# EFFECTS OF SPENT ENGINE OIL ON SEEDLING GERMINATION OF GROUNDNUT (*Arachis hypogaea* L.)

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## Abstract
*The indiscriminately disposal of spent engine oil drain from engine after servicing has been found to affect plant growth. A potted experiment was developed at College of Education (Technical) Lafiagi, to investigate the minimum concentration of spent engine oil that could be inhibitory to groundnut growth. Plastic containers filled with sandy-loam soil were contaminated with various concentrations of spent engine oil (SEO) (0ml, 25ml 50ml, 75ml and 100ml). Each treatment had three replicates arranged in complete randomized block design. Germination studies carried out showed that number of seeds of groundnut that grow into seedling decreased with increasing level of the contaminant. Percentages germination was found to decrease from 100% in 0ml to 60% in 25ml and to 33 % in 100ml. Seedling growth parameters such as plant height, number of leaves, stem girth and leaf area assessed for a period of one month were significantly (p< 0.05) reduced as the concentration level of the contaminant increased compared to control (0ml) except for 25ml of SEO which did not show significant shoot height difference. Polluted soil with 100ml of SEO was found to be phytotoxic as shown by significant marked reduction in all the aforementioned growth parameters. The results of this study suggest that spent engine oil at 25ml concentration could be considered inhibitory to groundnut growth. Also, higher concentration of this pollutant could become phytotoxic. Therefore, for crop safety and food security, there is need for adequate enlightenment on the indiscriminate disposal of spent engine oil.*

Keywords: Groundnut, Growth, Inhibition, used engine oil and Contamination.

## Introduction
Oil spill in the Niger-Delta region of Nigeria and indiscriminate disposal of spent engine oil into water drains and vacant plots around automobile mechanic workshops, where spent oil from motor vehicles and generators are spilled have been found to be hazardous to both plants and animals (Anoliefor *et al.,* 2001; Emmanuel *et al.,* 2006). It has been shown that the existing practice of indiscriminate disposal of spent oil does not only increase pollution incidents in the environment but is equally more prevalent than crude oil pollution (Odjegba and Sadiq , 2002). Reasons that could be adduced for this scenario is derived from upsurge in number of vehicles owners and epileptic power failure that necessitates the use of electric powers generators in most homes, shops and industries that make use of this lubricant (Anoliefor *et al.*, 2001).

The environmental effects of oil on growth and performance of plants have been well documented. Germination of *Amaranthus hybridus* seeds were significantly affected in spent engine oil polluted soil (Odjegba and Idowu, 2002 ). Agbogidi *et al.*, (2005) and Agbogidi *et al.,* (2006) showed that crude oil application to soil, significantly reduced crop growth and yield in okra and five cultivars of soyabeans respectively. Daniel-Kalio and Pepple (2006) reported a significant higher means of plant height, leaf area and dry weight of *Commelina benghalensis* (day flower) at 0mg/g oil pollution than at 50mg oil/g pollution level. Further still, Ibemesin (2010), reported that vegetative cutting of *Paspalum conjugation* (sour grass) grew well in absence of oil and salinity and that 75% of the test plant survived in low oiling but heavy oiling resulted in mortality.

Plants respond differently to pollutants. Contamination of soil with spent engine oil has been reported to cause growth retardation in plants with the effect more adverse for tomato (*Lycopersicum esculentum* L.) than pepper (*Capsicum annum* L) (Anoliefor & Vwioko, 1995) Similarly, Ogbo (2009) observed that 2% level of diesel fuel reduced radical length in Sorghum bicolor and *Zea mays* than in *Arachis hypogaea* and *Vigna unguiculata.*

Groundnut (*Arachis hypogaea* L) is an annual legume crop, belonging to the family Paplilonaceae. It is a major oil seed crops and such it is used as vegetable cooking oil. Its seeds are consumed either boiled or fried as refreshment in Nigeria. As legume it enriches the soil thus making it a popular crop among poor farmers who cannot afford to purchase fertilizers (Khan *et al.*, 2004 & Opeke , 2006). The choice of this crop for this study was because the plant is one of the major crops widely grown in the study area (Obi *et al.*, 2008). The present study was therefore, carried out with the sole objective to provide additional information on the response of this crop to spent engine oil with the view to establish minimum concentration of this contaminant that could pose hazard to its growth.

