ASSESSMENT OF CASSAVA PEEL AND LOCUST BEAN POD AS SOIL ORGANIC AMENDMENTS AND THEIR EFFECTS ON THE GROWTH AND YIELD OF*Amaranthus hybridus* (Linn.)

BY

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A THESIS SUBMITTED TO THE INSTITUTE OF ECOLOGY AND ENVIRONMENTAL STUDIES IN PARTIAL FUFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN ENVIRONMENTAL CONTROL AND MANAGEMENT OF THE OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA.

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DEDICATION

This thesis is dedicated to my Father Elder J. O. Babalola.

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ABSTRACT

This study evaluatedthe effect of locust bean pod and cassava peel on the growth performance of *Amaranthus hybridus*, determined the response of the plant to the application of the two wastes and assessed the effect of the wastes on soil physical and chemical properties. This was with a view to determining the most efficient agrowaste types for improved crop productivity.

The experiment consisted of four and eight weeks of soil incubation of agro-wastes amendment (locust bean pod and cassava peel wastes) which was conducted at the Laboratory of the Institute of Ecology and Environmental Studies and in a greenhouse at the Faculty of Agriculture, Obafemi Awolowo University (O.A.U.), Ile-Ife. The seeds of *Amaranthus hybridus* were purchased from National Horticultural Research Institute, Ibadan. Bulked top soil of 0-15 cm were collected randomly from a site that had been cropped continuously for five years with a history of poor nutrient status within the University Research farm. The agro-wastes were obtained from a cassava milling industry in Ile-Ife while the locust bean pod were collected from a nearby farm in Saki town of Oyo State and were milled into powder with a cassava grinding machine at the workshop of Agricultural Engineering Department of O.A.U., Ile-Ife. The milled cassava peel waste and locust bean pod were analysed to determine their constituent elements. There were three treatments (100% Cassava peel waste, 100% Locust bean pod and 50% Cassava peel + 50% Locust bean pod) and each treatment was applied at 0, 3, 6, 9 and 12 t/ha and replicated three times. For soil incubation study, each air-dried and sieved 3 kg soil were mixed manually with each treatment level into planting pots. Forty-five pots each were left to incubate for either four weeks oreight weeks. Pre-soil analysis were carried out on the degraded soil using standard methods to determine soil pH, N, P, Na^+, $K,^+$ Ca^{2+} $Mg^{2+}$and percentage organic carbon. Four seeds of *Amaranthus hybridus* were sown into the amended soils after incubation. The crop was irrigated twice in a week and weeds controlled manually. After germination, it was thinned to two stands per pot. Parameters such as plant height, number of leaves, and stem girth were determined at the tenth week after planting. Plant tissue and soil analysis were also carried to determine N, P, Mg^{2+}, Ca^{2+}, K^+ and Na^+ content using standard methods. The data were subjected to appropriate descriptive and inferential statistics.

The results showed that application of eight weeks incubated cassava peel and locust bean pod mixture at 12 ton/ha gave the highest plant height (52.8 cm) of *A. hybridus*. Eight weeks incubated locust bean pod mixed with cassava peel at 12 t/ha improved the stem girth and number of leaves by 6 % and 27 % of *A. hybridus*. Pots with four weeks incubated locust bean pod only and its mixture with cassava peel at 12 t/ha applications increased both the fresh and dry weights of *A. hbridus*by 14 % and 36 % respectively. Potassium, magnesium, phosphorus and Ca of *A hybridus*were all increased across the rates of application of amendments. Application of four weeks incubated locust bean pod at 6, 9 and 12 t/ha enhanced the total N, K, Mg, P and Ca contents of the soil. Available P was higher in pots with four and eight weeks incubated locust bean pod applied at 6 t/ha.

The study concluded that the response of *A. hybridus* to organic wastes application was dependent on the duration of incubation of the waste and the rate of application for improved plant growth and yield.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Soil amendments provide a better environment for root and plant growth, in a number of ways which include: improvement of the soil structure and water holding capacity, availability of the nutrient and the living conditions for soil organism which are important for the plant to grow (Reed, 2007). Soil amendment could consist of organic and or inorganic substances mixed into the soil for achieving better soil performance for plant productivity (Davis and Wilson 2005).

