American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-4, Issue-7, pp-52-61
www.ajer.org
Research Paper Open Access

Effects of fertilizers on soil's microbial growth and populations: a review

[1]Ojo OI, [2]Olajire-Ajayi BL, [2]Dada OV, and [2]Wahab OM
[1]*Dept of Agricultural Engineering, Ladoke Akintola University of Technology, Nigeria*
[2]*Dept of Forestry Technology, Federal College Of Forestry, Ibadan, Nigeria*

ABSTRACT: *Soil nutrients availability and decomposition of organic matter depends on microorganism but there are little available literatures on the possible effects of nutrients fixing chemicals and substances on the survival and population distribution of various microbes. Also, because of importance of organic and inorganic fertilizers to increase the soil microorganisms needed for the growth of plants there is need for comprehensive review of existing literature on the subject. This paper reviewed the effects of fertilizers on soil's microbial growth and populations in available literatures. Various studies agreed that low microbe population due to lack of organic matter can be easily rectified by amending the soil with fertilizers and organic matter and allowing time for microbial growth therefore jump-starting the reproduction of microbes by adding beneficial microbes along with organic matter. Microbe improves soil structure by the humus they create while digesting organic matter and also help in nitrogen fixing.*

I. INTRODUCTION

The real deal is that without soil microbe, we would all die. The work they do in our soil is incredibly complex but it all boils down to this: microbes eat, thus we eat. Plants are unable to take from the soil the nutrition they need without microbes working in the soil. Microbes are alive, and must have nutrition to survive, and that nutrition comes from organic matter. As they consume the nutrients they need, microbe creates foods like nitrogen, carbon, oxygen, hydrogen, phosphorus, potassium and trace minerals for our plants. It is the microbes that convert the NPK and minerals in the soil into a form our plants can use to grow and produce food flowers for us (Parr *et al. 1994*). Microbes are everywhere. They are in the air, in the rivers and oceans, in our drinking water, in the soil and our skin. Of course we know some microbes are bad, like salmonella and *Eumeria coli*, but more are considered beneficial and out-compete pathogens for survival in the soil (Higa, 1995). There are all kinds of microbes like algae, protozoa, bacteria and fungi with many others waiting to be discovered. Their population in soil are numerous as many as one billion of up to 13,000 species can preside gram of soil (1 gram = 0.0022 pounds, so maybe a teaspoon) (Dundas *et al*, 2002). Most microbes need organic carbon to live; they get this from eating wood chips, leaves, manures and other organic matter, they creates humus which increases soil structure, good for root penetration and development (compaction can nullify much of this action) (Parr *et al*., 1994). Microbes also get some carbon from the rhizosphere (the area immediately around plant roots) because roots gives off substances the microbes can use, like sugars and amino acids and then the microbes convert some of it back forms the plants can use, as minerals, vitamins, nitrogen's and smino acids. (Amino acids are building blocks of protein (Schulz and Jorgensen, 2001). Humans need 20 amino acids to make muscle, hair, skin, and connective tissues, and human bodies' only make use of 10 of them. While the other must be supplied by food from plants and animals (Cornis, 2002) some microbes (like some bacteria and blue-green algae) are able to fix nitrogen from air and make it available to plants. Some plants and trees cannot grow if deprived of specific microbes (mycorrhizal fungi) around their roots. That's why some plants need a good shovelful of additional soil from around their roots for company when transplanting (Horneck, 1981). There are microbes and touelene from gasoline leaks. The word for that action is bioremediation and research is ongoing to select microbes that digest other toxins our soil (Landford, 2004). There are many garden products available containing beneficial microbes for the soil. Some are fast-action form of foliar sprays, and some are home-brewed compost teas used to spray or drench. In all cases, foliar sprays are not enough; there most also organic matter you added last summer need continual replenishment. Microbes multiply, and if your microbes population is low due to lack of organic matter, it can easily rectified by mending the soil with soil organic and allowing time for microbial growth (Kuruvilla *et al.,* 2009). The uniqueness of microorganism and their often unpredictable nature and biosynthetic capabilities, has given a specific set of environment and cultural conditions, and it also make them likely candidates for solving particularly difficult problems in the life sciences and other sciences as well. The various ways in which microorganisms have been used over the past 50 years to advance medical technology, human and animal health, food processing, food safety and quality genetic engineering, environment protection, agricultural and municipal waste provide a most impressive record of achievement (Higa,1991). Many of these technology advances would not have possible using straightforward chemical and physical engineering methods, if they were, they would not have been practically or economically feasible (Parr *et al*., 1994). While microbial technologies have been applied to various agricultural and environment problems with considerable success in recent years. They are been widely accepted by scientific community because it is often difficult to consistently reproduce their beneficial effects (Parr and Hornick, 1992). Microorganisms are useful in eliminating problems associated with the use of the chemical fertilizers and pesticides. They are widely applied in nature farming and organic agriculture (Higa, 1991; Par *et al*., 1994).