## Materials and Methods

**Study Area:** The experiment was carried out in 2010 between the months of June and July at College of Education (Technical) Lafiagi, Kwara State (latitude $8^o$ $50^I$ N and longitude $5^o$ $25^I$E). Lafiagi is located in the Northern Guinea savanna zone of Nigeria. It is characterized with monomodal rainfall distribution pattern. The temperature of the cold months ranges between $27^0$C - $29^0$C, while that of the hot month's ranges between $33^0$C-$38^0$C. It should be noted that during the period of this study, total rainfall received was 226.6mm and the average diurnal temperature fluctuation ranges between $29^0$C and $34^0$ C.

**Sample Collection:** Seeds of *Arachis hypogaea* Linn. cv Samnut 10 commonly grown in the study area were obtained from a local farmer for the study. Healthy seeds with their testa intact were selected and packed in a sack and stored at normal room temperature (25-28$^o$C) until they were used for the study. Spent engine oil drained from vehicle obtained from three different auto-mechanic shops in Lafiagi Kwara State formed the pool that was used for the study. Two soil types used for the study (sand and loam) were collected from the college farm. The soil types were mixed in ratio 1:1 to obtain sandy-loamy soil.

**Soil Pollution:** The experiment was conducted in the Biology laboratory of School of Science, Kwara State College of Education (Technical), Lafiagi. For the purpose of this experiment fifteen plastic containers of equal size (17cm wide and 17cm deep) were filled with soil to a depth of 12cm. Holes were drilled at the bottom to facilitate drainage. The soil was polluted with the following volume of oil 0ml, 25ml, 50ml, 75ml and 100ml to establish five levels of treatments; where 0ml treatment is the Control. Pollution of the soil was achieved by thoroughly mixing each volume of oil properly with soil using hand glove. Each treatment had three replicates laid out in completely randomized block design.

**Sowing of Seeds and Germination:** Five seeds of *A. hypogaea* were planted at 2cm sowing depth in the soils treated with respective concentrations of spent engine oil. Seeds that germinated from each treatment were added cumulatively for seven days. The percentage germination in each treatment was calculated as:

Percentage germination = number of seeds that germinated /number of seeds sown x 100
It should be noted that watering was undertaking at two days interval with 20ml of water per replicate.

### Data Collection

A simple nondestructive technique adapted from Andrew and Janson (2000) was employed to collect growth parameters like shoot height, number of leaves, stem girth and leaf area. Shoot height was determined by measuring the plant from soil level up to the tip of the shoot using 30cm ruler. Leaf numbers were manually counted. Stem girth was determined using thread to encircle the circumference of the stem 2cm above soil level. The cut thread obtained was then measured on 10cm ruler and length covered recorded as stem girth. Leaf area was determined by measuring the width and length of an average leaf at the widest and longest point. Leaf area was determined by multiplying these two numbers together and dividing it by two. The resulting estimate was multiplied by number of leaves to obtain the total leaf area per plant. These growth parameters were assessed at four-day interval for sixteen days.

### Statistical Analysis

One way Analysis of Variance was used to analyze growth parameters (Steel and Torrie, 1980). The means were separated using least significance difference (LSD) at 0.05 level). The germination study was analyzed using simple percentage to determine the effect of SEO on *A. hypogaea*

## Results

Effect of Spent Engine Oil on Germination: Germination count carried out for seven days as shown in Table 1 revealed that percentage germination decreased with increased levels of oil contaminant. The Control treatment (0ml) had the highest percentage germination (100%). The percentage germination reduced from 60% in 25ml to 40% in 50ml and 75ml and 33% in 100ml of SEO.

