EFFECT OF EMAS IN CONDITIONING SOME SOIL STRUCTURAL INDICES IN SOUTHERN NIGERIA.

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ABSTRACT
A pot experiment was conducted in the screen house of the Teaching and Research Farm of Rivers State University (RSU) from March to July, 2018 to determine the contributions of effective microorganisms activated solution (EMAS) and organic materials (poultry manure (PM) and dry grasses (DG)) on some soil structural indices. The treatments made up of 2 levels of EMAS and 3 levels of organic materials were replicated three times and arranged in a completely randomized design (CRD). The treated soils were incubated for 4 weeks and samples collected for physical properties of the soil. The results show a significant different ($p < 0.05$) between soil + effective microorganisms activated solutions (S+EMAS), soil + poultry manure (S+PM), soil + dry grasses (soil +DG) and the control soil only (SO). Soils amended with PM had the higher bulk density (1.584gcm^{-3}) while soils amended with EMAS recorded the least bulk density (1.358gcm^{-3}) but soil amended with EMAS recorded higher porosity (0.487%) and SO had the least porosity (0.414%) SO + DG had the highest hydraulic conductivity (69.85cm/hr) and SO had the lowest hydraulic conductivity (21.60cm/hr), no significant difference was observed among the treatments in soil moisture content. The results show that soils amended with EMAS and OM improved soil physical properties. Hence recommending that EMAS and organic material (especially PM) should be used for improvement of soil physical properties to enhance nutrient availabilities for plants and to create a sustainable agriculture.
Keywords: Effective microorganism, Activated Solution (EMAS), Organic Material & Soil Structural Indices

INTRODUCTION
Soil is one of the most important resources a farmer has; soil health is fundamental to profitable and sustainable production. Soils are the most basis and most important resource we use in agriculture. Proper management of the soil is a key to plant health and crop productivity.
The uniqueness of microorganisms and their often unpredictable nature and biosynthetic capabilities given a specific set of environmental and cultural conditions, has made them likely candidates for solving particularly difficult problems in the life sciences and other fields as well. (Higa, 1991, Parr *et al*, 1994).
One popular microbial amendment is effective microorganism (EM) developed by TeruoHiga, a professor at the University of Ryukyus, Okinawa (Yamada &Xu, 2000). Effective microorganism has been used as inoculants to change soil microbial diversity and microbial interaction between soils and plant, thus effective microorganisms had been reported to improve soil quality and productivity of crops over a wide range of agro ecological conditions (Yamada &Xu, 2000). Soil structure has a strong impact on a range of processes influencing crop yield. It refers to the manner and stability with which individual sand, silt and clay particles are bound together in units called aggregates (Dickson et al., 1990).
Soil physical properties play an important role in crop production and water efficiency especially in high texture soils regions. Enhancing physical properties like structure. Physical properties like bulk density, porosity, void ratio, water permeability and hydraulic conductivity significantly improved when EM was applied (Hussian*et al*, 2001).
Studies examining how effective microorganisms and organic materials influence the contributions of soil structure are uncommon in literature. Thus, the main objective of this research was to examine how 2 organic materials and EMAS influence the contribution of soil structure in Rivers State University, Nigeria.

MATERIALS AND METHODS
Experimental Site
The study was conducted in a screen house located at the Teaching and Research Farm of the Rivers State University (RSU) located at Port Harcourt (4^{o} 46′ N, 7^{o} 10′E). Port Harcourt is in the humid forest zone which has an average elevation of 10m above sea level. The main annual rainfall is 2400mm, usually in a monomodaldistribution lasting from March and November. There is usually a day spell between December and March with little or no rain, the wettest months are between July and October. Temperature varies from 27^{o}C from February to April to 25^{o}C in July and August relative humidity remains high throughout the year and varies from 78% in February to 89% in July and September (Ikpe*et al*, 2003).
Treatment, Soil Sampling and Analyses
The treatments consisted of 3 levels of organic materials (Dry grasses (DG), poultry manure (PM) and No organic material (SO), and 2 levels of effective microorganisms activated solutions (EMAS) and (NO EMAS). The treatments were applied using a completely randomized design

(CRD) with three replications at 30t/ha of dry grasses and 50t/ha for poultry manure.

The EMAS for EMAS treated pots and water in water treated pots were added to field capacity and incubated for 30days after covering with polythene materials.

Soil sampling was collected using soil cores (0-15cm) taking form each pots and trowel.

Soil physical analysis was carried out using standard laboratory methods. Soil particle size was determined by hydrometer method modified by (Juo, 1979). Soil bulk density was determined by core method as articulated by (Opara-Nadi, 2000). Total porosity was calculated with core samples using the method of Flint and Flint 2002.

Soil moisture content were determined as a ratio of the mass of water to the mass of the dry soil as articulated by (Isirimah*et al*, 2010) while saturated hydraulic conductivity were determined on core samples using the constant head permeameter method (Klute& Dickson, 1986) as described by Orji &Oko-Jaja, 2016).

