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Original Article

Effects of Nutrient Amendments of Spent Engine Oil Polluted Soil on Some Growth Parameters of *Abelmoschus esculentus* (L.) Moench. in South-South Nigeria.

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ABSTRACT

The study investigated the effect of nutrient amendments of spent engine oil polluted soil on some growth parameter of okra (Abelmoschus esculentus). Two sets of soil samples were polluted spent engine oil and set one were amended separately with different grammes of poultry waste. Soil samples were also polluted with spent engine without amendment to achieve 60, 100, 160 and 250 mL pollution. Samples were analyzed at eight weeks after planting. The plant growth parameters were affected adversely by the spent engine oil pollution and the higher the level of pollution, the more the effect. The nutrient amendments were able to remedy the effect of the spent engine oil pollution. The remediation effect was nutrient weight dependent and the best remediation effect was observed in poultry waste amended samples. This study has shown that spent engine oil contaminated soil may have adverse effect on plants growth, but this can be remedied by addition of organic nutrient supplements especially poultry waste.

Keywords: *Abelmoschus esculentus, nutrient amendments, spent engine oil.*

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INTRODUCTION

Various petroleum products are common soil contaminants and often contain potentially hazardous chemicals, particularly the polycyclic aromatic hydrocarbons [7]. The accumulations of polycyclic aromatic hydrocarbons (PAHs) in soil are due to many anthropogenic sources such as coking plants, solid fuel domestic heating, aircraft exhaust, car exhausts and forest fires [17]. Amongst petroleum pollutants spent oil contains heavy metals and polycyclic aromatic hydrocarbons and chemical additives including amines, phenols, benzenes [10]. The spent lubricant, otherwise called waste engine oil, is usually obtained after servicing and subsequent draining from automobile and generator engines. Pollution from spent engine oil is one of the environmental problems and is more widespread than crude oil pollution [12]. The concentration of PAHs in lubricating oil increases with time of usage and those with two and three rings accumulate rapidly in used lubricating oil to very high levels [21]. Phytoremediation or bioremediation is an innovative technology that uses plants or animal wastes to remove environmental contaminants such as heavy metals and organic compounds. Utilizing plants or animal waste to absorb, accumulate and detoxify contaminants in the growth substrate through physical, chemical or biological processes is a wide spread practice [23]. This technology has been applied to both organic and inorganic pollutants present in soil (solid substrate), water (liquid substrate) or the air (gas substrate) as reported by Ghosh and Singh [6].

Okra, *Abelmoschus esculentus* (L.) Moench, belongs to Malvacea family, is a widely cultivated vegetable crop and very important in the diet of Africans [15]. It is a valuable crop that provides an excellent income and generates other opportunities for small-scale farmers [16]. Indeed, it is one of the important nutritional vegetable crops cultivated in Nigeria, covering an estimated land area of 1-2 million hectares. Okra grows in all types of soils and thrives best in a moist, friable, well-drained soil. The plant is tolerant to drought stress [9]; however, supplementary irrigation may be necessary during extended drought periods for a satisfactory production [14]. In Nigeria, the widely cultivated

okra is distributed and consumed either fresh (usually boiled, sliced or fried) or in a dried form [5]. The approximate nutrient content of the edible okra pod is as follows: water, 88%; protein, 2.1%; fat, 0.2%; carbohydrate, 8.0%; fibre, 1.7% and ash, 0.2% [19]. There is the need to find out a remediation method to counter the effects of some of the petroleum products on plants. This study therefore evaluates the effects of spent engine oil on the growth performance of okra and remediation effect of organic (poultry droppings) nutrient supplements.

MATERIALS AND METHODS

Collection of Seeds

Matured dry fruits of *Abelmoschus esculentus* (early fruiting variety) were obtained from Akwa Ibom State Agricultural Development Project (AKADEP) and the viable seeds were used for the study. The soil sample used in this study was obtained from the Botany Department Postgraduate Research Farm, University of Uyo, Uyo. The organic supplements used in this study was poultry droppings, obtained from Akwa Ibom State Agricultural Development Project (AKADEP), Uyo Zone, Uyo Local Government Area of Akwa Ibom State.

