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EFFECT OF COMPOSTED EMPTY OIL PALM FRUIT BUNCHES ON THE GROWTH AND YIELD OF AMARANTHUS AND SOIL PHYSICOCHEMICAL PROPERTIES

P.O. Oviasogie; E. Oko-oboh and E.I. Eguagie

Nigerian Institute for Oil Palm Research (NIFOR) P.M.B 1030 Benin City, Edo State, Nigeria

philipoviasogie5@yahoo.com

ABSTRACT

The effect of composted empty oil palm fruit bunches (EFB) on the growth and yield components of Amaranthus and soil physicochemical properties was evaluated at the Nigerian Institute for Oil Palm Research (NIFOR) main station. The composted EFB was applied at four different rates of 0, 10, 20, and 30 tons/ha. The experiment was replicated four times and arranged in a randomized complete block design (RCBD). Records of the vegetative growth and yield of Amaranthus were taken weekly until the termination of the experiment at four weeks after transplanting. The results showed that amaranthus responded at varying rates to composted EFB after application. However, application rate of 20 tons/ha gave the highest mean plant height of 28.54 cm, leaf number of 17.84, number of branches 8.48 and fresh weight of 5.76 tons/ha respectively. The different rates of compost treatment showed no significant difference in soil chemical properties at soil depths of 0-15 cm and 15-30 cm at ≥ *0.05P*

INTRODUCTION

The high cost of chemical fertilizers and the associated harmful effects on fruits and vegetable crops have renewed interest in use of organic materials as nutrient sources for the cultivation of crops such as tomato, spinach, okra, pulses and rice. The use of easily available and cheap agro industrial wastes by farmers in both urban and rural areas ensures sustainability of production, a more balance crop nutrition and mitigation or reduction in environmental impacts (Aisha, 2012). Organic fertilizers mainly come from crop residues and animal by-products like meat, bone meal, blood meal, fecal materials etc. They contain specifically high level of nutrients (e.g. N, P K) they have high organic matter content and a variety of micronutrients. As such they have widely been used as fertilizer.

The oil palm (Elaeis guineensis Jacq) plantations and processing industries generate significant amount of biomass. The extraction of crude palm oil and kernel from fresh fruit bunches (FFB) is carried out in palm oil mills. For every tonne of FFB processed, substantial amounts of mesocarp fiber, kernel shell, empty fruit bunches and liquid palm oil mill effluents are simultaneously produced. The empty fruit bunches represent about 22% and the highest amount of solid residue generated at post harvest of the oil palm (Aisha, 2012). They are the most bulky and difficult to handle compared to the fiber and shell, composting has been reported to be one of the alternative way to reduce the large biomass generated in the oil palm mill (Baharuddin et al 2009).

Furthermore, EFB (Empty Fruit Bunches) is a suitable material for recycling because it is produced in large quantities in localized areas (plantations). In the past, it was often used as fuel to generate steam at mills (Ma et al., 1993). Burning is now prohibited in several countries by regulations to prevent air pollution. The ash, with a potassium content of about 30% (Lim, 2000) was used as fertilizer. The EFB is now mainly used as mulch (Hamadan *et al.*, 1998), placed around young palms to release nutrients slowly, prevent erosion and maintain soil moisture.

However, due to labour shortages in oil palm plantations, the transportation and distribution of EFB in the field is getting expensive. There is presently a growing interest on composting EFB in order to add value and also to reduce the volume to make application easier (Aisueni and Omoti, 2000).

The importance of amaranthus (*Amaranthus caudatus*) in human and animal nutrition, diversifying the food basket, industrial use as ink and suitability for the tropics as a potential food crop has been reported in literature (Ojo and Obigbesan, 1999). The use of some organic manures in the cultivation of amaranthus has equally been reported in literature. However, the use of composted EFB in crop production especially in vegetable production has not received significant research attention, although the compost possesses the potential for improved crop yield.

In the present study, the effects of composted EFB on the growth of amaranthus and selected soil physicochemical properties were investigated.

MATERIALS AND METHODS

The experiment was conducted on the field at the Nigerian Institute for Oil Palm Research (NIFOR) Benin City, Nigeria.