Statistical Analysis

Data from all samplings were analysed after pooling values from all dry grass, poultry and EMAS treated pots. Analysis of variance using the general linear model procedure of SAS (SAS, 2013) and the treatments means were compared using standard error (SE±) at 5% level of significance ($P<0.05$).

RESULTS AND DISCUSSION

Particles Size Distribution

The particle size distribution and soil texture, as affected by effective microorganism and organic materials is as shown in Table 1.

There was no increase in sand, silt and clay contents when compared with the control, the soil texture is sandy loam.

Table 1

Treatments	Particle size (g/kg)			Texture	Bulk density (gcm-3)	Porosity (%)	Moisture content (%)	Hydraulic conductivity (cm/hr)
	Sand	Silt	Clay					
EMAS	804	40	156	Sandy loam	1.421[b]	0.465[a]	0.24[a]	59.4[b]
NO EMAS	804	40	156	Sandy loam	1.471[b]	0.439[bc]	0.23[a]	46.6[c]
S+DG	805	40	155	Sandy loam	1.380[bc]	0.478[a]	0.23[a]	69.84[a]
S+ PM	804	41	155	Sandy loam	1.584[a]	0.425[bc]	0.2[5]	48.72[b]
SO	804	40	156	Sandy loam	1.550[a]	0.414[c]	0.22[a]	21.60[d]

According to Nyle (1999) the texture of a soil in the field is not readily subject to change, so it is considered a basic property of a soil.

Bulk Density

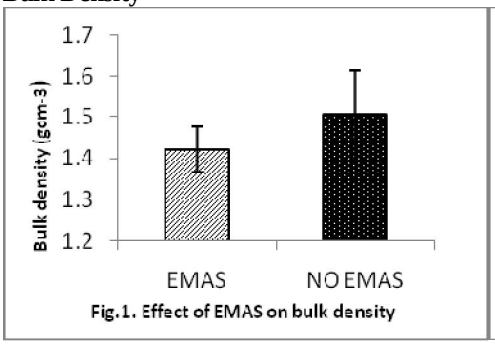

Fig.1. Effect of EMAS on bulk density

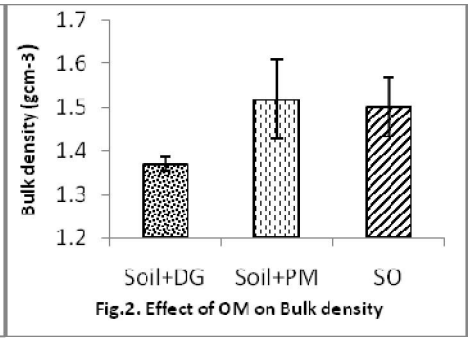

Fig.2. Effect of OM on Bulk density

Analysis indicated significant difference in bulk density amongst the various treatments at the 5% level of probability as in Fig 1&2. The treatments with no EMAS had the highest bulk density (1.471gcm^{-3}), the lowest bulk density was observed in soils amended with EMAS (1.421gcm^{-3}). The activities of the effective microorganisms may have resulted in a lower bulk density.

Addition of organic matter increase the soil bulk density, this observation agrees with the reports of (Mbah*et al*; 2004) and Adeleye*et al*; 2010) who stated that, application of organic manures improves and ameliorate several soil physical properties such

as bulk density. Similar result was reported by Mbonu and Opara-Nadi, 2008) which stated that, the conversion of natural forest into pasture soil and plantain plantation soils resulted in a higher bulk density. Treatments amended with poultry manure had the highest bulk density (1.584gcm^{-2}), this may be as a result of the large surface area and the size of the materials used as a soil amendment.

POROSITY

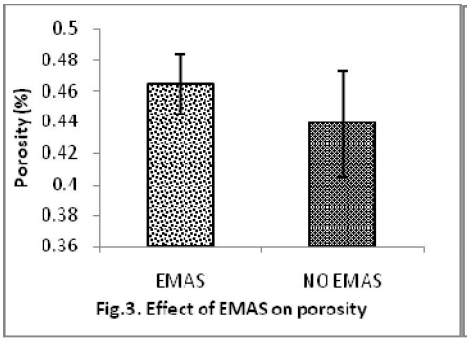

Fig.3. Effect of EMAS on porosity

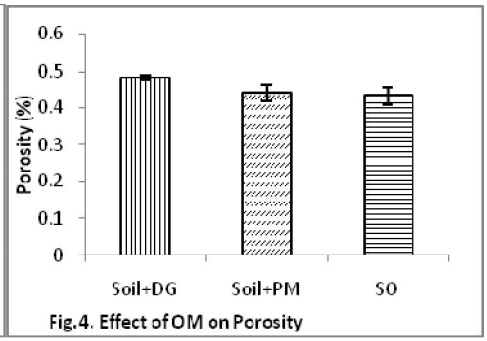

Fig.4. Effect of OM on Porosity

Higher total porosity value was recorded in the soil amended with EMAS (Fig 3), as compared with NO EMAS, this may be as a result of the activities of the microbes creating an improvement on the soil structures. Soil amended with dry grasses had a higher porosity than the poultry manure amended soils (Fig 4). According to Adeleye*et al* (2010) enhancement of soil with organic manures improved soil porosity due to structural improvement. It is further believed that improvement in total porosity might be as a result of the improved soil structure with corresponding increase in infiltration rate and decrease in soil bulk density. The presence of organic manure on the soil surface has some effect on soil physical properties such as reducing the impart of rain drop on soil surface which might cause splash erosion. Also reducing evaporation and excessive heating and allowing microbiological activities at optimum temperature (Uwizeyimana; 1997).