Organic fertilizers are composed of natural ingredient from plant parts such as leaves and peanut hulls, and poultry droppings. Compost, a blend of plant debris broken down by natural processes is also considered a natural or organic fertilizer. Inorganic fertilizers on the other hand are manufactured from minerals or synthetic chemicals. Both organic and inorganic supplement the soil and feed plants with nutrients. Macronutrients-those nutrients that plants require in large amounts which include nitrogen, phosphorus and listed as percentage on the fertilizer bag (Reganold *et l.,* 1990). Inorganic fertilizers nearly are readily dissolved and unless added have few other macro and micro plant nutrient). Inorganic fertilizer nitrogen, phosphorus and potassium compounds are released from the complex organic compounds as the animal or plant matter decays. In commercial fertilizer, the same required compounds are available in easily dissolved compounds when water is applied. Inorganic fertilizer are usually much more concentrated with up to 64 % (18-46-0) of their weight being a given plant nutrient, compared to organic fertilizers that only provide nutrient (Stewart *et al.*, 2005). The need to boost food production is on the increase everywhere in the world today as world's population is geometrically increasing day by day while the supply of land fixed, thus farmers regularly use forms of fertilizers and other organic manures to enhance productivity without considering the probable effects toxic or non- toxic on soil microbes. This review therefore considers it reasonable to identify some effects on soil's microbial growth and populations.

II. HISTORY OF SOIL BIOLOGY

Soil biology is the study of microbial and faunal activities and ecology in soil. Soil like, soil biota, or edaphon is a collective term for the organism within the soil. This organisms living include earthworm, nematodes, protozoa, fungi, bacterial and different arthropods, soil biology play a vital role in determine many soil characteristics yet, been a relatively new science, much remains unknown about soil biology and about the nature of soil is affected (Whitman *et al.,* 1998). The soil is home to large proportion of world's bio-diversity. The links between soil function are observed to be incredibly complex. The interconnectedness and complexity of this soil 'food web' means any appraisal of soil function must necessarily take into account interaction with the communities that exist within the soil (Higa, 1995). We know that soil organism prevent nutrient loss by leaching. Microbial exudates act to maintain soil structure, and earthworms are important in bioturdation. However, we find that we don't understand critical aspects about how these functions interact. The discovery of globalin in 1995 indicates that we lack the knowledge to correctly answer some of the most basic question about the biogeochemical cycle in soils. We have much work ahead to gain a better understanding of how soil biological components. We have much work ahead to gain a better understanding of soil biological components affect us and the biosphere (Comis, 2002). In balanced soil, plants grow in an active and steady environment. The mineral content of the soil and its healthful structure are important for their well being, but it is the life in the earth that powers its cycles and provides its fertility without the activities of soil organisms, organic materials would accumulate and litter the soil surface, and there would be no food for plants (Parr et al., 19994).

The soil biota includes:

i. Megafauna: Size range - 20mm upward, e.g moles rabbits, and rodents,
ii. Macrofauna: size range -2 to 20mm e.g. woodlice, beetles, centipedes, slugs, snails, ant and harvestmen,
iii. Mesofauna: size range -100 micrometres to 2mm e.g. Tardigrade, mites and springtails,
iv. Microfauna and microflora: size range -1 to 100 micrometres, e.g. yeast bacteria (commonly actinobacteria), fungi, protozoa, roundworms, and rotifiers.

Of these, bacteria and fungi play key roles in maintaining soil. They act as decomposers that break down organic materials to produce detritus and break down products. Soil detrivores like earthworms, ingest detritus and decompose it. Saprotophs (macrofauna) help by breaking down the same way but they also provide motion part as they move in their armies. Also the rodents, wood-eaters help the soil to be more absorbent (Parr and Hornick, 1992).

2.1 Characteristics and functions soil microbes in the soil

Soil biology involves work in the following areas:

i. Modelling of biological processes and population dynamics.
ii. Soil biology, physics and chemistry: occurrence of physicochemical parameters and surface properties on biological processes and population behavior.
iii. Population biology and molecular ecology: methodological development and contribution to study microbial and faunal population; diversity and population dynamics; genetic transfers, influences of environmental factors.
iv. Community ecology and functioning processes; interactions between organisms and minerals or organic compounds; involvement of such interactions in soil pathogenesis; transformation of minerals and organic compound compounds; cycling of elements; soil structuration.

Complementary disciplinary approaches are necessarily utilized which involve molecular biology, genetics, ecophysiology, biogeography, ecology, soil processes, organic matter, nutrient dynamics and landscape ecology (Comis, 2002).

2.2 Bacteria

Bacteria are single-cell organisms and most denizens of agriculture, with populations ranging from 100 million to 3 billion in a grain. They are capable of very rapid reproduction by binary fission (dividing into two) in favourable conditions. One bacterium is capable of producing 16 million more in 24 hours. Most soil bacteria live close to plat roots and are often referred to as rhizobacteria (Higa, 1991). Bacteria live in soil water, including the film moisture surrounding soil particles, and some are able to swim by means of flagella. The majority of the beneficial soil-dwelling bacteria need oxygen (and are thus termed aerobic bacteria), whilst those that do not require air are referred to as anaerobic, and tend to cause putrefaction of dead organic matter (Higa, 1991). Aerobic bacteria are most active in a soil that is moist (but not saturated, as this will deprive aerobic bacteria of the air that they required), and neutral soil pH, and where there is plenty food (carbohydrates and micronutrients from organic matter) available. Hostile conditions will not completely kill bacteria; rather, the bacteria will stop growing and get into a dormant stage, and those individuals with pro-adaptive mutations may compete better in new conditions. Some gram-positive bacteria produce spores in order to wait for more favourable circumstances, and gram-negative bacteria get into a “nonculturable” stage. Bacteria are colonized by persistent viral agents (bacteriophages) that determine gene word order in bacteria host (Higa, 1991; Parr *et al*, 1994).

