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Production of Organic fertilizer from poultry waste and Neem seed

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Abstract

Organic fertilizer obtained as a by-product from plants and animals requires less investment needs but are known to have huge benefits such as low risk of environmental damage and reduced risk of diseases in humans. This paper highlight the result of a research conducted at National Center for Agricultural Mechanization (NCAM) Ilorin Nigeria. The research employed the collection of sample materials of poultry waste from NCAM, Integrated Farm and Animal Product (NIFAP) and neem seed around NCAM compound. The samples were subjected to laboratory experimental test to determine the level of fertility of the macro-element and micro-nutrient, before and after production. The samples were dried to a considerably moisture content of 3.33% which allowed for smooth milling. The already dried fermented poultry waste of same moisture content were mixed together in a proportion of 1:1.5 neem seed to poultry waste, and were milled by an NCAM fabricated Hammer Miller. The resulting fine powder was pelleted using an NCAM fabricated pelletizing machine. The pelleted products were dried to acceptable moisture content 3.33% for both storage and easy dissolution during application on crops. The performance evaluation of the organic fertilizer produced revealed that it is a better replacement for inorganic fertilizer.

Keywords; Organic fertilizer, Hammer miller, pelletizer, neem seed, poultry waste.

Introduction

Organic fertilizer refers to regularly derived materials obtained as a byproduct or end product of naturally occurring processes. Organic fertilizers such as manure have been used in agriculture for thousands of years even though ancient farmers did not understand the chemistry involved, they recognized the benefits of providing their crops with organic material. Owing to the eco-friendly nature of organic fertilizers, many governments globally, have subsidized the prices thus increasing access to use by farmers. Organic fertilizers have become increasingly popular and far more effective in recent years. Advocates for organic produce claim that asides containing fewer harmful chemicals, it is more environment-friendly and may be more nutritious (Savci, 2012).

Over the years, there has been a high dependency on government for the importation and subsidizing of chemical fertilizers. The bottle neck involved in acquiring and subsequent delay in application of these chemical fertilizers eventually leads to low yield and low produce (AIAE, 2005). Government environmental policies of minimizing wastage and reduction in the consumption of non-biodegradable raw materials have led to an increased production of organic fertilizers. Regulations emphasizing more on human safety are supporting markets for organic fertilizers which reduce risk to human life and the environment.

Nigeria's food import bill for year 2000 was ₦164 billion or 13.3% of total value of imports and ₦ 173 billion in 2005 (CBN, 2006). This implies that there should be a campaign for a better organic fertilizer use via policy(s) that must meet up with the food demand. Hence, the production and application of organic fertilizers which are considerably of less investment from raw material that are readily available is canvassed.

Since organic fertilizers are extracted from naturally-occurring substances, the risk of environmental damage is low. Use of organic fertilizers also reduces the risk of diseases in humans, as many chemical fertilizers find their way to human food. Organic farming has

received a major boost in many countries and most probably worldwide since consumers have lost some trust in food derived from conventional production (Margulis *et al.,* 2006).

In a research conducted by XING, it was considered necessary to reduce the use of chemical fertilizers and pesticides because they can cause problems both to ecological and human health through over exposure to synthetic molecules following indiscriminate usage. Consumer awareness of the relationship between foods and health, together with environmental concerns, has led to an increased demand for organically produced foods. In general, the public perceives organic foods as being healthier and safer than those produced through conventional practices (Bourn and Prescott, 2002).

Organic fertilizer has witnessed steady growth in the recent past owing to government support and favourable perception among farmers and end-users in developed countries of the world. This factor is expected to augment the global organic fertilizers market over a long time period (Iren *et al.,* 2015).

Organic agriculture represents a system of production which is looking for harmony between the environment and agricultural productions. Encouraging findings have been obtained from studies comparing the usage of organic fertilizers with other types of fertilizers. High yields and adequate production of leaves, was reported in a study conducted to determine effects of application of organic fertilizer on production of leafy vegetables (Fashina *et al.,* 2002). A lot of studies have revealed various plant and animal components that could be utilized to locally produce organic fertilizer. Bone meal, often used for perennial bulbs, is high in phosphates and calcium with smaller amounts of nitrogen, potassium and manganese. Scrap from food processing is recycled, after composting into fertilizer. Some by-products, like hair and feathers, contain a high percentage of nitrogen. Grape skins contain only potassium. Peanut meal contains a good balance of nutrients, including calcium, manganese, sulphur and chlorine. Kelp is a "complete" food for plants, containing a full range of nutrients, minerals and amino acids and even useful as a mulch (Adeniyan and Ojeniyi, 2005).

Fertilizer ingredients must be balanced for specific uses and soil types (Sabbalakshmi *et al.*, 2012). The benefit in using an organic fertilizer is that it can be formulated for a specific purpose. Conducting Soil tests on an intended piece of land reveals available and/or deficient nutrients thus making it easy to compound appropriate organic fertilizer required for plants to grow and flourish. Native plant species survive in areas where the organic and mineral nutrients in the soil and climatic conditions favour their development (Ayito *et al.*, 2018).

Neem seeds contain almost all the required nutrient to revitalize the soil as well as the component of plant requirement for growth, leaf formation, flower production, and root formation. This study, therefore, aims at the production of an organic fertilizer from locally sourced neem seeds and poultry manure.

Materials and Methods

Study Area

The study was conducted at the National Centre for Agricultural Mechanization (NCAM), Ilorin, Kwara State. Ilorin is situated on Longitude $4^{o}35^{1}$East and Latitude 8^{o} 29 North with an altitude of 370 m above sea level. The mean annual rainfall is about 1,200 mm while the rainfall distribution is bimodal. The rainfall season spans from April through October with a dry spell in the month of August.

