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Research Article
Effect of Palm Oil Wastes Soil on Growth and Phytochemical Constituents of *Amaranthus hybridus*

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Abstract

Background and Objective: Palm oil wastes generated manually and mechanically pose a serious environmental problem in Nigeria. Most of these wastes are indiscriminately discarded into the environment with little or no treatment. This practice is an environmental concern which needs to be addressed. Alternative economic disposal methods are necessary and one potential method is to test for the effects of these wastes plants. This paper describes a study in which palm oil wastes soil was assessed for its effects on the growth and phytochemical constituents of *Amaranthus hybridus*. **Materials and Methods:** Soil samples polluted with palm oil wastes was collected in polythene bags from a palm oil wastes dumpsites at Ogodo, Ankpa local government area of Kogi state, Nigeria at a distance of 2, 4, 6 and 8 m away from the palm oil waste dumpsite which has been in existences for over 30 years. Thereafter, the soil samples were taken to Biological Sciences Department garden, Kogi state University Anyigba, Nigeria. Ten seeds of *Amaranthus hybridus* were sown in each of the soil samples. The control soil was without palm oil wastes. **Results:** Vegetative analysis of the *Amaranthus hybridus* plants after 2, 4 and 6 weeks of planting revealed significant increase ($p<0.05$) in plant height, leaf area, stem girth and number of leaf in the plants grown in palm oil wastes soil when compared to control soil. The highest growth performance was at 6 m while the lowest was at control. Phytochemical analysis of the *Amaranthus hybridus* plants after 2, 4 and 6 weeks of planting revealed significant increase ($p<0.05$) in the phytochemical constituents at 4, 6 and 8 m and a decrease at 2 m when compared to the control soil. The highest phytochemical constituents occurred at 6 m for tannin saponins and phytate while that of oxalate and flavonoid occurred at 8 m, respectively. Except for phenol, the lowest phytochemical constituents occurred at 2 m. **Conclusion:** The study therefore concludes that palm oil wastes soil increases the growth and phytochemical constituents of Amaranthus hybridus.

Key words: Palm oil wastes, *Amaranthus hybridus*, phytochemical, growth

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Palm oil is an edible plant oil derived from the pulp of the fruit of the oil palm *Elaeis guineensis*[1]. Globally, more than one-third of vegetable oil production is achieved by the processing of oil palm fruit together with other wastes including palm oil mill effluent (POME), empty fruit bunches (EFB), palm pressed fibre (PPF) as well as palm kernel shell (PKS)[2]. In addition to it, disposal of these wastes without any proper treatment causes harmful impacts to the environment[3].

In palm oil producing countries, many researches were conducted on composting of empty fruit bunches, fiber and palm oil mills effluents, which contain appreciable amounts of plant nutrients[4]. Huge amount of organic wastes such as palm oil wastes are generated as by product of palm oil and heaped on dump sites, posing potential environmental hazard[5]. It can simply no longer afford to dispose the residues when there is an economically useful alternative. Incorporating these wastes materials into the soil for crop production is expected to be beneficial to the buildup of organic matter layer that is needed for a steady supply of nutrients by tropical soils[6]. Hence there is an urgent need for a sustainable waste management system to tackle this wastes. This study investigated the effect of palm oil wastes soil on growth and phytochemical constituents of *Amaranthus hybridus.*

MATERIALS AND METHODS

Description of study area: The study was conducted between March-April, 2018 at the Biological Sciences Department, Kogi state University Anyigba, Nigeria. The site is located on 7°151N-7°291N and 7°111E-7°321E. The site is known with a suitable atmospheric condition having an annual mean rainfall and temperature of 1250 mm and 25°C, respectively. The vegetation is typical of derived Savanna with a sandy soil[7].

Collection of samples: The soil samples were collected from a palm oil wastes dumpsite in Ogodo Ankpa local government area of Kogi state, Nigeria. Seeds of *Amaranthus Hybridus* were obtained from Faculty of Agriculture farm, Kogi state University Anyigba, Nigeria.

Sample preparation: The methodology used in this present study is authors own methodology and is different from other existing literatures[8-10], where soil samples were treated/polluted with palm oil mill effluent and emphasis was laid majorly on palm oil mill effluent. In this study there is a modification in the use of palm oil wastes. This study comprises of all palm oil wastes such as palm oil mill effluent (POME), palm kernel cake (PKC), decanter cake, empty fruit bunches (EFB) and palm kernel shell (PKS). The soil samples used in this study was taken directly from an already contaminated palm oil wastes dumpsite that have been in existence for over 20 years. About 10 kg of soil sample was collected from a palm oil wastes dumpsite in Ogodo, Ankpa Local Government Area of Kogi state, Nigeria at a distance of 2, 4, 6 and 8 m away from the palm oil wastes dumpsite. The control sample without any trace of palm oil wastes was taken at a distance of 1 km away from the palm oil wastes dumpsite. Each sample was replicated three times making a total number of 15 replicates. The soil samples were taken to the biological science garden, Kogi state University, Anyigba, Nigeria. Thereafter, ten seeds of *Amaranthus hybridus* were sown in each of the prepared soil samples, respectively. The number of seedlings were thinned to 4 per pots, 2 weeks after germination.

