RESEARCHS / INVESTIGACIÓN

Comparative analysis of the effect of some organic manure on soil microorganisms.

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Abstract: This study showed that the abundance of different microbial groups was general in soil with amendments in comparison to soils without amendments. It was discovered that soils with organic manures were rich in bacteria and fungi diversity when compared with soil without organic manure, which recorded low microbial counts. *Escherichia coli* and *Staphylococcus aureus* were widely distributed in this study. The soil treatment which had Cow dung showed highest microbial count and heights for growth of maize seeds, and the compost manure soil treatment followed this, and the poultry manure soil treatment was next. This suggests that the higher the fertility in amended soils is revealed in the heights of the maize plant grown and colony counts. Plant height recorded under various amendments showed significant differences ($p<0.05$).

KeyWords: Organic manure, microorganisms, growth heights.

Introduction

One of the oldest ways to enhance soil quality for agricultural sustainability is to add to the organic amendment through increasing of manure[1]. Applying organic fertilizers is one of the critical technical ways of improving soil fertility. Organic manure provides basic nutrients for crops and improves soil physico-chemical properties; it is also able to enhance soil microbial activity of the soil, such as improving the activity of soil enzymes and increasing soil microbial biomass[2, 3]. Various environmental stresses and agricultural practices affect the quantity and nature of microorganism's species, as well as the number of individuals in the soil[5]. Environmental conditions for soil organisms favoring certain functional groups are created by different cultivation practices[6]. The absorption of fertilizing substances has a high impact on soil microbial communities which are important to agro-ecosystems, involved in key roles, such as soil aggregate formation, soil humus formation, nutrient cycling, decomposition of various compounds and other transformations[7, 8, 9]. Application of organic matter is important to cultivated soil because it enhances the rate of soil degradation and the decomposition of soil organic matter [10, 11, 12].

An example of a controlling input to the soil system and the processes within it are nutrients, for example, carbon content, cycling of nitrogen and phosphorus affect soil dynamics and agricultural production[13]. Application of organic nitrogen sources increases soil microbial population[14] compared to the inorganic form. Microorganisms and its function in soil show the soil quality and plant productivity[15]. The increasing cost of chemical fertilizers, reduction of soil micronutrients, environmental and health hazards and exorbitant prices for organically produced crops, the use of organic manure in farming has attracted a lot of attention recently[16]. Manures from livestock and poultry are necessary ways of taking back nutrients into the soil. It is better to use organic manure than mineral fertilizer due to the high cost of the latter. Organic manures can be got for free, but inorganic fertilizers can never be obtained free[17]. Crew and Peoples (2004)[18] stated that although chemical fertilizers give out their nutrients faster into the soil for productivity, their effects have resulted in negative effects in the sustainability of production. According to Savci (2012)[19], the bad effects of chemical fertilizers on the soil are not immediately seen because soils have strong buffering power due to their components, but the toxic substances are taken up by crops and cause harm to humans and animals who feed on them.

Materials and methods

Site description

The study was conducted at Michael Okpara University of Agriculture Umuahia, Abia State, Nigeria. The farm area is an agricultural soil with the typical loamy soil which is easy to cultivate on.

Experimental design

Four treatments using different manure applications were designed as follows: Poultry manure + soil (A1), Cattle manure + soil (A2), Compost manure + soil (A3), and soil alone, i.e. no manure (CT). These treatments were put into different perforated buckets respectively, and 3-4 seeds of maize were planted. The soil was gotten from agricultural farmland in the Michael Okpara University of Agriculture Umudike. The growth of the maize seedlings was monitored for 30 days by observing the heights from each treatment soil samples were taken from the topsoil (0-20cm soil).

Physico-chemical analyses of the Soil

Soil samples were also cooled, air-dried analyzed for exchangeable potassium, moisture content, pH, temperature, organic carbon, total nitrogen, and available phosphorus. These tests were also done for different treatments.

