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Population of Fungi and Bacteria in Alfisols is dependent on seasonal changes, poultry manure application and cowpea varieties

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INTRODUCTION & AIM

Soils and food crops like cowpea are known to harbour microbes that produce hormones and other chemicals that help to stimulate plant growth. Cowpea (*Vigna unguiculata* [L.] Walp) is a popular legume crop mostly grown as an important staple food in Africa for human and livestock diets worldwide (Kebede and Bekeko, 2020). Cowpea can grow in a wide range of soil types provided they are well-drained (Drahansky *et al*., 2016).

Alfisols are rich in aluminium (Al) and iron (Fe) and useful for food and fibre production. Alfisols are generally fertile and productive soils with sufficient moisture for part of the year (Demsew and Muluadam, 2017). In Nigeria, a major challenge in agriculture is poor soil nutrient. Organic amendments such as poultry manure are economical and rich source of nitrogen and phosphorus useful in increasing soil organic carbon and stimulate microbial activities in the soil.

Soil microbial population greatly depends on the crop type, amendment and soil type.

There is limited understanding on how poultry manure and cowpea varieties influence microbial populations in Alfisols. Therefore, the aim of the study is to determine the effects of poultry manure and cowpea varieties on the fungi and bacteria population density in an Alfisols at two seasons.

METHOD

The study was carried out at the Parry road Teaching and Research Farm, University of Ibadan, Ibadan, Oyo State on Alfisols located within the Southwestern region of Nigeria on coordinates: longitude 3°89′22″N, latitude 7°45′5″E and altitude of 199m above sea level. The seeds of cowpea were collected from the Seed Genebank Unit of the National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Apata, Ibadan, Oyo state. Poultry manure was sourced from the Poultry section of the Teaching and Research farm, University of Ibadan, Oyo State.

A split-plot experiment arranged in a randomised complete block design (RCBD) was set up with three cowpea varieties as subplots (FUAMPEA 1, FUAMPEA 2, ITO7K-318-33) and poultry manure at three levels: 0 t/ha, 2 t/ha and 4 t/ha as the main plots treatments. Each variety was planted with two seeds per hole, spaced at 75cm x 25cm.

The composite soil samples collected from 0-15cm depth using auger were air-dried and sieved through 2.0 mm mesh and 0.5mm mesh, respectively and subjected to routine analysis.

Estimation of Soil Microbial Population

The soil microbial population assessment was conducted for both bacteria and fungi in the soil using serial dilutions method. One ml of the sample of the appropriate dilution were plated using PDA and NA for fungi and bacteria respectively and incubated at 37°C for 24 and 72 hours respectively for bacteria and fungi (Khoshru *et al*., 2023) and colonies counted.

RESULTS & DISCUSSION

Table 1 shows the physical and chemical properties of the soil used for the experiment. The soil is clay loam. Soil pH value of 5.9 in (1:1) was moderately acidic and it contained low organic carbon content of 10.1 g/kg according to Xing *et al*., (2022). The values of nitrogen of 0.5 g/kg was low, phosphorus of 20 mg/kg was moderate. Low values of 0.2, 0.1, and 0.2cmol/kg for exchangeable Ca^{2+}, Mg^{2+}, and K^{+}, respectively and an exchangeable Na^{+} level of 0.7cmol/kg. The low exchangeable cation levels, acidic nature of the soil and low values of nitrogen and phosphorus indicated that the soil was depleted of nutrient.