Growth parameters

Plant height: The height of a plant was measured with meter rule every 2 weeks. This was recorded for all the treatments. The mean height was determined for all measurement.

Number of leaves: A plant was randomly selected for all plant and the numbers of leaves per this plant were counted every 2 weeks and the average number of leaves was calculated for each plant per treatment.

Leaf area: One plant was selected for each of the treatments. The length and breadth of the leaves of the selected plant were taken with the aid of thread which was later transferred on the meter rule and the average length and breadth was calculated for each plant per treatment. The leaf area of the *Amaranthus hybridus* was determined by the formula below:

$$LA = 0.75 \times L \times B$$

Where:

L = Leaf length
B = Leaf breadth
0.75 = Correction factor

Stem girth: This was measured using a thread which was later transferred to a meter rule to get the readings.

Quantitative phytochemical analysis: The leaves of *Amaranthus hybridus* were harvested at the end of the experiment. The wet leaves were macerated with the aid of a pestle and mortar and kept in samples bottles for analysis. The phytochemical content (saponin, tannin, oxalate, phytate, flavonoid and phenol) in each sample was determined using standard methods[11], at Biochemistry Department Laboratory, Kogi state University Anyigba, Nigeria.

Data analysis: Results were expressed as mean±standard deviation (SD). The data obtained were analyzed using analysis of variance (One Way ANOVA) (SPSS program, version 20 SPSS Inc., Chicago, IL, USA for windows Computer Software Package). The difference between the experimental groups were compared using the Duncan Multiple Range test. Values of $p<0.05$ were taken as significant.

RESULTS

Growth parameters (2 weeks after planting): The result of the growth parameter after 2 weeks of planting is presented in Table 1. The result shows that there was significant ($p>0.05$) difference in plant height, number of leaf, stem girth and leaf area in all the concentrations. The highest growth parameters occurred at 6 m while the lowest growth parameters occurred at control. All the results obtained in the palm oil wastes polluted soils are higher than that of the control.

Growth parameters (4 weeks after planting): The result of the growth parameter after 4 weeks of planting is presented in Table 2. The result shows that there was significant ($p>0.05$) difference for plant height, number of leaf, stem girth and leaf area in all the concentrations. The highest growth parameters occurred at 6 m while the lowest growth parameters occurred at the control. All the results obtained in the palm oil wastes polluted soils are higher than that of the control.

Growth parameters (6 weeks after planting): The result of the growth parameter after 6 weeks of planting is presented in Table 3. The result shows that there was significant ($p>0.05$) difference for plant height, number of leaf, stem girth and leaf area in all the concentrations. The highest growth parameters occurred at 6 m while the lowest growth parameters occurred at control. All the results obtained in the palm oil wastes polluted soils are higher than that of the control.

Phytochemical constituent (Mg/100 g): The result of phytochemical constituents for palm oil wastes soil planted with Amaranthus hybridus at different concentrations is presented in Table 4. The result shows that there was a significant ($p<0.05$) difference in the phytochemical constituents of *Amaranthus hybridus* planted with palm oil wastes soil when compared with the control soil. The highest

Table 1: Results of 2 weeks after planting (2 WAP)

Treatments	Plant height	Number of leaf	Stem girth	Leaf area
Control	8.17±0.75^{e}	5.00±0.00^{c}	11.13±0.70^{e}	1.13±0.55^{d}
2 m	13.40±0.46^{c}	6.67±0.58^{b}	29.57±0.65^{c}	4.33±1.26^{c}
4 m	15.77±0.65^{b}	7.33±0.58^{b}	34.80±0.85^{b}	9.63±1.42^{b}
6 m	20.47±0.75^{a}	8.33±0.58^{a}	42.17±1.76^{a}	14.70±2.29^{a}
8 m	10.97±0.40^{d}	5.67±0.58^{c}	24.57±0.51^{d}	1.80±0.61^{d}

Values with different letters on the same column are not statistically the same at $p\leq0.05$

Table 2: Results of 4 weeks after planting (4 WAP)

Treatments	Plant height	Number of leaf	Stem girth	Leaf area
Control	9.20±0.52^{e}	8.00±1.00^{c}	14.40±1.10^{e}	3.90±0.46^{e}
2 m	16.97±0.61^{c}	10.67±0.58^{ab}	40.00±0.92^{c}	13.57±1.76^{c}
4 m	20.00±1.46^{b}	11.33±0.58^{ab}	44.70±0.58^{b}	19.00±2.22^{b}
6 m	28.27±1.00^{a}	12.00±1.00^{a}	51.33±2.00^{a}	26.47±3.21^{a}
8 m	14.70±0.60^{d}	10.33±0.58^{b}	31.90±1.00^{d}	9.71±1.62^{d}

Values with different letters on the same column are not statistically the same at $p\leq0.05$

Table 3: Results of 6 weeks after planting (6 WAP)

