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Full Length Research Paper

ECONOMICS OF BIO-BASED FERTILIZER IN IMPROVING CROP PRODUCTIVITY THROUGH EXTENSION SERVICES DELIVERY

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Abstract

Organic fertilizers have been reported to increase the yield and quality of crops as well as soil properties. Production of organic based fertilizers help to convert wastes which would otherwise become a nuisance to the environment to environmentally friendly and agriculturally useful materials. The research work was done using different materials such as neem seeds, calcium carbonate, bone mill, blood mill, rice husk and potash. The production of the fertilizer was done by mixing the materials and taken to the hammer mill for milling. Finally, the milled fertilizer was taken to the granulator for granulation and later dried off and packaged. The chemical analysis of the finished product was carried out by different methods; Nitrogen (N) was analyzed by kjelahl method, Phosphorus (P) by brary & kurtz no.1 method, potassium (k) flame photometric method and organic carbon (c) by walkeley-black method. The result of the analysis is: Nitrogen (N) 0.672%, Phosphorous (P) 5.17 mg/kg, Potassium (K) 11.50 mg/kg, and Organic Carbon (C) 3.890. This project serves as the hands-on training venue for organic fertilizer production not only for university students but also for outside clients. The conversion of solid wastes into a valuable resource such as organic compost or organic fertilizer is a worthwhile strategy for saving the Earth from further degradation generated by improper waste disposal and management. Moreover, the continuous use of organic

fertilizer as a source of plant nutrients for agricultural production not only reduces the cost of fertilizer but serves as the ultimate solution for restoring the lost fertility of agricultural soils as well as soil health; this leads to sustained soil productivity. It is recommended that techno guide on solid waste composting for the production of organic fertilizer should be disseminated to people to solve waste disposal problems through conversion of biodegradable wastes into organic compost; this will ensure the availability of organic fertilizer for crop production.

Keywords: economics, bio-based fertilizer, improved crop productivity

Introduction

Organic fertilizers have been reported to increase the yield and quality of crops as well as soil properties. Production of organic based fertilizers help to convert wastes which would otherwise become a nuisance to the environment to environmentally friendly and agriculturally useful materials (Mustapha *et. al,* 2011). Different raw materials which could be of plant or animal origin are used for the production of these fertilizers; these could be used solely or in combination. Their efficiency will depend on the type of raw materials used for the preparation. Examples of raw materials used for the production of the organic based fertilizers are: neem plant/seed, mango pods/fruits poultry manure, saw dust, rice husk, city refuse, cow, pig dung, crop residues e. t. c. It is therefore necessary to compare the effects of commercially produced organic based fertilizers so as to ascertain their efficiencies and reduce environmental nuisance (Olowokere, 2005).

One of the most active ingredients isolated from neem cake is Azadirachtin. Azadiractin has been found to be the tree's main agent for battling insects. It appears to cause around 90% of the pesticidal effect on most pests. It does not kill insects instantly; instead it repels and disrupts their growth and reproduction. Research over the past 20 years has shown that it is one of the most potential growth regulator and feeding deterrents ever assayed. It repels or reduces the feeding habit of many species of pest and insect, as well as some nematodes. In fact it is so potent that a mere trace of its presence prevents some insects from even touching plants (Ayeni, Adeleye and Adejumo 2012) [5]. Meliantriol Another feeding inhibitor, Meliantriol is found in extremely low concentrations in neem cake to cause insects to cease eating. The demonstration of its ability to prevent locusts chewing on crops was the first scientific proof for saosis neems traditional use for insect control on India's crops (Mustapha, Bzugu, and Sanusi, 2012) [12].

Nimbin and Nimbidin Two more saosis neem cake pellet components nimbin and nimbidin have been found to have anti-viral activity. They affects potato virus X, vaccinia virus, and fowl fox virus. They

could perhaps open a way to control these and other viral disease of crops and livestock. Nimbin is the primary component of the bitter principles obtained when neem seeds are extracted with alcohol; it occurs in sizeable quantities about 2% of the kernel (Vijayalakshmi, Subhashini and Shivani 1996).

History and Development of Neem, *Azadirachta indica* is native to the arid regions of the Indian sub-continent, where it grows to 12-24 m high at altitudes between 50 and 100 m with 130 mm of sufficient rainfall per annum for its normal growth. The history of neem can be traced back to the ancient Harappa and Mohenjo Daro civilizations in India. The medical practitioners of the period studied a variety of natural occurring plants and trees having therapeutic value and neem tree was one of them. The earliest indication of neem tree being used for its medicinal properties in households began nearly 5000 years ago. Neem is said to have been widely used in traditional systems of medicine like Ayurveda and this is also mentioned in earliest Indian scriptures of medicine – the Charak Samhita and Sushruta Samhita.