2.2.1 Importance of bacteria: the nitrogen cycle

Nitrification: is a vital part of the nitrogen cycle, wherein certain bacteria 9which manufacture their own carbohydrates supply without using the process of photosynthesis) are able to transform nitrogen in the form of ammonium, which is produced by the decomposition of proteins, into nitrates, which are available to growing plants, and once again converted to proteins (Pimental, 2007).

Denitrification: while nitrogen fixation converts nitrogen from the atmosphere into organic compounds, a series of processes called denitrificationreturs an approximately equal amount of nitrogen to the atmosphere. Denitrifying bacteria tend to anaerobes, or facultative anaerobes (can alter between the oxygen dependent and oxygen independent types of metabolism), including Achromobacter and Pseudomonas. The purification process caused by oxygen-free conditions converts nitrate and nitrite in soil into nitrogen gas or into gaseous compounds such as nitrous oxide or nitric oxide. In excess, denitrification can lead to overall losses of soil fertility. However denitrification returns it to the atmosphere (Comis, 2002).

2.3 Fungi

A gram of garden soil can contain around one million fungi, such as yeasts and moulds. Fungi have no chlorophyll, and are not able to photosynthesis; besides, they cannot use atmospheric carbon dioxide as a source of carbon, therefore they are chemoheterophic, meaning that like animal, they require a chemical source of energy rather than being able to use light as an energy source, as well as a organic substrates to get carbon for growth and development (Higa, 1991). Many fungi are parasitic, often causing disease to their living host plant, although some have beneficial relationships with living plants. In terms of soil and humus creation, the most important fungi tend to saprotrophic; that is, they live on dead or decaying organic matter, thus breaking it down and converting it to forms that are available to the higher plants. A succession of fungi species will colonise the dead matter, beginning with those that sugars and starches, which are succeeded by those that are able to break down cellulose and lignins (Whitman *et al*, 1998). Fungi spread underground by sending long thin threads known as mycelium throughout the soil; these threads can be observed throughout many soils and compost heaps. From the mycelia the fungi is able to throw up its fruiting bodies, the visible part above the soil (e.g. mushrooms, toadstools and puffballs), which may contain millions of spores. When the fruiting body bursts, these spores are dispersed through the air to settle fresh environments, and are able to lie dormant for up to year until the right condition for their activation arise or the right food is made available. (Whitman *et al*, 1998).

Mycorrhizae: Those fungi that are to live symbiotically with living plants, creating a relationship that is beneficial to both, are known as mycorrhizae (from myco meaning fungal and rhiza meaning root). Plant root hairs are invaded by the mycelia of the mycorrhiza, which lives partly in the soil and partly in the root root, and may either cover the length of the root hair as a sheath or be concentrated around its tip. The mycorrhiza obtain the carbohydrates that it require from the root, In return providing the plant with living plants, creating a relationship that is beneficial to both, are known as mycorrhizae (from myco meaning fungal and rhiza meaning root). Plant root hairs are invaded by the mycelia of the mycorrhiza, which lives partly in the soil and partly in the root, and may either cover the length of the root hair as a sheath or be concentrated around its tip. The mycorrhiza obtains the carbohydrates that it requires from the root, in return providing the plant with nutrient including nitrogen and moisture. Later the plant roots will also absorb the mycelium into its own tissues (Parr and Hornick, 1992). Beneficial mycorrhizal association are to be found in many of our edible and flowering crops. Shewell cooper suggests that these include at least 80% of the brassica and solanum families (including tomatoes and potatoes), as well as the majority of tree species, especially in forest and woodlands. Here the limits of the tree's roots, greatly increasing their feeding range and actual causing neighbouring tree to become physically interconnected. The benefits of mycorrhizal relations to their plant partners are not limited to nutrients, but can be essential for plant reproduction; in situation where little light is able to reach the forest floor, such as the north American pine forest, a young seedlings cannot obtain suffient light to photosynthesis for itself and will not grow properly in a sterile soil, but if the ground is underlain by a mycorrhizal mat, then the developing seedling will throw down roots that can link with the fungal threads and through them obtained from its parents or neighbouring trees (Burges *et al*., 1967). David (1995) points out the plants, fungi, animal relationship that creates a "three way harmonious trio" to be found in forest ecosystems, wherein the plant/fungi symbiosis is enhanced by animal such as the wild boar, deer, mice, or flying squirrel, which feed upon the fungi's fruiting bodies, including truffles, and cause their further spread (David, 1995). A greater understanding of the complex relationships that pervade natural systems is one of the major justifications of the organic gardener, in refraining from the use of artificial chemicals and the damage these might cause. Recent research has shown that arbuscular mycorrhizal fungi produce globalin, a protein that binds soil particles are important part of soil organic matter (Comis, 2002).

2.4 Types of microorganism in soil

Living organisms both plants and animals constitute an important component of soil. The pioneering investigations of a number of early microbiologists showed for the first time that the soil was not an inert static material but a medium pulsating with life. The soil is now believed to be a dynamic or rather a living system, containing a dynamic population of microorganism than the fallow land, and the soil rich in organic matter contains much more population than sandy and eroded soils. Microbes in the soil are important to us in maintaining soil fertility/productivity, cycling of nutrient elements in the biosphere and sources of industrial products such as enzymes, antibiotics, vitamin, hormones, organic acids e.t.c. at the same time certain soil microbes are the causal agents of human and plant diseases. The soil organisms are broadly classified into two groups: which are soil flora and soil fauna, the detailed classification of which is as follows (Higa, 1991).