Table 1: Effect of spent engine oil on germination of *A. hypogaea.*

| Treatment | No. of Seed Sown | No of Seed Germinated | Percentage Germination (%) |
|---|---|---|---|
| 0 | 15 | 15 | 100 |
| 25 | 15 | 9 | 60 |
| 50 | 15 | 6 | 40 |
| 75 | 15 | 6 | 40 |
| 100ml | 15 | 5 | 33 |

Effect of Spent Engine Oil on Seedling Growth of *A. hypogaea*:-

Mean plant height decreased significantly with an increase in the concentrations of spent engine oil (Table 2). The mean height of the Control group of plants (14.4cm) was significantly ($p < 0.05$) greater than those of plants grown in soils polluted with 50ml, 75ml and 100ml spent engine oil (9.6cm, 7.9cm and 5.2cm, respectively). However no significant mean plant height difference was found between the Control and soil polluted with 25ml (12.5cm) (Table 2). Among the polluted soils, significance differences in plant height were not found ($P < 0.05$) with respect to *A . hypogaea* grown in soil polluted with respective concentrations of spent engine oil. As observed in this study, plant height of *A. hypogaea* grown in soil polluted with 100ml spent engine oil was significantly affected compared to other treatments studied ( Table 2). The results showed that spent engine oil inhibited plant growth as evidenced by the reduction in plant height and the effect was concentration dependent.

The highest mean number of leaves of A. hypogaea was obtained from the Control treatment (37.6 n/p) and this was statistically ($p<0.05$) different from that obtained in soil polluted with 25ml, 50ml, 75ml and 100ml spent engine oil (26.2, 24.8 19.7 and 12.4n/p respectively). Significant reduction in leaf production was observed in *A. hypogaea* grown in soil polluted with 100ml SEO compared to other treatments (Table 2).

Table 2 shows that mean stem girth of the Control plant was 1.42cm and this was significantly higher compared to that from soil polluted with 25ml, 50ml, 75ml and 100ml spent engine oil with mean values of 1.5cm, 1.09cm, 0.93cm and 0.85cm respectively. The fact that mean stem girth of *A. hypogaea* grown in soil polluted with 100ml spent engine oil was adversely affected, probably indicates that the contaminant at this level is phytotoxic.

The mean leaf area of the plants also declined with increase in concentration of spent engine oil pollution (Table 2). The mean leaf area of the Control plants ( 294.7cm$^2$) was significantly ( $p<0.05$) greater than those of plants grown in 25ml, 50ml, 75ml and 100ml spent engine oil polluted soils (116.3cm$^2$ 73cm$^2$56.4cm$^2$ and 28.6cm$^2$, respectively). Among the polluted soils, mean leaf area in plants grown in 25ml of spent engine oil differed significantly compared to other treatments studied

(Table 2). Like other growth parameters assessed plant receiving 100ml spent engine oil showed the least mean leaf area development.

**Table 2: Effect of spent engine oil on *A. hypogaea* shoot height, number of leaves, stem girth and leaf area**

| Treatment (ml) | Shoot Height (cm) | Number of Leaves (n/p) | Stem Girth (cm) | Leaf Area ($cm^2$) |
|---|---|---|---|---|
| 0 | $14.4^{a}$ | $37.6^{a}$ | $1.42^{a}$ | $294.7^{a}$ |
| 25 | $12.3^{ab}$ | $26.2^{b}$ | $1.15^{b}$ | $116.3^{b}$ |
| 50 | $9.6^{bc}$ | $24.8^{b}$ | $1.09^{bc}$ | $73.2^{c}$ |
| 75 | $7.9^{bc}$ | $19.7^{bc}$ | $0.93^{bcd}$ | $56.4^{cd}$ |
| 100 | $5.2^{c}$ | $12.4^{cd}$ | $0.85^{cd}$ | $28.6^{d}$ |
| F value P<0.05 | 24.83 | 6.29 | 21.78 | 33.28 |
| LSD value P<0.05 | 4.65 | 7.701 | 0.098 | 18.37 |
| SD | 2.50 | 11.08 | 0.82 | 24.10 |
| SE | 1.12 | 4.99 | 0.37 | 10.75 |

*Mean within vertical columns followed by the same letter(s) are not significantly different at P<0.05 as determined