Neem was earlier used in households for giving bath to newly born infants protect people from insect bites and also indigenously used to protect a number of plants as neem contained insecticidal properties (Vijayalakshmi, Subhashini and Shivani 1995). Generally, the fame of this 'wonder tree' spread to western countries and after a lot of researches funded by internationally acclaimed organizations like UN, neem and its products were accepted for their therapeutic value and having no side effects in US, UK, Australia among others. Neem tree has miraculous powers and scientists are beginning to unfold the powers and potential of this revealed tree. It is now being cultivated and grown in a number of countries to fully tap its potential and used on a commercial basis. (Aganon, *et al* 2004) [3]. Neem cake is a bio-fertilizer that can be used for organic farms, agriculture, gardens and lawns. Neem cake is obtained from neem seed kernel and consists of natural micro-nutrients with NPK. Neem cake organic fertilizer (manure) is the bye product obtained in the process of neem oil extraction from neem seeds through oil expellers or solvent extraction process. Neem cake organic fertilizer is traditionally being used in India as manure for soil application, since more than 5 decades, especially in southern states like Karnataka, Tamil Nadu and Kerala. Neem cake organic fertilizer contains organic nutrients like Nitrogen, Phosphorous, Potassium, Calcium, Magnesium etc. It is a proven soil conditioner and it is being used directly or in blends with other manure like Urea, farmyard manure etc., for its benefits of organic nutrients, pest repellant properties and its control on soil bound nematodes (Tewari, 1992).According to research calculations, neem cake seems to make soil more fertile due to an ingredient that block soil bacteria from converting nitrogenous compounds into nitrogen gas. It is a nitrification inhibitor and prolongs the availability of nitrogen to both short duration and long duration crops (Puri, 1990).

Neem is recognized today as a natural product which has much to offer in solving global agricultural, environmental and public health problems. Researchers worldwide are now focusing on the importance of neem in the agricultural industry. The magical tree and hundreds of its active compounds are used to manufacture a number of products. Natural properties of neem do not have any toxic reactions, so they are helpful in plant protection and management. All the parts of neem like seed, flowers, bark, and leaf can be used to produce high quality product. Products derived from Neem tree act as powerful Insect Growth Regulators (IGR) and also help in controlling several nematodes and fungi. Neem products reduce insects' growth in crops and plants. Neem products are used as neem insecticide, neem pesticide, neem pest fumigant, neem fertilizer, neem manure, neem compost, neem urea coating agent and neem soil conditioner (Bekeko, 2014) [7]. Neem-based Organic Fertilizer has many advantages among which include: Minimizes the requirement of nitrogen in crop production and hence reduces the cost of fertilizer, Increases crop yield substantially and very cost effective, Increases the efficiency of nitrogenous fertilizer use, and better yield than conventional urea and fertilizer, Protects plant roots from nematodes, soil grubs and improve soil organic content, In comparison to urea which is a nutrient collector, neem cake itself contains nutrient for plants, Can be used with other fertilizer / urea simultaneously, It contains 100% natural NPK content. (Anis Joseph *et al*., 2010)

Table 1: Available Plant Nutrients in Neem fertilizer

Nutrient	**Formula**	**Percentage Composition**
Nitrogen	N	1.5 – 3.0 %
Phosphorus	P	1.0 – 2.0 %
Potassium	K	1.0 – 2.0 %
Calcium	Ca	0.5 – 1.5 %
Magnesium	Mg	0.3 – 1.5 %
Sulphur	S	1.0 – 3.0 %
Zink	Zn	15 – 60 ppm
Copper	Cu	4.0 – 20 ppm
Iron	Fe	500 – 1200 ppm

Manganese	Mn	20 – 60 ppm

***Source*:** www.saosis.com/products/neem**cake**

Aim of the paper

The main aim of this paper is to assess the economics of bio- based organic fertilizer from neem seeds (organic wastes) in improving the yield of crops. Specifically, the objectives include:

1. To gather organic wastes e.g. rice husk, poultry litter etc. to produce organic fertilizer
2. To develop and disseminate technology on organic wastes composting for the production of organic fertilizer and determine the efficacy with which organic fertilizers generates major nutrients for Agricultural productions in Nigeria
3. To analyze the chemical composition of the organic fertilizer

Justification of the study

Improper organic waste disposal poses a major threat to the environment and high risks to human health. Most of these wastes are biodegradable and can be converted into valuable resource that reduces their otherwise negative impacts. The conversion of these waste materials to valuable resources can be observed in the production of organic fertilizer and its subsequent utilization as a source of plant nutrients in intensive small-scale organic-based production and for sustaining soil health and productivity. And also promote proper waste management by the society via organic fertilizer production and demonstrate the feasibility of growing plants using organic fertilizer as the major source of plant nutrients.