2.5 Habits and ecology

Microorganism is found in almost every habitat present in nature. Even in hostile environments such as the poles, deserts, geysers, rocks and the deep sea. Some types of microorganism have as extremophiles. Extremophiles have been isolated from rocks as much as 7 kilometres below the earth's surface, (Szcwzyku *et al*., 1994). It has been suggested that the amount of living organisms below the earth's surface may be comparable with the amount of life on or above the surface. (Gold, 1902). Extremophiles have been known to survive for a prolonged time in a vacuum, and can be highly resistant to radiation, which may even allow them to survive in space. (Horneck, 1981). Many types of microorganism have intimate symbiotic relationships with other larger organisms; some of which are mutually microorganism can use disease in host they are known as pathogens.

2.5.1 Extremophiles

Extremophiles are microorganisms that have adapted so that can survive and even thrive in conditions that are normally fatal to most life-forms. For example, some species have been found in the following extreme environments; Temperature: as high as 130^{0}c (266^{0}F), (Madigan and Martinko, 2006), as low as -17^{0}c (1^{0}F) (Rybicki, 1990). Acidity/alkalinity: Less than pH 0, (Max, 2012). Up to pH 11.5 (Christner *et al.*, 2008). Pressure: up to 1,000-2,000 atm, down to 0 atm (e.g. vacuum of space) (Schopf, 2006).

2.6 Soil microbes

The nitrogen cycle in soils depends on the fixation of atmospheric nitrogen, one way this can occur is in the nodules in the root of legumes that contain symbiotic bacteria of the genera rhizobium, bradyrhizobium and azorhizobium (Barae *et al*., 2005).

2.6.1 Symbiotic microbes

Symbiotic microbes such as fungi and algae from association in lichen, certain fungi form mycorrhizal symbioses with trees that increase the supply of nutrients to the trees (Tickell *et al*., 2000).

2.6.2 Importance of soil microbes

Microorganisms are vital to human and the environment, as they participate in the earth's element cycles such as the carbon cycle and nitrogen cycle, as well as fulfilling other vita roles in virtually all ecosystems, such as recycling other organisms' dead remains and waste products through decomposition. Microbes also have an importance place in most higher-order multicellular organisms are symbionts. Many blame the failure of biosphere 2 on an improper animal; stomach help in their digestion. For example, cows have a variety of different microbes in their stomachs that aid them in their digestion of grass and hay (Kitani *et al*., 1989).

2.6.3 Uses of microbes

2.6.3.1 Use in food

Food Fermentation: Microorganisms are used in brewing, winemaking, baking, pickling and other food-making processes. They are also used in the control of fermentation process in the production of cultured diary such as yogurt and cheese. The cultures also provide flavour and aroma, and inhibit undesirable organism.

2.6.3.2 Use in water treatment

Sewage treatment: Specially-cultured microbes are used in the biological treatment of sewage and industrial waste effluent. A process known as bio augmentation (Gray, 2004).

2.6.3.3 Use in energy

Algae fuel, cellulosic ethanol and ethanol fermentation: Microbes are in fermentation to produce ethanol, And in biogas reactors to produce methane (Piimental, 2007). Scientists are researching the use of algae fuels. And bacteria to converts various forms of agricultural and urban waste into usable fuels (Inslee *et al.*, 2008).

2.6.3.4 Use in production of chemicals and enzymes

Many microbes are used for commercial and industrial production of chemicals, enzymes and other bioactive molecules. Examples of organic acid produced include:

i. Acetic acid: produces by the bacterium acetobacter acetic and other acetic bacteria (AAB);
ii. Butyric acid Ibutanoic acid): Produced by the bacterium clostridium butyricum.
iii. Citric acid: produced by the fungus aspergillus niger, microbes are used for preparation of bioactive molecules and enzymes. Strepkinase produced by the bacterium strtoccus and modified by genetic engineering is used as a clot buster for removing clots from blood vessels of patients who have undergone myocardial infections leading to heart attack. Cyclosporine A is a bioactive molecules infarctions leading to heart attack. Cylosporin A is a bioactive molecule used as an immunosuppressive agent in organ transplantation. Stains produced by the yeast monascus purpureus is commercialized as blood cholesterol lowering agent which acts by competitively inhibiting the enzymes responsible for synthesis of cholesterol (Tickell, *et al*; 2000).

2.6.3.5 Use in science

Microbes are also essential tools in biotechnology, biochemistry, genetics and molecular biology. The yeasts (Saccharmyces cerevixiae) and fission yeast (Schizosaaharomyces pombe) are important model organism in sciences, since they are simple eukaryotes that can be grown rapidly in large numbers and are easily manipulated (Castrillo and Oliver, 2004). They are particularly valuable in genetics. Genomics and pproteonomics (Sunnerhagen, 2002). Microbes can be harnessed for uses such as creating steroids and treating skin diseases. Scientists are also considering using microbes for living fuel cells (Soni, 2007) and as a solution for pollution (Moses *et al*., 1999).

2.6.3.6 Use in warfare

Biological warfare: In the middle ages, diseases coepses were thrown into castles during sieges using catapults or other siege engines. Individuals near the corpses were exposed to the deadly pathogens and were likely to spread that pathogen to others (Langford, 2004).