Soil microbial biomass

The total heterotrophic plate count and total fungal counts were taken on nutrient and Sabouraud dextrose agar plates respectively after incubation for 24 - 48 hours and 3-5 days. The isolates were sub-cultured and stored from which biochemical tests for characterization and identification was done for microorganisms.

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Results and Discussion

Table 1 shows that treatment A2 had the highest growth at day 30 as compared to other treatments, this could either be as a result of the type of meal these animals are fed with, which was reflected in their feces. Lin et al. (2010)[20], who documented that other types of manure promoted higher peanut yield than chicken manure. Fertilization is the most common management of agricultural soils. Organic and inorganic fertilizers are primarily used to increase crop yield[21]. Soil fertility is a necessary type of renewable natural resource[22]. A fertile soil leads to an increase in profit for farmers[23]. To maintain and increase crop productivity and sustain agriculture for the long-term, effective, and efficient approaches to slowing nutrients, removal, and returning of nutrients to the soil will be required[24]. The maintenance of soil fertility means giving back to the soil the nutrients removed from it by harvests, runoff, erosion, leaching, and other loss pathways[25].

Samples Heights (CM)				
Days	Cattle manure + soil	Poultry manure + soil	Compost manure + soil	soil alone
	A2	**A1**	**A3**	**CT**
0	0.00	0.00	0.00	0.00
5	5.21	4.23	4.83	3.41
10	14.45	9.72	10.39	8.26
15	28.01	14.41	17.75	12.34
20	43.34	27.09	34.53	29.65
25	52.74	36.18	46.51	31.94
30	68.43	53.00	60.00	41.00

Table 1. Shows four treatments using different manure applications, The growth of the maize seedlings was monitored for 30 days.

Table 2 shows that cow dung treatment (A2) had the highest total heterotrophic plate count followed by A3, then A1 and next is CT, but there was a decrease in fungal counts. This must be as a result of the diet intake of these Cattles, which is reflected in their feces. It appears that higher bacterial counts for organic manure produced better plant growth.

Bacteria isolated were *E. coli, P. aeruginosa, Klebsiella spp., Salmonella spp., Staphylococcus sp., Shigella sp., Serratia sp.*, while fungi isolated were *A. niger, A. flavus, Rhodotorula spp., Rhizopus stolonifer*, source of plant nutrients is soil microbial biomass, and it is highly correlated with soil organic carbon[26]. Soil microbial activity can be enhanced, and it is associated with high available nitrogen for plants[27].

The community of microorganisms responds to changing environmental conditions by varying individual activity[28]. Factors such as soil humidity, pH, fertilization pre-determine the number and species composition of microorganisms in the soil. Stimulation of bacteria and Actinomycetes reducing the fungal population can be achieved with the supplement of organic fertilizers. Changes in soil properties or plant and animal communities come after changes in microbial communities, and such providing an early sign of soil improvement or an early warning of soil deterioration[29]. The nutrient release, which is as a result of mineralization processes in soils gives rise to plant production using organic farming. This means that a functional soil microflora and a good quantity of available nutrients have importance in organic farming. Every farmer's motive is to fertilize the soil instead of the plant to ensure adequate nutrient mineralization present to meet his profits[29]. An important reservoir of plant nutrients such as nitrogen and phosphorus is microbial biomass, which is among the most labile pools of organic matter[30]. This biomass, when responding to environmental changes, can have major effects for the availabilities of nutrients[31].

