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TOLERANCE OF *Abelmoschus* esculentus (L. Moench) TO DIESEL OIL POLLUTED SOIL

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ABSTRACT

The effect of diesel oil polluted soil on the growth and yield of *Abelmoschus esculentus* L. Moench was studied at the Department of Botany experimental garden, University of Uyo, Nigeria for sixteen weeks. The pollution levels of 40, 80 120, 160 and 200ml per 4kg of sandy loam soil were used, and 0ml (unpolluted soil) was used as control. Three (3) plants were maintained per poly bag, and each level of treatment was replicated three times using randomized complete block design. Significant ($P < 0.05$) reductions were obtained in plant height, leaf area, root length, fresh weight, dry weight, moisture content, fruit number and fruit weight of the crops in diesel oil polluted soil. No yield was recorded at 120 and 160ml level of diesel oil pollution, while 200ml concentration did not support any growth of the crop. All treatment levels gave significant ($P<0.05$) decrease in nutrient elements in leaves of *A. esculentus* below that of the control, except at 40ml of diesel oil for calcium and sodium contents. Therefore, *Abelmoschus esculentus* is not a suitable species for cultivation where diesel oil pollution occurs.
Key word: - Tolerance, diesel oil, polluted soil, *Abelmoschus esculentus*.

INTRODUCTION

Abelmoschus esculentus belongs to the family Malvaceae. It is widely cultivated in the tropics mainly for its fruit which is used as a vegetable in both green and dried state (Komolaje *et al*., 1981). It is cultivated widely in Nigeria, most especially in the southern part (Messiaen, 1989), where intensive oil exploration activity is going on with its attendant environmental pollution (Udosen 1991; NEST, 1991; Amadi *et al*., 1992, Moeller *et al*., 2008). The increase in production, refining and transportation of petroleum oil has brought with it an ever increasing problem of environmental pollution (Eisenberg and Laughlin, 2001). Petroleum oil pollution affects adversely the germination of seeds, growth and development of plants, and the soil medium for plant growth (Udo and Oputa, 1984; Pezeshski *et al*., 2000). Diesel oil exists as one of the refined components of petroleum oil and a broad mixture of hydrocarbons produced either as distillate, or residual materials, or as blend of the two during the refining of crude petroleum (Pohl and Hobson 1984; Moeller *et al.,* 2008). Petroleum oil pollution emanating from diesel oil may result from spills on vehicle repair sites, tanker accidents and accidents involving diesel engines either on land surfaces or water bodies. It is important to note that most of the terrestrial

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ecosystems and shorelines on which spillage occurs are agricultural lands and are under continuous cultivation (Amadi *et al*., 1992). Therefore, this research was conducted to examine the tolerance level of *Abelmoschus esculentus* to diesel oil pollution as a basis for further research study in proffering possible solutions to the problem.

Materials and Methods

The physico-chemical properties of the experimental soils (sand-loam soil, and contaminated soil) were analyzed using standard procedure (Allison, 1965; A.O.A.C., 1975; Udo and Ogunwale, 1986).

Four kilograms of the sandy-loam soil obtained from University of Uyo, Botanic garden, Akwa Ibom State, Nigeria were weighed into each polybag. Polluted soils were obtained by mixing thoroughly 4kg of sand-loam soil with 40, 80, 120, 160 and 200ml of diesel oil and left undisturbed for one week. 0ml (unpolluted garden soil) was used as control. The soil samples were placed in perforated poly bags (18 x 36cm). Seeds of *okro* (Lady finger) obtained from Akwa Ibom State Agricultural Development Project were sterilized with approximately 0.01 % mercuric chloride solution for 30 seconds, thoroughly washed several times with steriled distilled water and air-dried. Ten (10) seeds were sown (March, 2001) directly in each perforated polythene bag containing the polluted and unpolluted garden soils, and after germination were thinned up to three (3) seedlings per bag. Each level of treatment was replicated three times using randomized complete block design. The experimental work was maintained under natural light condition, the plants were watered as the need arose and allowed to grow for four (4) months in order to determine the growth and yield performances. Measurement of growth parameters such as shoot length, leaf area, root length, fruit number, fruit weight, fresh weight, dry weight and moisture content were determined after harvest. Similarly, estimation of nutrient elements (N, P, K, Ca, Mg and Na) in leaves of *A. esculentus* was carried out using analytical method (A.O.A.C., 1975; Hack, 2000). Standard errors -of the mean values were calculated for the replicate readings and data were subjected to analysis of variance (ANOVA) to compare the the phosphorus content, carbon/nitrogen ratio and other properties of diesel oil polluted soil than that of the garden (unpolluted) soil (Table 1). There were marked reductions in growth performances of *A. esculentus* in diesel oil polluted treatments compared to the control. There were significant ($P<0.05$) reductions in shoot length and root length with increasing concentration of diesel oil (Table 2). Reduction in leaf area, fresh weight, dry weight, moisture content and yield parameters were recorded with increasing concentration of diesel oil pollution (Table 2). All treatment levels gave significant ($P<0.05$) decrease in nutrient elements in leaves of *A. esculentus* below that of the control, except at 40ml of diesel oil for calcium and sodium contents (Table 3).