Treatments	Plant height	Number of leaf	Stem girth	Leaf area
Control	10.93±0.80^{e}	9.33±0.58^{e}	19.83±2.11^{e}	10.77±0.01^{e}
2 m	17.10±1.34^{d}	11.12±0.58^{d}	37.30±1.35^{d}	16.00±0.50^{d}
4 m	20.53±1.00^{c}	12.10±0.01^{c}	41.63±1.22^{c}	22.27±0.50^{c}
6 m	33.63±0.80^{a}	15.00±1.00^{a}	55.20±2.65^{a}	37.00±0.67^{a}
8 m	27.10±1.41^{b}	13.73±0.58^{b}	47.70±1.65^{b}	28.50±0.01^{b}

Values with different letters on the same column are not statistically the same at $p\leq0.05$

Table 4: Result of phytochemical constituents for *Amaranthus hybridus* at different concentrations

Parameters	Tannin	Saponin	Phytate	Oxalate	Flavonoid	Phenolic
Control	0.26±0.00^{c}	0.89±0.00^{d}	6.62±0.07^{b}	1.86±0.01^{a}	0.99±0.00^{b}	0.17±0.11^{e}
2 m	0.24±0.00^{d}	0.88±0.00^{e}	6.39±0.01^{d}	1.35±0.01^{d}	0.84±0.00^{c}	0.94±0.01^{b}
4 m	0.33±0.00^{b}	0.92±0.00^{c}	6.49±0.02^{c}	1.55±0.01^{c}	0.95±0.00^{b}	0.82±0.00^{d}
6 m	0.39±0.00^{a}	0.97±0.00^{a}	6.80±0.10^{a}	1.57±0.01^{b}	0.97±0.03^{b}	0.96±0.00^{a}
8 m	0.39±0.06^{a}	0.94±0.00^{b}	6.66±0.01^{b}	1.87±0.01^{a}	1.05±0.04^{a}	0.85±0.00^{c}

Values with different letters on the same column are not statistically the same at $p \leq 0.05$

tannin, saponins, phytate and phenolic constituents occurred at 6 m, while the highest oxalate and flavonoid constituents occurred at 8 m. Apart from phenolic constituents, the lowest phytochemical constituents occurred at 2 m.

DISCUSSION

From the result of the study carried out on the effect of palm oil wastes soil on the growth and phytochemical constituents of *Amaranthus hybridus* it was discovered that palm oil wastes soil increased the growth parameters (plant height, number of leaves, stem girth and leaf area) and phytochemical constituents (tannin, saponins, oxalate, phytate, phenols and flavonoid) of *Amaranthus hybridus*. High concentration of palm oil wastes soil (2 m) inhibits the growth of *Amaranthus hybridus* but increases its phytochemical constituents. The best palm oil wastes soil for optimum growth of *Amaranthus hybridus* is at 6 m. The result of the growth parameters in this study is similar to that of Okon and Elijah[8], where the addition of compost manure supplement (fermented oil palm spikelet) to contaminated palm oil mill effluent soil promotes growth parameters of *Amaranthus hybridus* but is different from that of Osubor and Oikeh[12], where palm oil mill effluents decreased the vegetative parameters of *Zea mays*.

Apart from this study, none of the authors mentioned above worked on the phytochemical constituents of *Amaranthus hybridus* grown on palm oil wastes soil. The oxalate values obtained in this study are similar to the report of Gupta *et al*.[13] in fresh leaves of *Amaranthus tricolor*. The tannin results in this study is similar to the report of Ogbadoyi *et al*.[14] in *Amaranthus cruetnus*. These flavonoid values are relatively lower compared to those reported by Olajire and Azeez[15] on the total anti-oxidant activity, phenolic, flavonoid and ascorbic acid contents of Nigerian vegetables. *Amaranthus hybridus* has been reported to have a high concentration of anti-oxidant components[16] and have anti-inflammatory properties[17]. According to Habiba[18], Uusiku *et al*.[19] and Embaby[20,21] cooking/heat processes decreases these phytochemical constituents to a substantial extent. Proper planning and utilization of cost effective methods are some of the ways of ridding the palm oil mills of the large quantities of solid and liquid wastes produced. Users should also be educated on the right quantity of palm oil wastes soil on plant. This planting process has the potential to address the environmental health concerns arising from the current way of dealing with palm oil wastes reduce the use of chemical fertilizers as palm oil wastes soil has shown to have high nutrient contents. This in the long run will be a cheap and eco-friendly means to ensuring a sustainable future for agriculture.

CONCLUSION

The present study shows that palm oil wastes soil enhances the growth of *Amaranthus hybridus*. Thus the optimum rate of palm oil wastes soil that provide *Amaranthus hybridus* with better growth performance is at 6 m. Palm oil wastes soil increases the phytochemical constituents of *Amaranthus hybridus*.

SIGNIFICANCE STATEMENT

This study discovered the optimum rate of palm oil wastes soil that could be beneficial for the better growth of *Amaranthus hybridus* and its phytochemical constituents. This study will help the researchers to uncover the critical areas of agricultural waste management and food security that many researchers were not able to explore. Thus a new theory on agriculture sustain ability, waste management and conservation may be arrived at.

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