The pH of these treatments is right for the growth of these crops. The best Soil pHs for overall availability of nutrients plant growth and microbial processes is slightly acidic to neutral (6.0-7.5). The amount of various constituents in the manure affects soil pH. There is a high concentration of NH_4-N in Liquid

Sample Code	THPC (X 10^5)	TFPC (X 10^3)
A2	5.3	2.2
A3	3.6	1.7
A1	2.8	1.4
CT	1.7	1.2

Table 2. Total count of heterotrophic plaques.

and poultry manures, and low amounts of organic matter; it is possible that NH_4- forming synthetic fertilizers, liquid, and poultry manures can reduce soil pH. Applying solid Cattle manure shifts the soil pH to neutral in acidic[32] and alkaline soils[33, 34] and this strengthens the availability of nutrients, for example, Phosphorus and micronutrients. The shift towards neutrality is best for the growth of the plant and many useful processes of microorganisms. Manure in solid form is a source

Sample	Exchangeable Potassium (K)	Moisture content (%)	pH	Temperature (°C)	Organic Carbon	Total Nitrogen	Available Potassium (P)
A1	1.32	11.11	6.6	34.0	1.10	1.26	7.70
A2	2.03	22.00	6.7	29.0	2.22	0.25	6.20
A3	2.15	20.43	6.8	32.0	3.21	0.21	6.30
CT	0.23	6.18	6.9	28.0	0.21	0.11	4.21

Table 3. Shows four treatments using different manure applications, The growth of the maize seedlings was monitored for 30 days.

of nutrients and an important soil conditioner[35].

Many soils take in potassium in a way that is sufficient enough to stop leaching, but not enough to plant roots. Soil's physico-chemical properties, soil microbial biomass, nitrogen contents, and phosphorus of soils can be improved using Organic fertilizers[2, 4]. Organic matter makes the physical characteristics of the soil better and adds the important plant nutrients to the soil[1].

Biological Oxygen Demand (BOD) for modern bathroom was higher than that of local bathroom. Chemical Oxygen Demand, Total Dissolved Solid, Total Suspended Solids, Conductivity and Dissolved Oxygen were higher for local bathrooms than modern bathrooms. Eze *et al.*, (2015)[36] recorded pH, 5.95 ± 0.41 to 6.30 ±0.42; Temperature, 26.6 ± 0.5ºC to 27.2 ± 1.6ºC; Conductivity, 34.9 ± 1.0µS/cm 106.0 ± 2.0µS/cm; total dissolved solids, 100.0 ± 3.0mg/L 600.0 ± 5.0mg/L; total suspended solids, 265.0 ± 4.0mg/L 348.0 ± 10.0mg/L, dissolved oxygen (DO), 10.35 ± 0.83mg/L - 31.6 ± 2.0mg/L, biochemical oxygen demand (BOD), 3.1 ± 0.04mg/L -14.0 ± 0.5mg/L; chemical oxygen demand (COD), 10.0 ± 0.5mg/L 20.0 ± 1.0mg/L.

In research by Noutsopoulos *et al.* (2015)[37], they recorded higher COD counts for influent sample in system A than system B. Nga'Ng' a recorded higher electrical conductivity for greywaters than drinking water and lower counts for DO and pH. Kotut et al. (2011)[38] also recorded mean counts from different greywater samples: for conductivity, 599.7-654.5 µS/cm^2, DO 3.5-5.2mgL^{-1}, pH 8.2-9.2, Temperature, 23.8-26.3, BOD5 (mgL^{-1}) 560-6250, Total Coliform counts (10^6) 2.3-6.5, Faecal Coliforms (10^5) 0.34-2.9. Wijaya and Soedjino (2018)[39] recorded higher counts for samples from Medokan Semamir and Genteng except for BOD, which was lower. Abedin and Rakib (2013)[40] also recorded that water from greywaters was higher than the standards given by Bangladesh (ECR, 1997)[41] and WHO guideline values (2004)[42].

Soil samples were also cooled, air-dried analyzed for exchangeable potassium, moisture content, pH, temperature, organic carbon, total nitrogen, and available phosphorus. These tests were also done for different treatments.

Conclusions

Organic manure achieves a high microbial load, high nutrient content for soil, and this leads to higher growth of crops. Farmers should be encouraged to use organic manure as a way of adding nutrients to the soil other than the use of fertilizers.

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