Pollution of Soil Samples

Four kilogrammes (4kg) of sterilised loamy soil were weighed using a Mettler (P-165) weighing balance into perforated polythene bags of 38 cm in width and 40 cm in length to enhance drainage. Each soil sample was thoroughly mixed with 2, 4, 6 and 8% of used engine oil and incubated for three days. The unpolluted soil sample served as a control for each treatment according to the methods of Amadi *et al.* [3].

Bioremediation Treatment

Organic supplements made up of chicken droppings at the ratio of 1:1 were added to the polluted soils (2, 4, 6 and 8% at the rate of 10, 20, 30 and 40 grammes). The mixture of used engine oil, loamy soil and organic supplements were left undisturbed for three days to facilitate loosening of the oil constituents [3, 6].

Pre-germination Studies/Determination of Growth Parameters

Five viable dry seeds of *Abelmoschus esculentus* were sown directly into perforated polythene bags filled with sterile sandy loam soil at the depth of 5cm. The experiment was conducted in the field. The growth parameters such as plant height (shoot length), petiole length, leaf width and leaf length, internode number, percentage germination and roots length were determined.

Determination of Leaf Area

Leaf area (LA) was determined by multiplying leaf length by leaf width with the correction co-efficient (r) which is 0.72 as proposed by Hoyt and Brafield [20]. Leaf Area was calculated thus: LA = L X W X r.

Statistical Analysis

Results are expressed as mean ± Standard Deviation (S.D.) of three replicates. Statistical significance between the different groups was determined by two-way Analysis of Variance (ANOVA) $P<0.05$ was considered as statistically significant.

RESULTS

The results obtained revealed that 100% germination was recorded in amended soil (Table 2) while unamended soil at 2, 4, 6 and 8% recorded 86.6$\pm$9.4, 83.3$\pm$11.7, 83.3$\pm$11.7 and 93.3$\pm$9.4 respectively (Table 3). The data showed that there was significant ($P<0.05$) reduction in shoot height, petiole length, internodes length, leaf area, number of node, moisture content and root length on okra sown on polluted soil when compared with the control (Table 1). Similarly, growth parameters were improved in polluted soil amended with poultry dropping (Table 2).

The yield results of okra fruit shown in Table 1 and 2 revealed that there was a significant difference between treatments. In polluted soil no yield was recorded when compared with the control (Table 1). The highest fruit yield was recorded in amended soil at 60 ml of used engine oil was 2.6$\pm$0.8 followed by 100 ml (2.4$\pm$0.4), 160 ml with 2.4$\pm$0.4 and the least value was recorded in 250 ml (1.4$\pm$0.4) when compared with the control groups (Table 2).

Table 1: Effect of used engine oil pollution of soil on the growth parameters of *Abelmoschus esculentus* seeds at 8 weeks of planting.

Conc. (%)	Shoot height	Petiole length	Internode length	Root length	Leaf Area	Number of fruit	Number of node	Moisture content	% germination
0	61.5±2.5	12.5±1.1	7.2±1.0	29.4±0.6	167.3±53.3	2.6±0.7	10.2±4.8	70.7±1.8	100±0.00
2	19.2±2.4	8.2±0.9	1.5±0.1	11.8±0.7	34.5±57.1	0.00±0.00	8.2±1.7	59.0±2.1	86.6±9.4
4	11.5±1.4	1.4±0.2	2.0±0.7	8.5±0.4	14.4±10.6	0.00±0.00	3.8±1.4	53.0±0.05	83.3±11.7
6	8.8±0.5	0.9±0.08	1.2±0.1	6.8±1.2	2.0±0.3	0.00±0.00	3.6±1.6	47.6±0.1	83.3±11.7
8	5.4±0.5	0.00±0.00	0.7±0.08	5.2±0.05	0.00±0.00	0.00±0.00	2.3±0.4	42.8±1.2	93.3±9.4

Data were processed and expressed as mean ± SD of three replicates.

Table 2: Effect of used engine oil pollution of soil and amelioration treatment on the growth parameters of *Abelmoschus esculentus* seeds at 8 weeks of planting.