Inorganic amendments are manmade resources that can be used to improve soil performance which needed to purchase and is highly expensive than organic amendments and its used as never been without ecological footprint (Giz, 2010). In addition, the industrial production process of inorganic amendments undergo great deal of energy before it can be produced therefore, these substances do not have the same degree of sustainability like organic amendment. Inorganic amendments are used to increase aeration, increase drainage, decrease excessive water holding capacity of soil (Olayiwola, 2002). Studies have shown that productivity of many tropical soils cannot be maintained by the use of inorganic amendment alone (Beets, 1990, Nanbiar, 1995). Also, the use of inorganic amendments have not been helpful under intensive agriculture because it was often associated with reduced crop yield, soil acidity and nutrients imbalance (Adediran*et al.,* 2003). Heavy application of inorganic amendments can also build up toxic concentrations of salts in the soilOjeniyi, (2004). In addition, the extent to which farmers depend on inorganic amendments is constrained by the unavailability of the right type of inorganic amendment at the right time, lack of technical know-how and lack of access to credit facility.

An organic amendment is any material of plant or animal origin that can be added to the soil to improve its physico-chemical properties (Mbah, 2006). The organic wastes provide a continuous decomposition substrate and consequent gradual input of soil organic matter(SOM), thereby improving the soil physically.

The main purpose of using organic amendment is to loosen the soil and create pores to increase aeration, drainage, usable water holding capacity, nutrient holding capacity, decrease growing medium weight and to feed soil microbes which will eventually serve as nutrient to soil (Anikwe, 2000). Application of organic manure improved the availability of some minerals in the soil, especially the transfer of nutrients from range land to the crop plants (Adebusuyi *et al*., 2002). Reports also show that organic wastesinfluence crop yield and also affect chlorophyll coloration, due to the amount of nutrients absorbed by the plant from the soil (Adeleye *et al.,* 2010).

Agro-wastes are becoming more increasingly important in addressing problem of the soil due to ecological footprint consequences of inorganic amendment (Mbagwu, 2001). Application of organic matter on soil had shown to help crops to withstand drought, increased SOM, nitrogen, pH, phosphorus (P) and cation exchangeable capacity (CEC), and reduced soil acidity (Adeniyan and Ojeniyi, 2003; Mbah, 2006; Ayeni *et al.,* 2008; Alabadan *et al.,* 2009). Furthermore, several agricultural wastes such as; wood and saw dust ash on tomato and pepper (Odedina *et al.,* 2003), bagasse ash on wheat, cocoa pod ash on tomato (Ayeni, 2010), coconut husk and corn cob on growth of *Corcorius olitorius* (Awotoye *et al.,* 2014), sawdust and poultry manure on maize (Oladipo *et al.,* 2010), burnt and unburnt rice husk on maize (Njoku and Mbah, 2012) have been used as amendment to their soils.

Application of organic materials as soil amendment is an important management strategy that can improve and up-lift soil quality characteristics and alter the nutrient cycling through mineralization turnover of added material (Khalil *et al.,* 2005; Campos *et al.,* 2013; Baldi and Toselli, 2014). Use of local organic materials derived either from livestock or plants have been attaining worldwide support for improving the fertility and productivity potential of degraded and nutrient-poor soils (Huang *et al.,* 2004; Tejada and Benitez, 2014).

Cassava processing generates solid and liquid residues including cassava peels and are considered to contribute significantly to environmental pollution and aesthetic nuisance. Most often, cassava peels are commonly found in farm locations and cassava industries after peeling it from the root tubers. These peels are regarded as wastes and are usually discarded and allowed to rot.Cassava peels, like many organic waste materials, are potential source of organic matter and plant nutrients (Akanbi *et al.,* 2007). It has been traditionally managed by direct incorporation into the soil, feeding of livestock or burning. The abundance, as less expensivenature of cassava peels had necessitated a research in its use by composting either solely or in combination for vegetable production. Composting cassava peels eliminate the problem of waste disposal and increase the useful value of the materials (Adediran *et al.,* 2003).

Locust bean is a perennial plant and its availability have been in multipurpose uses. The seeds of locust bean is popularly known as Dawadawa while the Yorubas call it iru. The fruit is sweet and can be consumed directly bypeople (Campbell-Patt, 2000). According to (Alabi*et al.,* 2005) seeds of *Parkia biglobosa* were found to be rich in lipid, protein, carbohydrate, soluble sugars and ascorbic acid, the seeds contain 54% fat and 30% protein in addition to vitamins and minerals such as Calcium, Potassium and Phosphorus. The bark of locust bean tree is boiled to make tea for treatment of wounds and fever (Campbell-Patt, 2000). Crop production in the tropics is largely dependent on the use of inorganic amendments that are scarce and expensive.

The tropical soils are known to be low in organic matter and deficient in Nitrogen (N), Sodium (Na), Potassium (K) Calcium (Ca) and available Phosphorus (P) in most cases (Deckers, 1997). According to Food and Agricultural Organization (2005), low crop yield in