

## The Impact of Diesel Contaminated Soil on Seedling Growth of Okro (*Abelmoschus Esculentus*), Pumpkin (*Amaranthus Hybridus*) Maize (*Zea Mays*) and Pepper (*Capsicum Annum*)



### Environment

**KEYWORDS :** Diesel contamination, *Abelmoschus esculentus*, *Amaranthus hybridus*, *Zea mays*, *Capsicum annum*

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### ABSTRACT

*This research work centered on "environmental impact of diesel contamination on seedling growth of okro (*Abelmoschus esculentus*), pumpkin (*Amaranthus hybridus*), maize (*Zea mays*) and pepper (*Capsicum annum*).*

*The soil sample of known weight 2.50kg was treated with different concentration (2ml, 4ml, 6ml) of diesel while one sample was not contaminated (control). The contaminated samples were mixed thoroughly by hands to ensure homogeneity and were filled into perforated plastic to allow aeration. Each bowl containing the control and contaminated soil were properly labeled. At least four (4) seeds were sown in each bowl and replicated thrice. The effect of diesel on these crops was determined after six (6) weeks of germination. It was observed that the seedlings with 4 and 6ml diesel concentration decreased leaf number from 7 to 0 in Okro (*Abelmoschus esculentus*), while reduction in leaf number were observed in Pumpkin (*Amaranthus hybridus*) from 23 to 13 leaves, 5 to 3 leaves for Maize (*Zea mays*) and 6 to 2 leaves for Pepper (*Capsicum annum*). Also, plants height decreases from 2 to 6ml of diesel concentration with 21.0cm to 0cm in Okro (*Abelmoschus esculentus*), 38.0cm to 19.0cm in pumpkin (*Amaranthus hybridus*), 32.0cm to 17.0cm in Maize (*Zea mays*) and 10.0cm to 1.0cm in pepper (*Capsicum annum*). The length of leaves decreases from 9.0cm to 0cm for okro (*Abelmoschus esculentus*), 9.0cm to 4.0cm for pumpkin (*Amaranthus hybridus*), 25.0cm to 12.3cm for maize (*Zea mays*) and 5.0cm to 0.2cm for pepper (*Capsicum annum*). The fresh and dry weight decrease across the plants from the control to the highest concentrated. The result from this study indicates that indiscriminate dumping of petroleum fractions (oil) has significant effect on plants growth and yield great environmental impact. For this fact, consciousness should be instilled into petroleum marketing, operators and automobile mechanics should stop unhealthy disposal of used petroleum products.*

### INTRODUCTION

Diesel oil is a complex mixture of hydrocarbons such as low molecular weight alkanes and polycyclic aromatic hydrocarbons (PAH) (Adams Duncan, 1992). It also contains sulfur, nitrogen and oxygen in low concentrations as well as metals such as lead, nickel, sodium, calcium, copper and uranium. Diesel is the type of fuel used in operating diesel engine, which can be power generators or transport vehicles such as buses, trucks, trains and boats. In day-to-day applications, diesel refers to the fossil fuel based product, obtained after the purification of crude oil. It is often regarded as petrol diesel or petroleum diesel and it is a heavy mineral oil used as fuel in diesel engines.

Contamination of soil by diesel fuel result in damage of crop growth, depending on the degree of contamination for some years or months the soil may remain unsuitable for plant growth. Diesel fuel is not a systemic killer; it kills plant cells on contact. Contamination by diesel fuel can kill the roots, and this prevents the plant from taking up water and other nutrients. It can also disrupt plants and water relationship in soil (MC Cown *et al* 1992). Diesel oil can cause chronic or acute effects in the plants. In addition to direct and indirect toxicity the oil causes interference in the hydric relations of the plants. This interference, accompanied by the anaerobic and hydrophobic conditions, has been found to be the most important effect of diesel oil contaminated soil on seed germination and plant growth (Ragne, 1994).

The increasing use of diesel oil in diesel engines of cars, industrial trucks and generators has led to an increased demand for diesel oil (Ogbo, 2009), accidental spillage of diesel and pollution of agricultural lands. Diesel oil is one of the major products of crude oil and it constitutes major sources of pollution to the environment (Nwaogu *et al*, 2002). Diesel oil can enter the environment through leakages of storage containers, refueling of vehicles, wrecks of oil tankers and warships carrying diesel oil and though improper disposal by mechanics when cleaning oil tankers (Hill, 1990). Soil pollution through such many small and common sources of these products poses large environmental threat (Wyszowski and Ziolkowska 2008). Diesel spills on agricultural land generally reduce plant growth (Nwaogu *et al*, 2002). Diesel reduces soil fertility and soil micro flora population (Torstensen *et al*, 1998). Wyszowski and Ziolkowska (2008) also reported that the addition of diesel oil to the soil led

to a significant reduction of organic carbon content of the soil. Diesel oil is phyto toxic to plants at relatively low concentrations Ogbo (2009) reported that diesel oil contamination of the soil caused a reduction in the length of the radicals of *Arachis hypogea*, *Vigna unguiculata*, *Sorghum bicolor* and *Zea mays*. The findings of Anoliefo *et al*, (2002) show that soil from abandoned mechanic village in Nigeria depressed and inhibited the growth a hypogea.