Table 1: Pre planting characteristics of Alfisols used for the experiment

Properties	Values
pH (1:1) water	5.9
Organic Carbon (g/kg)	10.1
Total Nitrogen (g/kg)	0.5
Available Phosphorus (mg/kg)	20
Exchangeable bases (cmol/kg)	
Ca	0.2
Mg	0.1
K	0.2
Na	0.7
Exchangeable Acidity (cmol/kg)	1.0
Particle size Analysis (g/kg)	
Sand	332
Silt	328
Clay	340
Textural class	Clay Loam soil

Figure 1 shows the population for three cowpea varieties as influenced by poultry manure application across different weeks after sowing (WAS) in the dry season. The fungi population varied significantly ($p<0.05$) among poultry manure application and cowpea varieties during the dry season. There was no significant difference at 2WAS, but significant interactions at fungi

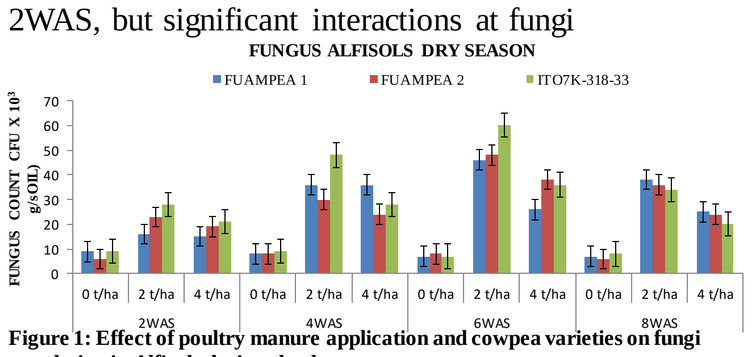

Figure 1: Effect of poultry manure application and cowpea varieties on fungi population in Alfisols during the dry season

population density of 6.0 x 10^4 CFU/g of soil across the weeks while, the control gave the least fungi population density of 6.0 x 10^3 CFU/g of soil with FUAMPEA 2.

At 8WAS, 2t/ha poultry manure application gave the highest fungi population of 3.8 x 10^4 CFU/g of soil with FUAMPEA 1, this was not significantly different from FUAMPEA 2 and ITO7K-318-33 at 2t/ha, the control had the least population of 6.0 x 10^3 CFU/g of soil with FUAMPEA 2.

This shows that the population of fungi with the three cowpea varieties increases weekly at 2t/ha while, there was fluctuation at 4t/ha. However, there was a decline from 6WAS with 2t/ha and 4t/ha.

Figure 2: Effect of poultry manure and cowpea varieties on bacteria population in Alfisols during the dry season

Figure 2 shows that there was no significance difference ($p<0.05$) among poultry manure application and cowpea varieties during the dry season at 2t/ha and 4t/ha however, 4t/ha with FUAMPEA 2 gave the highest bacteria population density across 2, 4 and 6 WAS. Poultry manure application at 4t/ha with FUAMPEA 2 gave 5.2 x 10^6 CFU /g of soil at 2 WAS. At 4WAS, 2t/ha gave the highest bacteria population of 8.2 x 10^6 CFU/g of soil with FUAMPEA 2. At 6 WAS, 4t/ha with FUAMPEA 2 gave the highest bacteria of 8.5 x 10^6 CFU/g of soil while, at 8 WAS, 4t/ha with ITO7K-318-33 gave 7.6 x 10^6 CFU/g of soil.

Nevertheless, the control at 6 WAS, 4t/ha with FUAMPEA 2 gave the highest bacteria of 8.5 x 10^6 CFU/g of soil while at 8 WAS, 4t/ha with ITO7K-318-33 gave 7.6 x 10^6 CFU/g of soil. The control gave the least across 2, 4, 6 and 8 WAS with ITO7K-318-33.