The drastic reductions in shoot length and root length as well as the entire stunted growth of plant in diesel oil polluted soil may be due to a high degree of toxicity causing damage to the root and shoot tissues thereby making the absorption of nutrients impossible (Udo and Oputa, 1984; Renalt *et al*., 2000). Diesel oil pollution also affected the leaf area of the crop, and this may be as a result of interference of the oil constituent with photosynthesis and transpiration probably by clogging the stomata (Al-Azab *et al.,* 2005). The concentration of diesel oil pollution influenced the yield parameters of the crop with low and no yield being recorded at low and high pollution levels, respectively, compared to the control. It may be suggested that the reduction in crop yield could have been due to competition for the limited nutrients between microbial population and the crop as a result of high carbon content in the soil relative to nitrogen - (Inoni, 2006; Fernet, 2008), as depicted from the physico-chemical properties of the polluted soil in this study. In oil polluted soils, nitrogen and phosphorus quickly become limiting to biodegradation of oil and plant growth, resulting in a delay in the rate of soil recovery and a decrease in crop yield. (Vwioko and Feshemi, 2005).

The drastic reductions in the nutrient elements contents in leaves of *A. esculentus* in diesel oil polluted soil compared with the control may be as a result of disturbance of the plant - water - relationship leading to disruption in the nutrient supply to the plant (Odejimi and Ogbalu, 2006).

with the uptake of nutrients and water due to increase osmotic potential resulting from the high salt contents in the polluted soil (Udo and Oputa, 1984; Al-Azab *et al.,* 2005).

The overall deteriorating state or poor growth and other symptoms of plants in diesel oil polluted soil may be attributed to certain physiological, morphological and biochemical changes occurring within the plants (Chupakhina and Maslennikov, 2005), due to the anaerobic and hydrostatic conditions of the polluted soil that interfere with the normal plant-water relationship of the root within the soil (Amadi *et al*., 1992; Al-Azab *et al.,* 2005).

Table 1: The Physico-chemical properties of the Experimental Soils before Harvesting

Soil properties	Garden (Unpolluted)	Polluted soil (Diesel)
pH	6.90±1.02	7.56 ±0.06
Available phosphorus (mg/Kg)	9.90±2.17	5.83±1.26
Calcium (me/100g)	2.36±1.21	4.05±0.22
Magnesium (me/100g)	2.40±1.30	4.47±1.66
Sodium (me/100g)	0.09±0.01	4.98±0.06
Potassium (me/100g)	0.26±0.02	2.96±1.34
Organic Carbon (%)	1.20±0.10	3.59±1.07
Total nitrogen (%)	0.08±0.01	0.05±0.04
Sand (%)	69.50±2.31	69.64±2.17
Silt (%)	20.40±2.10	9.21±1.30
Clay (%)	9.80±1.34	17.20±1.27
C/N ratio	15.00±1.26	71.80±2.33

Mean ± Standard Error ($P<0.05$)

Table 2: Growth and Yield Parameter of *Abelmosclus esculentus* as affected by Diesel oil Polluted Soil

Concentration (ML)	0	40	80	120	160	200
Parameters						
Shoot length (cm)	40.50±1.21	30.63±1.33	26.45±2.04	21.50±4.21	15.98±2.11	0.00±0.00
Leaf Area (cm^2)	128.54±2.31	75.97±2.86	41.16±2.40	37.21±3.50	18.40±2.67	0.00±0.00
Root Length (cm)	19.50±0.31	16.35±1.50	13.40±2.10	11.20±0.72	9.30±2.11	0.00±0.00
Fruit number	2.00±0.21	1.30±0.42	1.00±1.06	0.00±0.00	0.00±0.00	0.00±0.00
fruit weight (g)	9.01±2.01	6.06±0.40	5.42±0.21	0.00±0.00	0.00±0.00	0.00±0.00
Fresh weight (g)	10.69±1.20	6.25±0.24	4.28±0.54	4.01±0.36	3.20±1.51	0.00±0.00
Dry weight (g)	3.12±0.61	2.04±1.30	1.45±0.63	1.74±0.81	1.34±0.42	0.00±0.00
Moisture content (%)	70.81±0.57	67.36±2.41	69.93±0.80	56.61±0.25	58.13±1.72	0.00±0.00

Mean ± Standard Error ($P<0.05$)

Table 3: Nutrient Element Contents in Leaves of *A. esculentus* in Diesel Oil Polluted Soil

Concentration of oil (ml)	Nutrient element (%)					
	Ca	Mg	Na	N	P	K
0	1.25±0.21	1.66±0.17	0.08±0.01	2.82±0.23	1.38±0.31	0.98±0.05
40	1.27±0.20	0.51±0.05	0.08±0.01	2.66±0.12	0.31±0.06	0.88±0.06
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CONCLUSION

This study shows that *Abelmoschus esculentus* (L. Moench) is not suitable for cultivation where diesel oil pollution occurs, and therefore calls for the development of remediation practices to restore the soil.

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