Conc. (ml)	Shoot height	Petiole length	Internode length	Root length	Leaf Area	Number of fruit	Number of node	Moisture content	% germination
0	63.6±1.9	24.3±2.7	7.8±0.4	32.0±1.0	182.2±22.9	3.0±0.8	15.4±1.9	71.3±2.81	100 ± 0.00
2	40.3±4.8	11.0±1.7	6.6±0.4	24.7±8.9	121.6±1.86	2.6±0.8	12.5±1.8	65.0±3.41	100 ± 0.00
4	31.4±1.0	8.6±0.4	3.9±0.6	19.2±1.0	104.8±8.60	2.4±0.4	7.4±0.8	63.8±1.21	100 ± 0.00
6	25.9±0.8	7.3±0.4	3.8±0.7	11.8±0.3	94.1±7.82	2.4±0.4	6.0±0.8	62.4±0.05	100 ± 0.00
8	17.6±0.5	6.3±0.5	2.9±0.1	9.2±0.3	57.7±2.7	1.4±0.4	5.6±0.4	59.5±0.00	100 ± 0.00

Data were processed and expressed as mean ± SD of three replicates.

DISCUSSION

Spent engine oil like the other petroleum products adversely affects the growth and performance of plants as indicated in the results. The effect of the spent engine oil on the plant height observed here were similar to those reported on the effect of spent oil on *Amaranthus hybridus* [12]. Njoku *et al*. [11] also found similar findings on the effect of crude oil the growth of accessions of *Glycine max* and *Lycopersicon esculentum*. Adedokun and Ataga [1] also showed that treatment of soils with crude oil, automotive gasoline oil and spent engine oil significantly affected the time of germination, percentage germination, plant height, leaf production and biomass of *V. unguiculata* delaying germination and growth rate. Okon *et al*. [13] also reported that at high concentrations show adverse effect on tubers production of *Manihot esculenta* but organic supplements were found to reduce the toxic effects of crude oil. The present studies showed similar results. Sun *et al*. [18] made similar observation when they studied the effect of diesel fuel on the growth of *Nerlum oleander*, beach naupaka, false sandalwood, common ironwood, kou, milo and kiawe. The effect on leaf area diesel pollution of soil indicates that the diesel oil interrupts with the growth of the plant. In this studies leaf area was greatly affected by spent engine oil than the bioremediated soil. According to Kathirvelan and Kalaiselvan [8] the leaf surface area determines in large part the amount of carbon gained through photosynthesis and the amount of water lost through transpiration and ultimately the crop yield. Therefore the reduction of the leaf area as was observed in this study implies that there would be low a photosynthetic efficiency of the plant as much of the solar energy emitted by sun would not be absorbed by plant for photosynthesis. This can lead to low yield of the plant with subsequent low availability of food and poor economy due to low sales of such plant's products. Walker *et al*. [22], availability of nitrogen in the soil directly affects the relative growth rate of plants. Since petroleum-products are known to reduce nitrogen availability [2], that could be the cause of adverse effect on the plant growth parameters with decrease in the percentage concentration of the spent engine oil pollution. Dimitrow and Markow [4] showed that the presence of oil in the soil significantly decreased the available forms of phosphorus and potassium to plants. These nutrients (nitrogen, phosphorus, potassium and oxygen) are essential to plant growth and development hence reduction in their bioavailability will lead to reduced plant growth. Organic amendment had clear influence on some agronomic traits of the okra. It is worthy to note that the okra yielded large fruits in amended soil and other growth parameters were improved.

CONCLUSION

From the study, it can be concluded that spent engine oil contaminated soil may result in low soil fertility. But this can be remedied by the addition of organic nutrient supplements especially poultry waste and the quantity supplement added has significant effect on the remediation process. Moreover, it can be deduced from this research work that plants can perform relatively better in

spent engine oil polluted agricultural soil if such soil is amended with reasonable quantity of animal waste especially poultry waste while the autochthonous microbiota naturally attenuates the petroleum hydrocarbon. Based on the findings from these studies, the toxicity of spent engine oil in our environment should be checked with all seriousness and *Abelmoschus esculentus* should not be planted on polluted soil without nutrient amendment.

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