A nursery bed of 2m x 2m was made and amaranthus seeds were raised for two weeks before being transplanted into the experimental plots measuring 1m x 1m with 0.5m inter rows. Composite soil samples were collected using stainless auger from 0-15cm and 15-30cm depth prior to treatment application and after the termination of the experiment. The soil samples collected were air dried at room temperature and sieved through a 2 mm sieve. The resulting soil samples were analyzed for their physical and chemical properties as follows: Particle size was determined by hydrometer method. Available Phosphorous (P) was determined by Bray P-I method. Total Nitrogen (N) was determined by macro-kjedhal method. Soil pH was determined in a 1:2 soil to water suspension using a pH meter. Exchangeable bases were extracted using NH_40AC buffered at pH 7.0. While Potassium (K) and Sodium (Na) were read from a flame photometer, Exchangeable Calcium (Ca) and Magnesium (Mg) were determined using atomic absorption spectrophotometer. Total Exchangeable acidity ($H^+ + Al^{3+}$) was by titration method while effective cations exchange capacity was determined by summation of exchangeable cations and exchangeable acidity.

Composted EFB obtained from the compost yard at NIFOR was characterized for its physicochemical properties using standard methods. This was applied to the soil by broadcast two weeks before transplanting. The transplanting was done at a spacing of 0.25 m x 0.25 m with a total of 16 plots per experimental unit. Application rates of 0, 10 kg, 20 kg and 30 kg per experimental unit which is equivalent to 0, 10, 20 and 30 t/ha were used. The experiment was laid out in a randomized complete block design (RCBD) and replicated four times. Biometric observations namely plant height, leaf numbers and numbers of branches were taken from 2 weeks after planting (WAP). Data obtained were analysed statistically using ANOVA. The means were separated using LSD at 5% probability level.

RESULTS AND DISCUSSION

Amaranthus responded to composted EFB application. The growth and yield responses varied with different application rates. In terms of plant height, application rates of 0 - 30 t/ha gave a mean plant height of between 21.69 cm - 28.54 cm, with the highest value of 28.54 cm recorded at 20 t/ha; 21.69 cm was recorded at zero application or control plot. This low value may be due to no application of treatment. Value of economically important component such as number of leaves, ranged from 14.83/plant - 17.84/plant, the highest value of 17.84/plant was also recorded at 20t/ha. Similar trend was also observed when the number of branches was considered. The 20 t/ha gave the highest mean number of branches of 8.48 as against 5.82 for the control. Application rate of 20 t/ha gave the highest herbage of 5.76 t/ha as against 2.240 t/ha of control. This is in agreement with Tsai (1989) who reported the recommended rate of 15-20 t/ha compost for leafy and fruiting vegetable. Anon (1989), also suggested that Okro would benefit more from the application of between 20 - 25 t/ha of farm yard manure worked into the soil at land preparation. The effects of composted EFB on the growth parameter are as presented in table 3. Though statistically, there was no significant effect of composted EFB on soil physicochemical properties at the termination of the experiment, this could be as result of the short time and slow release pattern of organic manure. Table 4

CONCLUSION

Application rate of 20 t/ha gave the highest value of plant height, number of leaves and branches. In addition, composted EFB contains organic matter and nutrients which are available for improving the soils nutrient supply for the crop and thereby increasing crop yield. Considering the growth and expansion in the Nigeria oil palm industries, utilizing the empty bunches and other wastes that will be generated for compost making and application of same for Amaranthus production could be a good means of disposing the waste product which would otherwise pose an environmental hazard.

Table 1: Physicochemical properties of compost

Parameters	Values
pH (H_2O)	6.8
Electrical conductivity	0.35 ds/m
Nitrogen	2.01 %
Phosphorus	0.910 %
Potassium	0.703 %
Magnesium	0.311 %
Calcium	1.838 %
Sodium	0.039 %
Organic matter	21 %

Table 2: Physicochemical properties of soils prior treatment application

Soil depth cm	pH	P (mg/kg)	Na	K	Mg
			Cmol/100g		
0-15	5.406	27.63	0.0863	0.1581	0.963
15-30	5.506	22.025	0.0800	0.1263	0.75
LSD	0.1254	8.48	0.0181	0.3624	0.3248

Table 3: Means of the Plant Biometric Observation

EFB	Plant height	No of leaves	No branches
0	21.69	14.83	5.82
10 kg	26.08	16.12	7.20
20 kg	28.54	17.84	8.48
30 kg	28.45	15.82	7.51
LSD	4.969	1.469	2.041

Table 4: Physicochemical Properties of Soils at the Termination of the Experiment

EFB	pH	P (mg/kg)	Na	K	Mg
			Cmol/100g		
0	5.252	24.3	0.0775	0.1463	0.840
10 kg	5.313	26.7	0,0875	0.1400	0.755
20 kg	5.488	21.25	0.0788	0.1088	0.820
30 kg	5.500	27.1	0.0888	0.1738	0.940
LSD	0.1774	11.99	0.01811	0.5125	0.4593

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