Materials and Methods

Table 2: List of Materials used for the research

Materials	**Source**
Neem seeds Neem seeds	Zuru
Rice husk	Technology incubation center (TIC) B/K
Poultry litters	Diggi Village
Bone mill	Technology incubation center

	(TIC) B/K
Blood mill	Technology incubation center (TIC) B/K
Potash	Technology incubation center (TIC) B/K Calcium carbonate (CaCO3) Sokoto Cement, Sokoto
Gum Arabic	Tambuwal

Source: Research Data, 2017.

Table 3: List of Instruments/Equipment used

Instruments	**Source**
Weighing Balance (analogue)	Technology Incubation Center (TIC) B/K
Shovel	Technology Incubation Center (TIC) B/K
Bucket	Technology Incubation Center (TIC) B/K
Hammer mill	Technology Incubation Center (TIC) B/K
Granulator	Danyaro Investments Ltd, Sokoto

Method of Fertilizer Production

30kg of neem seeds, 17kg of rice husk, 13kg of poultry liter, 3kg of blood mill, 6kg of bone mill, 1kg of potash and 30kg of calcium carbonate were accurately measured using analogue weighing balance and homogeneously mixed up together. The homogeneous mixture of the samples were fed in to the Hammer mill for crushing and grinding (milling) in to a fine powder (fertilizer). The fertilizer was taken to the granulator to make into granules and passed in to the dryer for drying. After drying the fertilizer, it was finally packaged in a well- designed bag.

Results

Table 4: Showing the Chemical Analysis

Nutrients	**Symbol**	**Standard**	**Compositions of fertilizer**
Nitrogen	N	1.5-3.0%	0.672%
Phosphorous	P	1.0-2.0%	5.17mg/kg
Potassium	K	1.0-2.0%	11.50mg/kg
Carbon	C	-	3.890%

***Source*:** Research data, 2017.

Discussion

Considering the large volume of wastes generated in the world and the fact that 60% is biodegradable, an information campaign, which included segregation of waste at source, waste classification and waste recycling was intensively carried out through frequent group discussion. Segregated wastes collected from neem tree were brought to the material recovery facility (MRF) and were used as the substrate for organic fertilizer production. The production of organic fertilizer from solid waste (neem seeds) composed of assembly area, composting area, drying area, and storage area. Substrates used as compost materials included the neem seed, lime stone, potash, blood meal, bone meal, chicken manure as microbial activators, and carbonized rice hull as a stabilizer. The nutrients in the fertilizer are Nitrogen (N) 0.672% which is in agreement with saosis work on plant nutrient in neem fertilizer (2005), Phosphorous (P) 5.17mg/kg which is also in agreement with Nenita (2011), *production of organic fertilizer from solid waste and its utilization* and Potassium (K) 11.50mg/kg which is in agreement with the research work of Mustapha *et al* (2012), *the need for organic farming in extension.* The results of table 3.1 is comparatively in agreement with the work of Ayeni *et al* (2012) [5], *comparative effect of organic fertilizer* and IFOAM (1999) *basic standard for production and processing of organic waste and their effects*

Nitrogen (N) is necessary for lush, green, leafy growth. An excess, however, will promote vegetative growth at the expense of fruits or flowers. Nitrogen is generally applied at higher concentrations in

early growth stages. Phosphorous (P) is necessary for big, bright blooms and enhance fruit production. It is essential for fruiting, flowering, strong root growth and quality seed development. Potassium (K) helps produce strong sturdy plant and quality fruits. It's naturally increases a plant resistance to all types of stress and is vital for cell growth and carbohydrate metabolism.

Conclusion/ Recommendations

The study served as an avenue for organic fertilizer production not only for university students but also for outside clients. Converting solid waste into organic fertilizer will not only increase farm and household income but also become a stable source of organic fertilizer for rehabilitating highly nutrient depleted agricultural soils and reduce environmental pollution generated by improper waste disposal. The conversion of solid wastes into a valuable resource such as organic compost or organic fertilizer is a worthwhile strategy for saving the Earth from further degradation generated by improper waste disposal and management. Moreover, the continuous use of organic fertilizer as a source of plant nutrients for agricultural production not only reduces the cost of fertilizer but serves as the ultimate solution for restoring the lost fertility of agricultural soils as well as soil health; this leads to sustained soil productivity. Production of organic fertilizer from solid wastes and its subsequent utilization in crop production and soil rehabilitation.

It is therefore recommended there should be a reduction in the volume of wastes brought to dumpsites, minimize environmental pollution and degradation and increase the productivity of agricultural land. Heavy application of inorganic fertilizers has polluted surface and groundwater resources, therefore, the use of organic based fertilizers which is ecofriendly is recommended. It is recommended that solid waste composting for the production of organic fertilizer should be disseminated to people to solve waste disposal problems through conversion of biodegradable wastes into organic compost; this will ensure the availability of organic fertilizer for crop production.

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