Materials

Poultry residue samples were collected from Poultry Section of NCAM Integrated Farm while neem seeds were obtained within and around NCAM.

Methodology

Twenty five kilograms of ripe Neem seed was collected from neem trees around NCAM and 30kg of poultry waste was collected from NCAM Integrated farm. The materials were dried at the Land and Water Engineering Laboratory with Heraeus oven (0-250^{0}C) at 103.5^{0}C to 3.33%

moisture content. Five grammes of each material were taken for pre-production analysis to determine Nitrogen, Phosphorus, Potassium, Magnesium, calcium and pH level of the materials.

The already fermented dried poultry waste and neem seeds were mixed together in ratio (1:1.5) neem seed to poultry waste. The mixture was milled using a medium hammer mill fabricated by NCAM to obtain a fine powder. Powdered starch of about 1: 200 of starch to fertilizer materials was added with little quantity of water to form a paste for granules production. The paste was transfer to NCAM fabricated pelletizing machine with 4mm disc for the production of organic fertilizer pellet. The resulting pellet was dried to 3.33% moisture content. 5g of the product was taking for post-production analysis.

The evaluation performance of the organic fertilizer was carried out on two plots of land measuring 8m by 12m each. The land preparation was done in the month of January, 2019. The organic fertilizer was applied on one of the field before planting and the other field was used as control. The planting of water melon seed was done on the 7th of February, 2019 on the two plots with 90cm spacing. After two weeks of germination, 75g of the organic fertilizer was applied on each plant in a ring form. This was repeated on the test plot when the water melon plant was about fruiting. The total organic fertilizer used for the experiment was 25kg. The length of the plant stem was measured every three weeks. This was done until the plant started fruiting. The yield of the water melon plant on the test field and control field was taking into consideration.

Results and Discussion

Table 1 shows the result of pre-process nutrient analysis of neem seed and poultry waste. It was deduce from the result that neem seed and poultry waste is rich in Nitrogen, phosphorous and potassium which are major component of fertilizer. The Nitrogen content of neem seed is 1.52% while that of poultry waste is 0.6%. Phosphorous are 68.45mg/kg in neem seed and 59.78mg/kg in poultry waste, while potassium level in neem seed are 45.80mg/kg and 60.40mg/kg in poultry waste. The pH of the neem seed and poultry waste was within acceptable value for crop and other macro-nutrients like calcium and magnesium have higher value.

Table 2 shows the results of nutrient analysis of the organic fertilizer produced from neem seed and poultry waste. The nitrogen level of the fertilizer is 3.84% and this is higher than the

nitrogen content of the materials used for the organic fertilizer. The same trend was followed in the level of phosphorous of the organic fertilizer which stand at 75.14mg/kg but the value for potassium content of the fertilizer was lower than the potassium content of the materials used.

Table 3 shows the length (cm) of water melon crop, three crops were taken at random from experimental plot and control plot. These were labeled A, B and E at the experimental plot while E, F and G were the crop chosen at control plot. The first record was taken two weeks after germination and three consecutive records were taken at 5 days interval until the water melon crop started fruiting. The total length of the crop on the experimental plot ranges between 450 - 500cm while the length of the crop on the control plot ranges between 119 - 425 cm. This shows a great performance of organic fertilizer applied to the crop on the experimental plot.

Table 4 revealed the yield of the crops on the experimental plot and control plot. The experimental field had 20 numbers of fruit with a total weight of 83.77kg while the control experiment had 10 numbers of fruit with a total weight of 16.76kg.

Conclusion

The performance evaluation carried out on the organic fertilizer produced from combination of neem seed and poultry waste showed that crop planted with the application of organic fertilizer had a better performance in length and yield of the than crop raised without the application of fertilizer. Therefore organic fertilizer produced from neem seed and poutry waste is a better replacement for organic fertilizer on agricultural crops.

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Table 1: result of nutrient analysis of neem seed and poultry waste.

Sample codes	**N_2 (%)**	**Na(mg/kg)**	**Ca(mg/kg)**	**K (mg/kg)**	**Mg(mg/kg)**	**P(mg/kg)**	**pH**
Neem Seed	1.520	28.800	38.900	45,800	4.890	68.450	5.820
Poultry Waste	0.600	25.500	55.600	60.400	5.570	59.780	5.770

Table 2: Result of nutrient analysis of organic fertilizer**.**

	N_2 (%)	**Na(mg/kg)**	**Ca(mg/kg)**	**K (mg/kg)**	**Mg(mg/kg)**	**P(mg/kg)**	**PH**
Organic fertilizer	3.838	10.285	18.500	12.493	3.772	75.138	5.795

Table 3: length of crops (cm)

Age of the Crop	**Length of the Crop with Organic Fertilizer**			**Length of the Crop without Organic Fertilizer**		
	A (cm**)**	**B(**cm**)**	**C(**cm**)**	**E (**cm**)**	**F(**cm**)**	**G (**cm**)**
14 days old	160	160	110	10	60	160
19 days old	120	100	90	47	60	100
24 days old	120	130	150	36	50	90
29 days old	100	110	100	26	45	75
Total Length	**500**	**500**	**450**	**119**	**215**	**425**

Table 4: Yield of crops (kg)

S/N	**Crop yield without Organic Fertilizer(kg)**	**Crop yield with Organic Fertilizer(kg)**
1	0.80	3.50, 3.51
2	0.98	3.52, 3.56
3	1.05	3.60, 3.65
4	1.54	3.80, 3.80
5	1.54	3.80, 3.85
6	1.82	4.42, 4.42
7	2.00	4.44, 4.48
8	2.00	4.50, 4.50

9	2.05	5.00,	5.02
10	2.98	5.20	5.20
Total	**16.76Kg**	**83.77kg**	