### MATERIALS AND METHODS

#### Sample Collection

Diesel oil was collected with gallon from the petrol station.

Loamy soil used was collected from the back of female hostel, Petroleum Training Institute, Warri, Delta State. It was ensured that there was no particle of dirt on the soil.

Thirty seven (37) plastic bowls were purchased from Effurun market. Each bowl was 25cm wide 15cm deep and they were perforated to allow aeration.

The seeds of each of the plants used were bought at Effurun Market, Warri, Delta State Nigeria.

#### Method of Soil Analysis

The soil of known weight 2.50kg was treated with different concentration (2ml, 4ml and 6ml) of diesel. The soil sample was mixed with each concentration of the fractions by hands to ensure homogenous mixture. Each polluted soil and control soil was properly indicated by labeling. The experiment was replicated in threes.

#### Growth of Plants

Viability test was carried out on the seeds. The seeds were poured in water; the floated ones were thrown away. The settled seeds were then planted in garden soil for both plants. This was done on the 4<sup>th</sup> of April 2013 and then planted on perforated bowls which contains 2.50kg of the soil sample. The contamination of the soil was done two weeks before planting. The seedlings were being watered at least once a day.

#### Determination of Growth Parameters

Growth parameters, such as plant height, leaf number, length of

longest leaf, fresh and dry weight were measured and recorded.

**Measurement of Height**

The height was measured from the soil level to the terminal bud. Measurements were taken on a weekly basis from the day of treatment with spent lubricating oil to the day of harvest using measuring ruler.

**Determination of Leaf Number and Length of Longest Leaf**

The number of leaves produced per plant was determined by counting while the leaf length was measured from the leaf base to the tip.

**Fresh and Dry Weight Determination**

The fresh and dry weights were determined after harvest. This was carried out following the methods of Hunt (1981). At harvest, the root system was retrieved by immersing the plastic bowls in water and washing carefully. The harvested seedlings were quickly put in polyethylene bags and taken to the laboratory for analysis. The plants were cleaned with tissue paper to remove sand and water before weighing. The plants were separated into roots, stems and leaves. The total fresh weight of plant parts was obtained using the mettler PC 180 electronic balance. The dry weight was obtained by drying the plant parts in a ventilated oven at 80°C for 24 hours in envelopes made from old newspapers and weighing them on the mettler PC 180 electronic balance.

**RESULT AND DISCUSSION**

The data on the rate of survival of *Abelmoschus esculentus* (okro), *Amaranthus hybridus*(pumpkin), *Capsicum annum*(pepper) and *Zea mays*(maize) grown at different concentration of diesel oil contaminated soil are shown table I

**TABLE- I LEAVES NUMBER**

Conc. Of Diesel Oil (ml)	<i>Abelmoschus esculentus</i> Okro	<i>Amaranthus hybridus</i> Pumpkin	<i>Zea mays</i> Maize	<i>Capsicum annum</i> Pepper
0	7.0	23.0	5.0	6.0
2	2.0	19.0	4.0	4.0
4	-	15.0	4.0	2.0
6	-	13.0	3.0	2.0

The table above shows the effect of diesel oil on the number of leaves of *Abelmoschus esculentus* (Okro), *Amaranthus hybridus* (Pumpkin), *Zea Mays* (Maize) and *Capsicum annum* (Pepper).

The number of leaves for sample of *Abelmoschus esculentus* (okro), *Amaranthus hybridus* (pumpkin), *Zea mays* (maize) and *Capsicum annum* (pepper) was 7.0, 23.0, 5.0 and 6.0 respectively for control. The effect of the diesel oil was more observed in the Okro seedling than the others at 4 and 6ml diesel oil concentration. The Pumpkin still produced much leaves (13) even at 6ml diesel oil concentration, the value that is higher than the leaf number observed in the other plants. This shows that pumpkin can thrive well in a diesel oil populated soil compare to others. From this observation diesel oil impact is much felt as its concentration in the soil

