Soil Physicochemical Properties, Growth and Development of Sweet Melon (*Cucumis melo* L.) as Influenced by some Organic Amendments at Awka, South Eastern Nigeria

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KEYWORDS

Bat Guano,
Neem leaves;
Organic amendments;
Soil physicochemical properties,
Sweet melon;

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ABSTRACT

A study on the soil physicochemical properties and agronomy of sweet melon (Cucumis melo L.) as influenced by different organic amendments was conducted at the Soil Science and Land Resources Management Research Farm, Faculty of Agriculture, Nnamdi Azikiwe University, Awka. The experiment was laid out in randomized complete block design (RCBD) with five treatments, replicated three times. The treatments were: Bat manure (10t/ha), Pig manure (10t/ha), Dry neem leaves (10t/ha), Poultry manure (10t/ha), and a control (0t/ha). Data collected were subjected to Analysis of Variance (ANOVA) using Genstat4th edition statistical software. Means were separated usingFisher's Least Significant Difference (F-LSD) at 5% probability level. The results obtained showed that the application of organic amendments had significant effects on some soil physical properties but did not significantly affect any of the chemical parameters tested. Meanwhile, some growth parameters studied as well as the yield component showed significant differences among the various treatments at 3, 6 and 9weeks after planting (WAP). Bat Guano recorded the highest values for most physical properties, growth parameters and fruit weight, and is closely followed by poultry manure. Though soil chemical properties did not show statistical significant differences, application of organic amendments resulted to increased value of soil organic carbon, Total N, pH, CEC, and exchangeable bases. Bat manure though scarce, is recommended for farmers to be used in the production of Sweet Melon in the study area for higher yield and an alternative manure source for sustainable soil fertility management.

INTRODUCTION

Organic farming has become an essential priority worldwide in view of the growing demand for healthy and safe food, long-term sustainability and concerns regarding the environmental pollution related to the indistinctive utilization of chemical fertilizers, (Al-Erwy *et al*., 2016). Over the years, use of synthetic materials in crop production has been a common practice globally. The attendant detrimental effects of the chemicals used in the formulation of these synthetics on animal and human health as well as the environment has made researchers to look out for a better agronomic practice that would not only improve productivity but at the same time sustain a healthy environment (Onunwa, *et al*., 2021).Organic materials are very important soil amendments that sustain the productivity of soils in tropical and subtropical areas where there is low soil organic carbon (SOC) content and lower input of organic materials (Zheng *et al*., 2016). Using organic wastes including Poultry manure, Bat guano (bat manure), Pig waste and dry neem leaves as soil amendments is an ideal way to maintain soil organic matter, improve soil quality and provide nutrients essential to plants (Ghasem *et al*., 2014).

Sweet melon (*Cucumis melo* L.) fruit is one of the most important and popular fruit vegetables grown in Egypt; it is used mainly as a desert and refreshing fruit. It is rich in bioactive compounds such as phenolics, flavonoids and vitamins as well as carbohydrates and minerals (especially potassium). In addition, it is low in fat and calories (about 17 kcal/100g). It has a large amount of dietary fiber (Tamer *et al*., 2010). This study was designed to investigate the effect of selected organic amendments on soil physicochemical properties as well as the growth and yield of sweet melon (*C. melo* L.). The specific objectives were to determine: the effect of organic amendments on soil physical and chemical properties; the effect of organic amendments on the growth and yield of sweet melon '*C. melo* L.'.

MATERIALS AND METHODS

This study was carried out at the Soil Science and Land Resources Management Research Farm, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra state. Awka is located within Latitudes 06°14.0'N – 06°15.95'N, and Longitudes 07°6.0'E – 07°7.8'E. It has a bimodal rainfall system which lasts between March and October, with a short break around July/August called August break. The rainfall ranges from 1,500 to 2,000mm per annum. The temperature ranges from 20 to 35°C, while the relative humidity ranges from 63% to 88%. (Ezenwaji *et al*., 2014).

Sweet melon *(C. melo* L.*)* was imported from East-West Seed International ltd, Thailand. Guano was collected from empty bat infested buildings at Ifite-Ogwari, Anambra State. Poultry manure was gotten from Food Soldiers Farms; Pig waste was collected from Animal Science Research farm; Neem leaves were harvested fresh from neem plants (and were dried properly under sunlight) all within Nnamdi Azikiwe University, Awka, Anambra State.

The experiment was laid out in randomized complete block design (RCBD) with five treatments, replicated three times. The treatments were: Bat manure (10t/ha), Pig manure (10t/ha), Dry neem leaves (10t/ha)., Poultry manure applied at 10t/ha and a control (0t/ha).

Land area of about 0.49ha was mapped out using measuring tape, rope and pegs. The site previously cropped to corn, was cleared manually and the residue turned into the soil. Melon seeds were planted directly to the soil at the rate of one seed/hole and at a spacing distance of 30cm x 45cm.Weeds were controlled by hand picking every two weeks.