MOISTURE CONTENT

The gravimetric contents as affected by effective microorganisms activated solution and organic matter is as shown on Fig 5&6.

The results of gravimetric moisture content at saturation, which is a reflection of the water holding capacity of the soil (Orji &Oko-Jaja, 2016). There was no significant difference in moisture content.

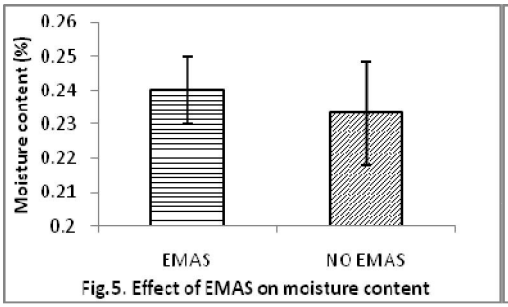

Fig.5. Effect of EMAS on moisture content

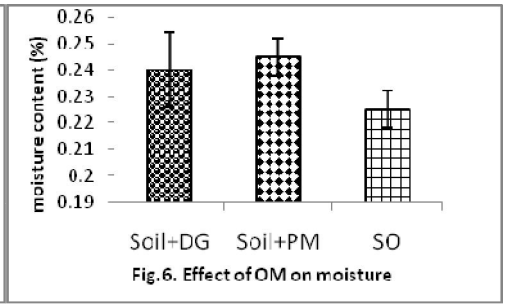

Fig.6. Effect of OM on moisture

The highest value (0.24%) were for EMAS treated soils followed by NO EMAS treated (0.23%). This followed the same tread with total porosity result. The moisture content was higher in soil + PM (25%) followed by (23%) and soil +DG and (22%) in the control SO respectively, soils amended with organic materials, this do not follow the same tread as the result of total porosity as the water holding capacity of the soil is highly dependent on the total pore spaces in the soil.

Applications of EMAS and organic materials on soils improved moisture content possibly due to colloidal and hydrophobic nature of the organic wastes (David *et al* 2012). This findings supported the work of other scientists, who reported that the use of organic material can improve soil health and crop yield on sustainable basis (Mbah*et al*, 2004, Mbagwu, 2006). Similarly, enhancement of soil water retention capacity due to EMAS and manure, according to the study of (Adeleye*et al*,2010) could be probably due to structural improvement, which is increase in total porosity and the fraction of porosity involved in soil water storage.

It is further believed that improvement in total porosity might be as a result of the improved soil aggregation, brought about by the improved soil organic matter content of the amendments EMAS and organic materials.

Saturated Hydraulic Conductivity

The result of the effect of effective microorganism activities solution (EMAS) and organic materials such as (Poultry manure (PM), dry grasses (DG) and the control soil only (SO) is shown in Table 1.

The results indicated that there was a significant difference in saturated hydraulic conductivity values in EMAS and NO EMAS treated soils, the highest value of (59.4cm/hr) was observed at EMAS treated soils and (46.6cm/hr) in NO EMAS treated soils. The result indicates that EMAS influences hydraulic conductivity which indicates an improvement in soil aggregates and the increase in soil porosity of the amended soil treatment. This results do not agree with the findings of (Kee-Choon, *et al*, 2001) which reported that effective microorganisms did not affect soil hydraulic conductivity while organic materials only affect hydraulic conductivity. Studies have also established that inoculation of soil/plant ecosystem with cultures of EM had improved soil quality and soil health. Improved soil quality is generally characterized by increased infiltration, aggregation, aeration and organic matter content and by decreased erosion, bulk density; compaction and crusting according to (High & Parr, 1994) organic materials also show significant difference in saturated hydraulic conductivity. The highest value of saturated hydraulic (69.48cm/hr) was obtained in the soil amended with dry grasses (Soil + DG), followed by soil amended with poultry manure (48.72cm/hr) and the control (21.60cm/hr) respectively. This result also is in agreement with the report by Ohu (1985). The result above may be due to poor mode of compaction. Saturated hydraulic conductivity is the ability of soil to transmit water under saturated condition (Jabro, 1996), is simply the ease with which water flow through the soil.

CONCLUSION

Variations in soil physical properties as a result of effective microorganism activated solution (EMAS) and organic materials(OM) were examined.

EMAS and OM significantly influenced soil physical properties. Activities of the effective microorganism and poor mode of compaction brought about by the organic materials contributed positively to a number of physical properties of soil, including bulk density, porosity, moisture content and hydraulic conductivity. It is therefore recommended that EMAS and organic material (especially PM) should be used to improve or enhances soil structure.

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