**TABLE-II PLANT HEIGHT (cm)**

Conc. of Diesel Oil (ml)	<i>Abelmoschus esculentus</i> (Okro)	<i>Amaranthus hybridus</i> (Pumpkin)	<i>Zea mays</i> (Maize)	<i>Capsicum annum</i> (Pepper)
0	21.0cm	38.0cm	32.0cm	10.0cm
2	11.0cm	27.0cm	23.0cm	2.5cm
4	-	23.0cm	20.0cm	2.0cm
6	-	19.0cm	17.0cm	1.0cm

The table above shows the effect of diesel on the height of *Abelmoschus esculentus*(okro), *Amaranthus Hybridus*(pumpkin), *Zea Mays*(maize) and *Capsicum annum*(pepper). It was observed that the seedling of *Abelmoschus esculentus* (okro) did not survive at 4 and 6ml diesel oil concentration as earlier seen in the leaf number. The rate at which the plant height reduced in Pep-

per in the control experiment and the soil with 2ml of diesel oil was higher than the other plants (10.0 – 2.5cm). This shows that the concentration of diesel oil has much effect on the length of pepper seedling when compare with the others

**TABLE-III LENGTH OF LEAF (cm)**

Conc. of Diesel Oil (ml)	<i>Abelmoschus esculentus</i> Okro	<i>Amaranthus hybridus</i> Pumpkin	<i>Zea mays</i> Maize	<i>Capsicum annum</i> Pepper
0	9.0	9.0	25.0	5.0
2	2.5	7.0	16.2	0.5
4	-	5.1	15.0	0.3
6	-	4.0	12.3	0.2

The length of longest leaf of *Abelmoschus esculentus* (okro), *Amaranthus hybridus* (pumpkin), *Zea mays* (maize) and *Capsicum annum* (pepper) was 9.0cm, 9.0cm, 25.0cm and 5.0cm respectively for control. For 2ml contamination, the length of longest leaf for each crop was 2.5cm, 7.0cm, 16.2cm and 0.5cm respectively. For 4ml contamination, the length of longest leaf for each crops were 0cm, 5.1cm, 15.0cm and 0.3cm respectively. For 6ml contamination, the length of longest for each crops were 0cm, 4.0cm, 12.3cm and 0.2cm respectively.

From this observation diesel oil shows no impact on control (the uncontaminated sample). The impact increases as the rate of concentration of diesel oil increases from 2ml to 6ml in all the crops.

Plant Parts		Conc. of Diesel Oil (ml)			
		0	2	4	6
Leaves	<i>Amaranthus hybridus</i> (pumpkin)	7.20g	5.32g	3.86g	1.80g
	<i>Abelmoschus esculentus</i> (okro)	6.78g	3.59g	-	-
	<i>Zea mays</i> (maize)	1.38g	0.71g	0.69g	0.35g
	<i>Capsicum annum</i> (pepper)	0.90g	0.17g	0.04g	0.01g
Stem	<i>Amaranthus hybridus</i> (pumpkin)	2.58g	1.78g	1.05g	0.79g
	<i>Abelmoschus esculentus</i> (okro)	2.67g	1.12g	-	-
	<i>Zea mays</i> (maize)	0.60g	0.48g	0.30g	0.21g
	<i>Capsicum annum</i> (pepper)	0.39g	0.20g	0.13g	0.05g
Root	<i>Amaranthus hybridus</i> (pumpkin)	4.36g	3.10g	1.87g	0.69g
	<i>Abelmoschus esculentus</i> (okro)	5.36g	3.15g	-	-
	<i>Zea mays</i> (maize)	1.30g	1.19g	0.89g	0.39g
	<i>Capsicum annum</i> (pepper)	0.26g	0.15g	0.09g	0.26g
Total weight	<i>Amaranthus hybridus</i> (pumpkin)	14.14g	10.20g	6.78g	3.28g
	<i>Abelmoschus esculentus</i> (okro)	14.81g	8.18g	-	-
	<i>Zea mays</i> (maize)	3.28g	2.38g	1.88g	0.95g
	<i>Capsicum annum</i> (pepper)	1.55g	0.52g	0.26g	0.10g

**TABLE -IV Fresh Weight**

**TABLE -V Total Wet Weight Determination**

Plant Parts	Conc. of Diesel oil			
	0	2	4	6
<i>Abelmoschus esculentus</i> (okro)	14.8g	8.2g	-	-
<i>Amaranthushybridus</i> (Pumpkin)	14.1g	10.2g	6.8g	3.3g
<i>Zea mays</i> (Maize)	3.3g	2.4g	1.9g	1.0g
<i>Capsicum annum</i> (Pepper)	1.6g	0.5g	0.3g	0.1g

The fresh weight of *Abemoschus esculentus* (okro), *Amaranthus hybridus* (pumpkin), *Zea mays* (maize) and *Capsicum annum* (pepper) was 14.8g, 14.1g, 3.3g and 1.6g respectively for control. For 2ml contamination, the fresh weight for each crops were 8.2g, 10.2g, 2.4g and 0.5g respectively. For 4ml contamination, the fresh weight for each crops were 0g, 6.8g, 1.9g and 0.3g respectively. For 6ml contamination, the fresh weight for each crops were 0g, 3.3g, 1.0g and 0.1g respectively.

