# Abundance of Some Bacterial Species in Soil Using Organic and Inorganic Fertilizers in Afaka Area of Kaduna Metropolis, Kaduna State, Nigeria.

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## Abstract

The objective of this study is to isolate and identify those bacterial species associated with organic and inorganic fertilized soils in Afaka farms Kaduna Metropolis, Kaduna State , Nigeria.

Soil samples were collected by simple random sampling and standard sterile methods from organic and inorganic fertilized soils separately in Afaka farm. Isolation of bacteria is the two soil samples, characterization and identification of the bacterial isolates by gram staining and biochemical tests (Cheesbrought, 2001) were carried out. The results showed in all, a total number of 168 colonies of bacteria in organic soil and 8 colonies in the inorganic soil. 5 bacterial species and 1species were formed in the organic and inorganic soil fertilized respectively. T-test analysis showed high significant difference ($P \leq 0.05$) between bacteria isolated from organic soil and inorganic soil respectively. It justified the fact that organic soil contains more bacteria than inorganic soil. The species of bacteria isolated and characterized include *Pseudomanas* sp, *Bacillus* sp, *Escherichia coli*, *Streptomyces* sp, *Flavocterium* sp in the descending order of percentage of occurrence such as *Pseudomana* sp. > *Bacillus* sp. > E. coli > *Streptomyces* > *Flavobacterium*.

**Key word:** Bacteria, Organicaly fertilized soil, inorganically fertilized soil,*Pseudomonas* sp., *Streptomyces*

## Introduction

Soil represents a favorable habitat for micro-organisms and is inhibited by a wide range of micro-organisms. Micro-organisms are found in large number in soil usually between one to ten millions micro-organisms are present per gram of soil with a dominant number of bacteria and fungi. Soil organisms contribute to important soil function such as food, fiber, energy. They absorb, neutralize, transform compounds

otherwise become pollutants in the environment. Soil micro-organisms are very important as almost every chemical transformation taking place in soil involves active contribution of these microbes. Soil microbial diversity is influenced by both organic and inorganic matter. Soil organic matter is generally used to represent organic constituents in the soil, excluding undecayed plants and animal tissue, their partial decomposition products and the soil biomass (Dick, 2000). The soil organic matter provides a favorable habitat for the micro-organisms to grow as compared to inorganic soil. The bacterial diversity present in the soil is greatly influenced by organic matter. It has been consistently reported that soil organic matter favors the growth of bacteria present in the soil. Studies have revealed that bacteria diversity is approximately one hundred times greater than the other microbial diversity (Barns et.al, 1999). Bacteria are one of the most important components of the soil micro biota and don't occur freely in the soil solutions but are closely embedded in organic matter even after acting as the dispersing agents (Atlas et.al, 2000). Moreover, they play a major role in organic matter decomposition, biotransformation, biogas production and nitrogen fixation. In particular they play an active role in soil fertility as a results of their involvement in the cycle of nutrients like potassium, phosphorus, and nitrogen which are required for plant growth (El Frantroissi, et.al, 2005).

## Organic fertilizer

Organic fertilizers have been known to improve biodiversity and long-term productivity of soil, (Enwall, et.al, 2005; Birkhofera, et.al, 2008) and may prove a large depository for excess carbon-dioxide. (Lal, R. 2004; Rees, 2009; Fliessbach, et.al, 2009). Organic nutrients increase the abundance of soil organisms by providing organic matter and micronutrients for organisms such as fungi mycorrhiza, (PIMENTEL, et.al, 2005). (which aid plants in absorbing nutrients), and can drastically reduce external inputs of pesticides, energy and fertilizer, at the cost of decreased yield (Mader, et.al, 2009). In general, the nutrients in inorganic fertilizer are both more dilute and also much less readily available to plants. According to the University of California's integrated pest management program, all organic fertilizers are classified as 'slow release' fertilizers, and therefore cannot cause nitrogen burn (Healthy Lawans, et.al, 2010). Organic fertilizers from composts and other sources can be quite variable from one batch to the

next (Crazy, 2010). Without batch testing, amount of applied nutrients cannot be precisely known. Nevertheless, one or more studies have shown they are at least as effective as chemical fertilizers over long periods of use (CSA, 2010).

### Inorganic fertilizer

Inorganic fertilizers nearly always are readily dissolved and unless added have few other micro and macro plant nutrients nor added any 'bulk to the soil'. Nearly all nitrogen that plants use is in the form of ($NH_3$) or ($NO_3$) compounds. The usable phosphorus compounds are usually in the form pf phosphoric acid ($H_3PO_4$) and potassium (K) is typically in the form of potassium chloride (KCI). In organic fertilizers, nitrogen, phosphorus and potassium compounds are released from the complex organic compounds as the animal or plant matter decays. In commercial fertilizers, the same required compounds are available in easily dissolved compounds that require no decay-they can be used almost immediately after water is applied. Inorganic fertilizers are usually much more concentrated up to 64%(18-46-0) of their weight being a given plant nutrient, compared to organic fertilizers that only provide 0.4%. The objective of this study is to determine the abundance of bacteria found in organic and inorganic fertilized soil

## .Materials and methods

### Study area

The study was conducted in Afaka farm, Kaduna. Average tempreture of Kaduna is about 23degree C and the town is located at latitude 10degree 25N to 10degree 37N and longitude 7degree 24E to 7degree 30E. the town is located in Igabi Local Governmen tArea of Kaduna Metropolis. Afaka farm is about 20km away from Kaduna city centre and it is managed by Igabi Local Government Authority. Soil samples were collected by sterile methods from organic and inorganic fertilized soil in Afaka farm and brought to the laboratory in air tight polytene bags for further analysis. Isolation was done by serial dilution.

