganic fertilizer can improve soil fertility, though the combination of both showed the highest level of improvement. Furthermore, the significant improvements observed in the soil fertility transcended into improve leaves number and plant height, an indication that the combinatory effects of the fertilizers are beneficial and non-toxic. However, there was difference in the plant's improvement quality when compared across location, an indication that the beneficial potential of the combination of organic and inorganic fertilizers may be limited by the previous quality of the soil. Conclusively, the combinatory effect of the rabbit urine and urea fertilizer was beneficial and non-toxic, however their effects were significantly different across locations.

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