Diesel oil contaminated soil sample shows a negative impact on the fresh weight of the seedlings of the plants used. This maybe that, the contaminated soil affects the uptake of minerals and water from the soil as the concentration of the diesel oil increase thereby affecting the fresh weight of the seedlings as observed in tables IV and V above.

TABLE VI DRY WEIGHT

Plant Parts		Conc. of Diesel Oil (ml)			
		0	1	2	3
Leaves	<i>Amaranthus hybridus</i> (pumpkin)	5.93	4.20g	2.30g	0.9g
	<i>Abemoschus esculentus</i> (okro)	4.57g	2.30g	-	-
	<i>Zea mays</i> (maize)	1.0g	0.47g	0.15g	0.07g
	<i>Capsicum annum</i> (pepper)	0.75g	0.12g	0.03g	0.005g
Stem	<i>Amaranthus hybridus</i> (pumpkin)	1.56g	1.21g	0.82g	0.32g
	<i>Abemoschus esculentus</i> (okro)	1.80g	1.0g	-	-
	<i>Zea mays</i> (maize)	0.03g	0.23g	0.12g	0.05g
	<i>Capsicum annum</i> (pepper)	0.21g	0.15g	0.10g	0.03g
Root	<i>Amaranthus hybridus</i> (pumpkin)	3.21g	2.32g	0.87g	1.57g
	<i>Abemoschus esculentus</i> (okro)	3.0g	2.30g	-	-
	<i>Zea mays</i> (maize)	1.15g	0.89g	0.29g	0.08g
	<i>Capsicum annum</i> (pepper)	0.13g	0.10g	0.05g	0.02g
Total weight	<i>Amaranthus hybridus</i> (pumpkin)	10.7g	7.73g	3.99g	2.7g
	<i>Abemoschus esculentus</i> (okro)	9.37g	5.6g	-	-
	<i>Zea mays</i> (maize)	2.45g	1.59g	0.66g	0.2g
	<i>Capsicum annum</i> (pepper)	1.09g	0.57g	0.18g	0.08g

The dry weight of *Abemoschus esculentus* (okro), *Amaranthus hybridus* (pumpkin), *Zea mays* (maize) and *Capsicum annum* (pepper) was 9.4g, 10.7g, 2.5g and 1.1g respectively for control. For 2ml contamination, the dry weight for each crops were 5.6g, 7.7g, 1.6g and 0.6g respectively. For 4ml contamination, the dry weight for each crops were 0g, 4.0g, 0.7g and 0.2g respectively. For 6ml contamination, the dry weight for each crops were 0g, 1.6g, 0.2g and 0.1g respectively.

From the observation, diesel oil shows no impact on control (the uncontaminated sample). The impact increases as the rate of concentration of diesel oil increases from 2ml to 6ml in all the crops.

CONCLUSION

Seedlings of *Abemoschus esculentus* (okro) have normal growth at control and decreases in polluted soil. There was no germination of *Abemoschus esculentus* (okro) at higher percent of diesel oil contamination. Seedlings of *Amaranthus hybridus*(pumpkin) have normal growth at control and moderately decreases on further increase in pollution.

Seedlings of *capsicum annum* (pepper) have normal growth at control and moderately decrease on further increase in pollution.

Seedlings of *zea mays* (maize) have normal growth at control and moderately decrease on further increase in pollution.

From this research work, it has been observed that diesel oil contamination causes severe damage to the growth of plants. The results of the effect of diesel oil on the growth of *Abemoschus esculentus* (okro), *Amaranthus hybridus* (pumpkin), *Capsicum annum* (pepper) and *Zea may* (maize) shows that they can tolerate diesel oil to some extent i.e they germinate but plant parts like the number of leaves, length of leaves, stem, root, height of plants and the weight of plants were affected as the amount of concentration increases.

TABLE VII- Total Dry Weight

Conc of Diesel Oil (ml)	<i>Abemoschus esculentus</i> .Okro	<i>Amaranthus hybridus</i> Pumpkin	<i>Zea mays</i> Maize	<i>Capsicum annum</i> Pepper
0	9.4g	10.7g	2.5g	1.1g
2	5.6g	7.7g	1.6g	0.6g
4	-	4.0g	0.7g	0.2g
6	-	1.6g	0.2g	0.1g

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