2.6.4 Diseases caused by microbes

Pathogenic microbes: Microorganisms are the cause of many infectious diseases. The organisms involved include pathogenic bacteria, causing diseases such as plague, tuberculosis and anthrax; protozoa, causing diseases such as malaria, sleeping sickness and toxoplasmosis; and fungi causing diseases such as ringworm, candidiasis or histoplamsmosis. However, other diseases such as influenza, yellow fever or AIDS are caused by pathogenis viruses, which usually classified as living organisms and are not, therefore, microorganisms by the strict definition. As of 2007, no clear examples of archaean pathogen are known, (Eckburg *et al*., 2003). Although a relationship has been proposed between the presence of somemethanogens and human periodontal diseases (Lepp *et al*., 2004)

2.6.5 Ecology

Microbes are critical to the processes of decomposition required to cycle nitrogen and other element back to the natural world.

2.6.6 HYGIENE

Hygiene is the avoidance of infection or food spoiling by eliminating microorganisms from the surroundings. As microorganisms, in particular bacteria, are found virtually everywhere, the levels of harmful microorganisms can be reduced to acceptable levels. However, in some cases, it is required that an object or substance be completely sterile, i.e. devoid of all living entities and viruses. A good example of this is a hypodermic needle (Burges *et al*., 1967). In food preparation microorganisms are reduced by preservation methods (such as the addition of vinegar), clean utensils used in preparation, short storage periods, or by cool temperatures. If complete sterility is needed, the two most common methods are irradiation and the use of an autoclave, which resembles a pressure cooker. There are several methods for investigating the level of hygiene in a sample of food, drinking water, equipment, e.t.c. water samples can be filtrated through an extremely fine filter. This filter is then placed in a nutrient medium. Microorganisms on the filter then grow by replacing a sample in a nutrient both designed to enrich the organism in question. Various methods such as selective media or PCR can then be used for detection. The hygiene of hard surfaces, such as cooking pots, can be tested by touching them with a solid piece of nutrient medium and allowing the microorganism to grow on it. There are no conditions where all microorganisms would grow and therefore often several different methods are needed. For example, a food sample might be analysed on three different nutrient mediums designed to indicate the presence of total bacteria 9condition where many but all, bacteria grow), molds (conditions where the growth of bacteria is prevented by, e, g, antibiotics) and coliform bacteria (these indicates sewage contamination) (Burges *et al*., 1967).

2.7 Factors affecting distribution, activity and population of soil microorganisms

Soil microorganism (flora and fauna), just higher plants depends entirely on soil their nutrition, growth and activity. The major soil factor which influences the microbial population, distributions like soil are: soil fertility, cultural practices, soil moisture, soil temperature and soil aeration. Others include light, soil pH (h-ion concentration), organism matter, food and energy supply, nature of soil and microbial association. All these factors play a great role in determining not only the number and type of organisms but also their activities. Variations in any one or more of these factors may lead to the changes in the activity of the organisms which affect the soil fertility (Schilz and Jorgensen, 2001). Brief account of all these factors influencing soil micro flora/ organisms are their activities are discussed below:

i. Cultural practices (Tillage): Cultural practices viz, cultivation, crop rotation, application of manures and fertilizers. Liming and gypsum application, pesticide/fungicide and weedicide application have their effect on soil organism. Ploughing and tillage operations facilitate aeration in soil and exposure of soil to sunshine and thereby increase the biological activity of organisms, particularly of bacteria. Crop rotation with legume maintains the favourable microbial population balance, particularly of N2 fixing bacteria and thereby improve soil fertility. Liming of acid soils increases activity of bacteria and actinomycetes and lowers the fungal population. Fertilizers and manure applied to the soil for increased crop production, supply and nutrition not only to the crops but also to microorganisms in soil and thereby proliferate the activity of microbes (Eckburg *et al*., 2003). Foliar or doil application of different chemical (pesticides, fungicides, nematicides e.t.c) in agriculture are either degraded by the soil organism or are liable to leave toxic residues in soil which are hazardours to cause profound reduction in the normal microbial activity in the soil (Stewart *et al*., 2005).

ii. Soil fertility: Fertility level of the soil has a great influence on the microbial population and their activity in soil. The availability of N, P and K require for plant as well as microbes in soil determines the fertility level of soil. On the other hand soil micro flora has greater influence on the soil fertility level (Reganold *et al.*, 1990).

iii. Soil moisture: It is one of the important factors influencing the microbial population and their activity in soil. Water 9 soil moisture is useful to the microorganisms in two ways i.e. it serve as a source of nutrient and supplies hydrogen/oxygen to the organism and it serve as solvent and carrier of other food nutrient to the microorganisms. Microbial activity and population proliferate best moisture range of 20% to 60%. Under excess moisture condition/water logged conditions due to lack of soil aeration (oxygen) anaerobic micro flora become active and the aerobes get die out due to tissue dehydration and some of them change their forms into resting stages spore or cysts and tide over adverse conditions. Therefore optimum soil moisture (range 20 to 60%) must be there for better population and activity of microbes in soil (Burges *et al*., 1967).