Soil Sampling and Analysis

A total of 6 disturbed and 6 undisturbed soil samples were collected at a depth of 0-15cm from different location at the experimental field using auger and core samplers. The disturbed samples were bulked together to obtain a composite sample while the 6 undisturbed samples were used for the determination of bulk density, moisture content and hydraulic conductivity. The post harvest soil samples were collected at designated points. Both samples were air dried and passed through a 2mm sieve and analyzed for both physical and chemical properties.

The following analyses were carried out on the samples: Moisture content was determined using gravimetric method (Jalota *et al*., 1998); Particle size analysis was done using Bouyoucos hydrometer method as described by Gee and Bauder (1986); Soil bulk density was determined using core method as described by Blake and Hartage (1986); Organic carbon was determined by Walkley and Black wet oxidation method as outlined by Nelson and Sommers (1982); Exchangeable bases (K, Ca, Na, and Mg) were extracted with 1N NH_4OAC buffered at pH 7.0 (Thomas, 1982). The amount of Ca and Mg were determined using Ethylene Diamine Tetra-Acetic (EDTA) titration method while potassium and sodium were determined by flame photometer (Rhoades, 1982); Available P was determined using Bray 2 extraction method (Bray and Kurtz, 1945); Exchangeable acidity was extracted with 1N KCL (Thomas 1982) and was determined by titration method using 0.005N NaOH and phenolphthalein as indicator; Total nitrogen was determined using macro kjedahl method (Bremer and Mulvancy, 1982); Soil pH was determined potentiometrically in a slurry system using an electronic pH meter (Mclean 1982); The base saturation was calculated mathematically as: TEB/ECEC × 100/1

Where TEB = Total Exchangeable Bases (Ca, Mg, K and Na); and ECEC = effective cation exchange capacity

Effective Cation Exchange Capacity (ECEC) was calculated as the summation of the exchangeable bases (Ca, Mg, K, and Na) and exchangeable acidity.

Plant data were collected from the experimental unit on the following parameters; vine length (cm), number of leaves and number of braches per plant at 3, 6 and 9WAP; as well as the plant yield (fruit weight)(t/h).

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) using Genstat4th edition (2011); means were separated using Fishers Least Significant Difference (F-LSD) at 0.05 probability level.

RESULTS AND DISCUSSION

Effect of Organic Amendments on the soil physical properties

Table 1 showed the effects of organic amendments on the physical properties of the soil. Observed result indicated that there was a significant difference in the physical parameters tested. The parameters as portrayed by the result were in this order: Bulk density (g/m^3) followed the order: Bat manure, BM (1.52) = Control, C (1.52) > Poultry manure, PM (1.50) > Pig waste, PW (1.49) >Neem Leaves, NL (1.46). Porosity followed the order: NL (45.09) > PW (43.90) > PM (43.52) > BG (42.64) > C (42.61). Soil Moisture content followed this order: BM (46.12) > PM (45.85) > C (45.24) > NL (45.13) > PW (44.93) and hydraulic Conductivity (Ksat) was in this order: C (68.20) > BM (65.80) > NL (57.20) > PW (55.30) > PM (54.50). This result obtained could be attributed to the addition of organic matter to the soil as a result of the amendments used. This finding corroborates the finding of Eilín and McDonnell (2012), who observed that organic amendments played important and multi-faceted role in soil by influencing soil structure and all its associated properties. Eloi *et al*. (2022) also reported that *Tithonia diversifolia* fresh biomass and poultry manure (PM) lowered the soil bulk density, increased soil total porosity and water holding capacity.Only Ksat had significant interaction effect among all the treatments. Every other parameter tested did not show any interaction effect.

Table 1: Effect of organic Amendments on Soil Physical Properties

Manure type (MT)	Physical properties BD g cm-3	Porosity	MC (%)	Ksat mm hr
Bat Guano	1.52	42.64	46.12	65.8
Neem Leaves	1.46	45.09	45.13	57.2
Pig Waste	1.49	43.9	44.93	55.3
Poultry manure	1.5	43.52	45.85	54.5
Control	1.52	42.61	45.24	68.2
LSD (0.05)	0.04	1.64	0.78	34.42

BD = Bulk Density, MC= Moisture Content, Ksat = Saturated Hydraulic Conductivity

The chemical parameters tested (Table 2) did not show any significant differences/variations and there was no interaction effect. However, it was observed that application of organic amendments increased the value of most chemical parameters measured as against the control. This observation is in agreement with the findings of Kaur *et al*. (2005) who reported that the application of organic manures improved soil organic carbon content.