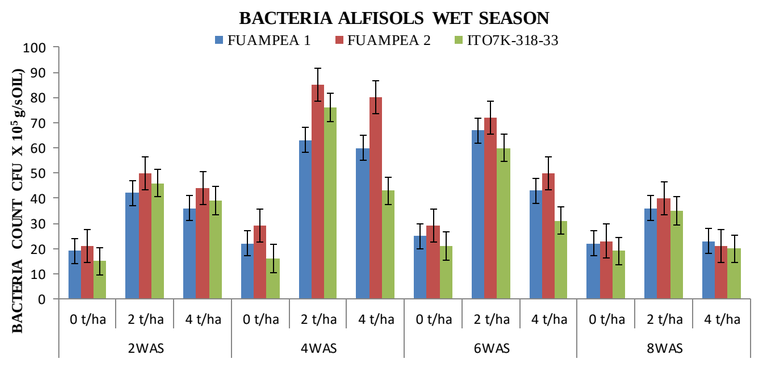

Figure 3: Effects of poultry manure and cowpea varieties on bacteria population in Alfisols during the wet season

Figure 3 showed influence of poultry manure application on bacteria population in an Alfisols during wet season. The highest bacteria populations of 5.0 x 10^6 CFU/g of soil, 8.5 x 10^6 CFU/g of soil, 7.2 x 10^6 CFU/g of soil and 4.0 x 10^6 CFU/g of soil, respectively at 2, 4, 6 and 8WAS were observed with FUAMPEA 2. Nonetheless, the control had the least bacteria population across 2, 4, 6 and 8 WAS with ITO7K-318-33 but, decline was observed at 8WAS across the poultry manure applications.

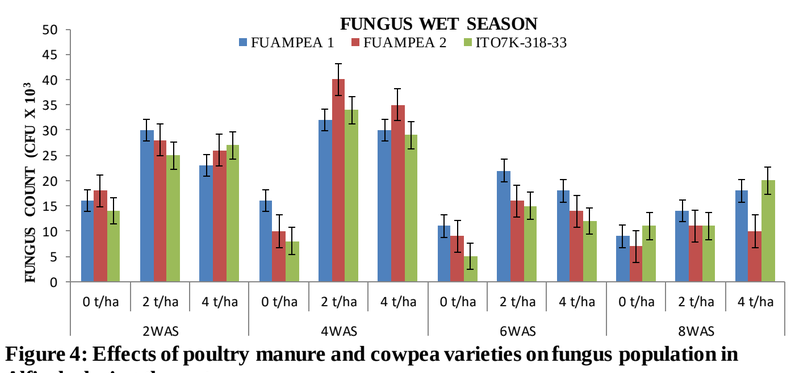

Figure 4: Effects of poultry manure and cowpea varieties on fungus population in Alfisols during the wet season

Figure 4 showed effect of poultry manure applications and cowpea varieties on fungi population during the wet season in Alfisols. There was a general increase in fungi population at 2 and 4 WAS but, a decline was noticed at 6 and 8 WAS, At 2 WAS, FUAMPEA 1 had the highest fungi population of 3.0 x 10^4 CFU/g of soil at 2t/ha and this was not significantly different from 4t/ha with ITO7K-318-33 being the highest fungi population of 2.7 x 10^4 CFU/g of soil.

At 4 WAS, 2t/ha and 4t/ha gave a higher fungi population of 4.0 x 10^4 CFU/g of soil and 3.5 x 10^4 CFU/g of soil, respectively, with FUAMPEA 2.

However, the control had the least population of fungi across 2, 4, 6 WAS with ITO7K-318-33 but at 8 WAS, there was a decline in the population of fungi with FUAMPEA 2.

CONCLUSION

The study therefore concludes that the accumulation of bacteria and fungus in Alfisols were seasonal, selected based on preference and compatibility with cowpea varieties and rates of poultry manure applications at different weeks after sowing.

REFERENCES

Kebede, E. and Bekeko, Z. (2020). Expounding the production and importance of cowpea (Vigna unguiculata (L.) Walp.) in Ethiopia. Cogent Food & Agriculture, 6(1), 1769805.

Khoshru, B., Khoshmanzar, E., Lajayer, B. A. & Ghorbanpour, M. (2023). Soil moisture– mediated changes in microorganism biomass and bioavailability of nutrients in paddy soil. In Plant Stress Mitigators (pp. 479-494). Academic Press.