iv. Soil temperature: Next to moisture, temperature is the most important environmental factor influencing the biological physical and chemical processes and of microbes, microbial activity and population is soil. Though microorganisms can tolerate extreme temperature (such as -60 or +60 u) condition, but the optimum temperature range at which soil microorganisms can grow and function actively is rather narrow. Depending upon the temperature range at which microorganisms can grow and function, are divided into three groups i.e. psychrophiles (growing at low temperature below 10^0c) and mesophiles (growing well in temperature range between 20^0c to 45^0c) and thermopiles (can tolerate temperature above above 45^0c and optimum 45- 60^0c). Most of the soil microorganisms are mesospheric (25 to 40^0) and optimum temperature for most mesophiles is 37^0c. True psychripiles are almost absent in soil, and thermopiles though present in soil behaves like mesophiles. True thermopiles are more abundant in decaying manure and compost heaps where high temperature prevails. Seasonal changes in soil temperature affect microbial population and their activity especially in temperature regions. By winter, when temperature is low (below 50^0c) the number and activity of microorganisms fall down, and as the soil warms up in spring, they increase in number as well as activity. In general. Population and activities of soil microorganism are the highest in spring and lowest in winter season (Burges *et al*., 1967).

v. Soil air (aeration): For growth of microorganisms better aeration (oxygen and sometimes co_2) in the soil is essential. Microbes consume oxygen from soil air and gives out carbon dioxide. Activities of soil microbes is often measured in terms of the amount of oxygen absorbed or amount of co_2 evolved by the organisms in the soil environment. Under high soil moisture level/water logged conditions, gaseous exchange is hindered and the accumulation of co_4 occurs in soil air which is toxic to microbes. Depending upon oxygen requirement, soil microorganisms are grouped into categories viz aerobic (require oxygen for like processes), anaerobic (do not require oxygen) and microaerophilic (require oxygen concentration/level of oxygen) (Lepp *et al.*, 2004).

vi. Light: Direct sunlight is highly injurious to most of the microorganism except algae. Therefore upper portion of the surface soil a centimetre or less is usually sterile or devoid of microorganisms. Effect of sunlight is due to heating and increase in temperature (more than 45^0) (Burges et al., 1967).

vii. Soil reaction / soil pH: Soil reaction has definite influence/ effect on qualitative composite on of soil microbes. Most of the soil bacteria, blue-green algae, diatoms and protozoa prefer a neutral or slightly alkaline reaction between pH 4.5 and 8.0 and fungi in acidic reaction between pH 4.5 and 6.5 while actinomyvetes prefer slightly alkaline soil reaction also influence the type of the bacteria present in soil. For example nitrifying bacteria (*Nitrosomonas* and *Nitrobacter*) and diazotrophs like *Azobacter* are absent totally or inactive in acid soils while diazotrophs like Beijerickia, Derxia, and sulphur oxidizing bacteria like thiobaccillus thiooxidans are active in acidic soils (Langford, 2004).

viii. Soil organic matter: The organic matter in soil being the chief source of energy and food for most of the soil organisms, it has great influence on the microbial population. Organic matter influence directly or indirectly on the population and activity of the microorganisms (Arthur and Lars, 1997).

ix. Food and energy supply: Almost all microorganisms obtain their food and energy from the plant residues or organic matter/ substance added to the soil. The heterotrophy utilizes the energy liberated during the oxidation of complex organic simple inorganic compounds (chemoautotroph) or from solar radiation (photoautotroph). Thus, the source of food and energy rich material is essential for microbial activity in soil. The organic matter, there serves both as a source of food nutrients as well as energy required by the soil organisms (Langford, 2004).

x. Nature of soil: The physical, chemical physiochemical nature of soil and its nutrient status influence the microbial population both quantitatively and qualitatively. The chemical nature of soil has considerable effect on microbial population in soil. The essential for optimum microbial activity. Similarly nutrient (macro and micro) and organic consistent of humus are responsible for absence or presence of certain type of microorganisms and their activity. For example activity and presence of nitrogen fixing bacteria is greatly influenced by the availability of molybdenum absence of available phosphate restrict the growth of *Azobacter* (Higa, 1995).

xi. Microbial association / interactions: Microorganism interacts with each other giving to antagonistic or symbiotic interaction. The association existing between one organism and other whether of symbiotic or antagonistic influences the population and activity of soil microbes to a great extent. The habit protozoa and more mycobacter which feed in bacteria may suppress or eliminate certain bacteria. On the other hand, the activities of some of the microorganisms are beneficial to each other. For instance organic acids liberated by fungi, increase in oxygen by the activity of algae, change in soil reaction e.t.c. favours the activity of bacteria and other organism in soil (Higa, 1995).

2.8 Fertilizer

All fertilizer supply plant with the nutrients your garden needs to be in tip-top shape. However, organic and inorganic fertilizer supplies nutrients to soil in different ways. Organic fertilizers create a healthy environment for the soil over a long period of time, while inorganic fertilizers work much quickly, but fail to create a sustainable environment (Stewart *et al*., 2005). These will help the people in choosing the one that best fits your needs, or consider combining them to get the best of both options.

2.8.1 Organic and inorganic fertilizer

Organic fertilizers are composed of natural ingredient from plant or animals. Example includes manure and a blend parts such as leaves and peanut hulls. Compost: a blend of plant debris broken down of natural processes is also considered a natural or organic fertilizer (Stewart *et al*., 2005). Inorganic fertilizer, on the other hand, is manufactures from minerals or synthetic chemicals. Both organic and inorganic fertilizers supplement the soil and feed plants with nutrients. Macronutrients: -those nutrients that plant requires in large amounts include nitrogen, phosphorus and potassium and are listed as percentage on the fertilizer bag (Reganold *et al*., 1990).