## Laboratory analysis of samples

## Isolation of bacteria

Soil samples were collected by sterile methods from organic and inorganic soils and brought to the laboratory in the air tight polybags. The vertical samples were taken from 5 and 10cm depths. The samples were processed using soil dilution plate method. One

gram of soil sample were serially dilute with sterile water up to 10-1, 10-2, 10-3, 10-4 and 100ml of each dilution was added to 20ml of nutrients agar medium in 90mm diameter sterile Petri dishes and then enumerated. Simple separate colonies on the agar plates were selected at random according to standard medium and streaked on the nutrients agar slants and incubated for 24hrs at ± $30C^0$. Code names were given to each of the isolated plate and stored at ± $40C^0$ for characterization and identification by standard methods. Once colonies rose on the media, the subculturing was continued until a pure isolate was obtained. Identification of microbes was done with the help of standard literature. For isolation of bacteria, different media like nutrients agar medium, nutrient broth medium etc. (HI) media were prepared and to differentiate between gram +ive and gram –ive bacteria gram's staining was done.

## Results and Discussions

Table 1: Occurrence of bacteria colonies in serial dilution in both organic and inorganic soils.

| | Organic soil | Inorganic soil |
|---|---|---|
| Dilution | No. of colonies in serial dilution | No. of colonies in serial dilution |
| $10^{-1}$ | 84 | 37 |
| $10^{-2}$ | 60 | 33 |
| $10^{-3}$ | 17 | 9 |
| $10^{-4}$ | 7 | 1 |
| Total | 168 | 80 |

Table 2: Percentage of occurrence of various bacteria in both organic an inorganic soils

| | Bacteria from organic soil | | | bacteria from inorganic soil | | |
|---|---|---|---|---|---|---|
| S.N | Species | colon | Occurrence % | Species | colony | Occurrence % |
| 1 | *Pseudomonas sp* | 70 | 41.66 | | 40 | 50 |
| 2 | *Bacillus coli sp* | 38 | 18.75 | | 25 | 31.25 |
| 3 | *Escherichia sp* | 25 | 14.88 | | - | - |
| 4 | *Streptomyces sp* | 22 | 13.09 | | 15 | 18.75 |
| 5 | *Flavobacterium* | 13 | 7.73 | | - | - |
| Total | | 168 | | | 80 | |
| | | 68% | | | 32% | |

Table 1 shows the occurrence of bacteril colonies in serial dilution $10^1$ indicated 60 for organic soil and 37 for the inorganic soil.In all a total number of 168 colonies were recorded for the organic soil (68%) and 80 colonies(32%) for the inorganic soil.Table.2 shows the % of occurrence of various bacterial species in which 5 bactrial spp were obtained from organically fertilized soil and 1sp was found I the inorganic soil.Statistical analysis showed a high significant difference ($P<0.05$) between bacteria from organic soil as against the inorganic soil. -Lal, R. (2004). "Soil carbon sequestration impacts on global climate change and food security. Science Journal 304:1623-7 both the bacteria Geneva were able to tolerate adverse microclimate in soil and decompose organic materials and can synthesize inorganic

minerals. Moreover, they can sporulate properly and could help in making soil more nutritive with the help of different types of enzymes produced by them (Westover, et.al, 1997). On the other hand, *Streptomyces, Flavobacterium sp,* and *Escherchi coli* were not isolated from inorganic soil samples may be due to their non occurrence in these types of soil or could not rose in used culture medium. The isolation of various fungal and bacterial species showed that the soil of organic filed is quite rich in microbial flora. This aggress with the work of Bernard et.al (2007) who explained that bacterial diversity is approximately 100 times greater than the other microbial diversity. Atlas et.al also explained that bacterial are one of the most important components of the soil microbiota. The results showed that the soil was rich in bacterial diversity (248 colonies). . E.I. Frantroussi et.al, 2007 also agrees with the importance of the microbes in the soil. He explained that they play a major role in organic matter decomposition, biotransformation, biogas product and Decrease in population of microbes in organically fertilized soils may be due to some reasons which include over fertilization (NPK, 2012), "fertilizer burn" in accordance with salt index (Understanding soil index, 2012). Also regular use of acidulated fertilizers generally contributes to the accumulation of soil acidity in soil which progressively increases aluminum availability and hence toxicity and death of soil microbes (Shrack, 2009). It is acknowledged now that farmers are becoming 100% dependent on water soluble in organic fertilizers sample soil noted to becoming sterile been devoid of soil natural micro flora and microphageThus soil structure may be destroyed (Shrack, 2009). Comparatively, (Enwall, *et.al*, 2005; Birkhofera, *et.al*, 2008; Lal, *et.al*, 2009) explained the usefulness of organic fertilizers in a high terms of its improvement of biodiversity, long-term productivity, soil and creating a conducive habitat for micro-organisms. Alvers, *et.al*, 2000; Itu and Van Brugger, 2001; Tuld, *et.al*, 2000; Boehm, *et.al*, 2002, 2004; Deleij, *et.al*, 2003; Maloney, *et.al*, 2007 and workneh, *et.al*, 2008) all agreed in their studies that revelation of diversity of micro-organisms associated with various soil parameters such as disease suppression and organic matter decompensation were observed

## Conclusion

This study proved that organic fertilizers have great capacity to give a good atmosphere for microbial growth comparatively than in inorganic fertilizers because synthetic fertilizers depends on the chemical reactions while due to organic fertilizers, natural physiological activities occur among various microbes. The consequences of the present study is that the organic farm soils have a great capacity to give space to the microbial survival which renders a fruitful outcome in the form of good crop production having a great tolerance to atmospheric pathogens and diseases