Table 2: Effect of organic Amendment on soil chemical properties

	Soil Chemical Properties (Cmol/kg)											
Manure type (MT)	**Na+**	**Ca2+**	**Mg2+**	**K+**	**TEA**	**CEC**	**%BS**	**Al3+**	**H+**	**pH**	**%TN**	**%OC**
Guano	0.39	4.22	1.48	1.59	0.06	6.24	98.8	0.01	0.05	6.1	0.21	1.8
Neem	0.99	4.11	1.33	1.47	0.07	7.96	99.1	0.02	0.05	6.05	0.11	0.85
Pig	0.52	4.67	1.88	2.08	0.05	9.21	99.35	0.01	0.04	6.1	0.22	1.8
Poultry	0.38	4.27	1.36	1.66	0.06	7.76	99.15	0.01	0.05	6.1	0.2	1.7
Control	0.13	4.1	1.32	0.51	0.07	5.38	98.78	0.02	0.05	6	0.09	0.8
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS = Not Significant

Table 3 showed the effect of organic amendments on the number of leaves, vine length, number of branches. Observed data indicated that there was significant difference in the number of leaves at 3 and 6 weeks after planting (WAP); significant difference in the vine length at 6 and 9 WAP; and significant difference in the number of branches at 6 and 9 WAP. Meanwhile, at 9WAP, number of leaves did not show significant difference; at 3WAP, vine length did not show significant difference and at 3WAP, number of branches did not show significant difference.

For the number of leaves, at 3 WAP, Guano was the highest (43.67) while control was the least (33.58). At 6WAP, guano also had the highest value (62.50) while control had the least (46.08). For Vine Length, at 6WAP, Guano was the highest (90.83) while control was the least (84.08 and at 9WAP, poultry was the highest (154.00) while control was the least (141.33). For the number of branches, at 6WAP, Guano = Neem = Poultry were the highest (5) while control was the least (3.67) and at 9WAP, guano was the highest (8.17) while PW was the least (6.67). The result obtained indicated that guano manure had the highest values among other treatments. This could be as a result of higher solubility of the guano amendment in the soil where mineralization takes place as compared to other soil amendments studied. These results corroborated the reports by Mlay and Sagamiko (2008) and Thi *et al*. (2014) that the use of bat guano had a positive influence on plant growth.

Table 3: Effect of Organic Amendments on number of leaves, vine length and number of branches at 3, 6 and 9 weeks after Planting

	Sweet melon											
Treatments	**Number of leaves**				**Vine length (cm)**				**Number of branches**			
Organic Amend.	3WAS	6WAP	9WAP	Mean	3WAP	6WAP	9WAP	Mean	3WAP	6WAP	9WAS	Mean
Guano	43.67	62.5	112.3	72.82	37.83	90.83	153.67	94.11	2	5	8.17	5.06
Neem	42	57.17	103.7	67.62	38	87.83	151	92.28	2	5	7.17	4.72
Pig	41.17	53.67	99.3	64.71	38.5	85.33	146	89.94	2	4.33	6.67	4.33
Poultry	43.5	59.33	126.8	76.54	38.5	90.5	154	94.33	2	5	7.67	4.89
Control	33.58	46.08	78.9	52.85	38.08	84.08	141.33	87.83	2	3.67	6.75	4.14
LSD (0.05)	1.86	1.76	NS		NS	1.49	0.48		NS	0.51	0.83	

Table 4 showed the effect organic amendments on sweet melon growth parameters.It was only the percentage emergence and yield (fruit weight) that significantly varied among the parameters measured. Fruit weight was in this order: Guano (13t/ha) = Poultry (13t/ha) >Neem (11.5t/ha) > Pig waste (11.2t/ha) > Control (10.2t/ha).This could be an indication that the growth parameters measured were not significantly affected by the various organic amendments. According to Ambouta *et al*. (2020), bat guano essentially improved the availability of nutrients in the soil and increased the growth and yield of vegetable crops. They also opined that plots treated with bat guano gave highest yields compare to the control.

Table 4: Effect of organic Amendment on sweet melon fruit circumference, fruit length, percentage emergence, fruit weight, number of fruits per plant and days to edible maturity.

	Sweet melon					
Manure type (MT)	**FC (cm)**	**FL (cm)**	**% EM**	**FW (t/ha)**	**NF**	**DEM**
Guano	35.5	20.5	90.5	13	4.17	82.83
Neem	38.5	20.5	76.2	11.5	3.67	85.67
Pig	37	20	90.5	11.2	3.67	85.33
Poultry	41	20.5	92	13	4	85.67
Control	36.75	18.25	89.1	10.2	3.83	84.08
LSD (0.05)	NS	NS	6.44	1.1	NS	NS

NS = Not Significant, FC = fruit circumference, FL = fruit length, %EM = percentage emergence, FW = fruit weight, NF = number of fruits per plant, DEM = days to edible maturity

CONCLUSION AND RECOMMENDATION

The application of selected organic amendments at 10t/ha each significantly influenced Soil bulk density, moisture content and hydraulic conductivity but had no significant effect on the chemical parameters tested possibly due to the short period the experiment lasted or the rate of amendment application was lower than could affect the chemical parameters. The selected Organic amendments used, positively influenced some of the plant parameters assessed and the yield of Sweet Melon. It could therefore be recommended that Sweet Melon farmers in the study area should farm with Bat Guano at 10t/ha for higher yield and sustainable soil fertility management.

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