2.8.2 Pros and cons of organic and inorganic fertilizer

There are benefits and what some may consider disadvantages of organic and inorganic fertilizer, deciding which kind to use may depend on your horticultural situation. According to North Caroline state university, organic matter in natural fertilizers promotes and environment conducive for earthworms and increase the capacity for holding water and nutrients. Organic fertilizer release nutrient slowly, relying on soil organisms to break down organic matter. A slow-release scenario decreases the risk of nutrient leaching but takes time to supply nutrient to plant. Inorganic fertilizer contains a higher percentage of nutrients and provides them more quickly than organic fertilizer. This is a benefit for plants with a short life span, such as bedding plants, but the concentrated form increase the risk of burning the plant if applied incorrectly, and the quick-release of nutrients may result in soil leaching (Artur and Lars, 1997).

2.8.3 Long-term effectiveness or organic and inorganic fertilizer

Research comparing organic and inorganic fertilizer provides compelling evidence that organic fertilizer bolster soil health over the long term. In a study conducted in Sweden over32 years, scientists Arthur Granstedt and Lars Kjellenburg reported on the difference in soil structure crop quality between an organic and inorganic system. They found that soil in the organic system had higher fertilizer, and organic crops had higher starch content than the inorganic system. In contrast, long-term use of synthetic fertilizer depletes soil organisms of the organic matter they need, state the main organic farmers and gardeners association. Eventually, these organisms disappear in soil dependent on inorganic fertilizer (Artur and Lar, 1997).

2.8.4 Integrated approach

It does not have to be either organic or inorganic fertilizer. An integrated approach blends the use of both. A study published in 2009 describes the benefits of an integrated system on rice fields in India. The authors found that a combination of organic and synthetics fertilizers resulted in yield that increased over five years. They concluded that an integrated approach improved the capacity of soil to supply nutrients. A blend of both organic and inorganic fertilizers may suit your landscape (Kuruvilla *et al*., 2009).

III. RECOMMENDATION

Microbes multiply and if your microbe population in low due to lack of organic matter, it can be easily rectified by amending the soil with organic matter and allowing time for microbial growth jump-starting the reproduction of microbes by adding beneficial microbes along with organic matter is an option depending on how soon you want to see result, and the cost. It can be said that microbes are the workhorse of our gardens. Microbes make nutrient in the soil available to plants in a form the plants can use. Microbes create some of those nutrient; they resist disease better and tolerate environmental stress better. Microbe improves soil structure by the humus they create while digesting organic matter. Microbes help in nitrogen fixing.

REFERENCES

[1]. Artur, G. and Lars, K. (1997): Effects of organic and inorganic fertilizers on soil fertility and crop quality". "Proceedings of an International Conference Boston, Tufts University, *Agricultural Production and Nutrition,* Massachusetts; Long term filed experiment IN Sweden.

[2]. Barea, J., Pozo, M., Azon, R. and Azon-Aguilar, C. (2005): "Microbial co-operation in the rhizosphere" *Journal of Soil biology and Biochemistry.* 56 (417): 1761-71.

[3]. Burges, A. and Raw, F. (1967): Soil biology*: Journal of Soil Fertility and Biodiversity in Organic Farming,* 296 (5573: 1694-1697.

[4]. Carstrillo, J. and Oliver, S. (2004): "Yeast as a touchstone in post-genomic research strategies for integrative analysis in functional genomics. *"Journal of Biochemistry and Molecular Biology, 37(1): 93-106.*

[5]. Christner, B. (2008): "Ubiquity of biological ice nucleators in snowfall". *Journal of Biological Science, 319(5867): 1214.*

[6]. *Comis, D. (2002): "*Glomalin: hiding place for a third of the world's stored soil carbon" Agricultural Research (United States Department of Agriculture Agricultural Research Service): 4-7.

[7]. Dundas, E., Paul, O. and John H. (2002): Mahavira is dated 599-527 BCE. The jains London: Routledge ISBN 0-415-26606-8 PAGE 24.

[8]. Dyall-Smith, M. Mike, O. and Haloarchea, K. (2002): University of Melbourne. *Journal of WHO mortality data assessed* 20, January 2007. 69(1): 21-25

[9]. Eckburg, P., Lepp, P. and Roland D. (2003): "Archaea and their potential roles in human disease". *Infect immune 71 (2): 6176-81.*

[10]. *(*French) Domin: que soltner, les bases de la production vegetal, tome: Le sol et son amelioration, collection sciences et Techniques Agricoles, (2003).

[11]. FRIN, (2008): Agro metrological station report, Forestry Research Institute of Nigeria, pg 96-120.

[12]. Gillen, B. and Alan, L. (2007): The genesis of germs: the origin of diseases and the plagues. *Journal, new leaf publishing group.* 47: Pp 4495-4499.

[13]. Gold, T. (1992): "The deep, hot biosphere". Applied and environmental microbiology 71 (10) 5779-5786.

[14]. Gray, N. (2004): Biology of waste treatment. *Journal of Imperial College press 7:5-11.*

[15]. HIga, T. (1991): Effective microorganisms: A biotechnology for mankind. Page 8-14 in J. F. Parr, S. B. Hormick and C. E. Whitman edition proceedings of the first international Conference on kyusei Nature farming U.S. Department of Agriculture, Washington, D.C., U.S.A.

[16]. Higa, T. (1995): Effective microorganisms: their role in kyusei nature farming and sustainable edition: proceedings of the third international conference on kyusei nature farming U.S. Department of Agriculture, Washington, D.C., U.S.A.

[17]. Higa, T. and Wididana, G. (1991): The concept and theories of effective microorganisms. Pp. 118-124 In pair, S.B Hormick, and C.E. Whitman edition; proceedings of the first international conference on kyusei nature farming U.S. Department of Agriculture, Washington, D.C., U.S.A.

[18]. Horneck, G. (1981): Survival of microorganisms in space". A review advance space resource 1 (14): 39-48.

[19]. Hormick, S. (1992): Whitman edition. Proceedings of the first international conference on kyusei nature farming U.S Department of agriculture. Washington D.C., U.S.A. Pp 8-14.

[20]. Hormick, S. (1995): Effective microorganisms: their role in kyusei nature farming and sustainable edition: Proceedings of the third International Conference on kyuse nature farming U.S. Department of Agriculture, Washington D. C., U.S.A. Pp.65.
[21]. Islee, R., Jay, I. and Payne, A. (2008): Apollo's fire igniting America's clean energy economy. Journal of island press, Page 157.
[22]. Kitani, A., Osumu, E. and Carl, W. (1989): Biomass handbook. Taylor and Francis U. S. page 236.
[23]. Kuruvilla, V., Delong, E. and Pace, N. (2009): the proceedings of the international plant nutrition collopuim xvi.
[24]. Langford, R. (2004): Introduction to weapons f mass destruction: Radiological, chemicals, and Biological, Wiley – IEEE. Page 140.
[25]. Lepp, P., Brinig, M., Osuverney, C., Palm, K., Armitage, G. and Relman, D. (2004): "methanaogenic archaea and human periodontal disease". Proc national academic science U.S.A. 101(16): 6176-81.
[26]. Mader, P., Andreas, D., Dubois, L., Gunst, P., Fried N. and Niggli, U. (2002): "Soil Fertilizer, and Biodiversity in Organic Farming" Pp. 1694-1697.
[27]. Madigan, M. and Martinko, J (2006): Brook biology of microorganisms' 13th edition, Pearson education, *Journal of Agricultural and Biological Science*, Pp 1096.
[28]. Max, P. (2012): "Horizontal DNA transfer between bacteria in the environment" Journal of health physics 67 (30): 280-282.
[29]. Moses, A., Vivian, O. and Cavalier-Smith, T. (1999): Biotechnology: the Science and the business. CRC press page 563.
[30]. Parr, J. and Hornick, S. (1992): Agricultural use of organic amendments. *A historical perspective American journal alternative agric.* 7:181-189.
[31]. Parr, J., Hornick, S. and Kaufmman, D. (1994): Use of microbial inoculants and organic fertilizers in agricultural production. Proceedings of the International Seminar on the use of Microbial and Organic Fertilizers in Agricultural Production, Published by the food and fertilizer technology center, Taipei, Taiwan.91
[32]. Pismental, D. (2007): Food, energy and society CRC press. Page 289.
[33]. Pinmentol, D., Hepperly, P., Hanson, J., Douds, D. and Seidel J. (2005): Environment, Energetic, and Economic Comparisons of Organic and Conventional Farming System", *Journal of Biological Science. Vol. 55 No. 7 Pp. 573-582.*
[34]. Reganold, J., Papendick, R. and Parr, J. (1990): Sustainable Agriculture, *Journal of Scientific America. 262(6): 112-120.*
[35]. Rybicki, E. (1990): "the classification of organisms at the edge of life, or problems with virus systematic. Page. 861: 182-6.
[36]. Schoopf, J. (2006): "Fossil Evidence of Archaean Life" Phios trans R. soc lond B Biology Science 361 (1470): 869-85.
[37]. Schulz, H. NS Jorgensen, B. (2001): "Big bacteria". *Annual revision microbiology 55:105-37.*
[38]. Soni, S. (2007): Microbes, A source of energy for 21st century, New India (Mumbai Publishing page 14-6.
[39]. Stewart, W., Dibb, D., Johnson, A. and Smyth, T. (2005): "The contribution of commercial fertilizer nutrients to food production". *Journal of agronomy. 97: 1-6.*
[40]. Sunnerhagen, P. (2002): "Prospects for functional genomics in schizosaccharomysces pombe" Current genetics. 42(2): 73-84.
[41]. Szewzyk, U., Szewzyk, R. and Stenstorm, T. (1994). Themophilic, anaerobic bacteria isolated from a deep borehole in granite in Sweden. *Journal of Agricultural and biological science. 5: 1810-3.*
[42]. Tickell, N., Joshua, E. and Suter. B. (2000): From the Fryer to the fuel tank: The complete guide to suing vegetable oil as an alternative fuel. Biodiesel America. Page 53.
[43]. Whitman, W., Coleman, D. and Wiebe, W. (1998): "Prokaryotes: the unseen majority. "Applied and environmental Microbiology 71(10): 5779-5786.
[44]. Zublena, J., Baird. And Lilly, J. (2009): "Soilfacts-Nutrient Content of Fertilizer and Organic Materials". North Carolina Cooperative Extension Services, Pg. 115.