## Discussion

In this study, spent engine oil at varying concentrations was found to disrupt both the germination and seedling growth of *A. hypogaea.* As shown in Table 1, percentage germination was adversely affected as the concentration of the contaminant increases. The failure of some of the seeds to germinate is attributed to increase in soil temperature due to dark nature of contaminated soil. As visually observed in this study, polluted soils were darker than the control and dark soils are good absorber of heat as light soils. Some black coal mining wastes and dark colored oil-shale residues reached temperature of 65-70$^{o}$C, which are phytotoxic to many plants that would otherwise grow in those soil (Donahue *et al.,* 1990). Anoliefor and Edegbai (2001) observed that polluted soils with spent lubricating oil experienced what can be described as physiological drought in terms of disruption of plant water relation and root respiration that are necessary for seedling germination and development. Also, oil coating of the seed could affect physiological function within the seed resulting in loss of seed viability (McGill and Nyborg 1975; Rowell, 1977)

Plant height of *A. hypogaea* was significantly affected by spent engine oil at all concentrations studied. These findings are in congruent with the data presented for *Glycine max* , *Vigna unguiculata* and *Zea mays* (Njoku *et al*., 2008; Kayode *et al*., 2009 ), Similarly, Al.-Qahatami and Refdan (2011) had reported significant reduction in plant height and dry matter contents of *Vinca rosea* in soil contaminated with oil refinery sludge compared with the control treatment.

With respect to number of leaves production, statistical difference was observed between the polluted soil and the Control. This goes further to show that spent engine oil is inhibitory to plant growth and this could be attributed to large amount of hydrocarbons in used oil, including the highly toxic poly aromatic hydrocarbon (PAHs) as reported by Ang *et al*., (2000)

Stem girth of A. hypogaea followed the same trend as that of plant height and number of leaves. These findings were at variance with the data presented for *Zea mays,* where Okonokhua *et al*., (2007) reported no significant difference in maize stem girth at all spent engine oil pollution rates studied, though stem girth values were found to decrease as the concentration increases. The significant difference observed in this study could be attributed to the fact that crops differed in their responses to pollutants as reported by Adenipekun and Kassim, (2006). Also, the stage of growth of the test crop is another plausible explanation that could account for the significant difference that was observed.

Leaf area production was significantly inhibited by spent engine oil at all concentrations studied. The findings supported the data presented for *Chromolaena odorata* and *Arachis hypogaea* (Anoliefor *et al*., 2003; Osubor and Anoliefor, 2003) where the authors reported a marked reduction in leaf area at higher concentration of crude oil and spent lubricating oil, respectively. The growth parameters assessed in this study, were adversely affected because spent engine oil has been found to interfere with factors such as soil aeration, mineral availability, plant water relation and soil temperature that are suitable for plant growth and development( Rowell, 1977; Amakiri and Onofeghara, 1984; Esenowo *et al*., 2006).

## Conclusion

From the findings of this study, it is crystal clear that spent engine oil as low as 25ml is capable of becoming deleterious to groundnut growth. Thus, there is need to enlighten the citizenry on indiscriminate disposal of this pollutant so as to ensure crop safety and food security.

## References

Adenipekun, C. O. & Kassim, L. O. (2006). Effect of spent engine oil on the growth of parameters content of *celosia argentea*. *In Botany and Environmental Health,* Akpan, G. and C.S.J. Odoemena (Eds). University of Uyo, Uyo, Nigeria.Pp. 108-111.

Agbogidi, O. M., Nweke, F. U. & Okechukwu, E. M. (2005). Effects of crude oil polluted soil on the performance of okra (*Abelmoschus exculentus.* Moench). in Delta State. *African J. Nat Sci.* 8(1) (in press)

Agbogidi, O. M., Nweke, F. U. & Okechukwu, E. M. (2006). Yield performance of five cultivars of soya beans (*Glycine max* (L) Merr) as influenced by soil contaminated with crude oil. *Nig. J. Trop. Agric, 8, 303-308.*

Al.-Qahatami, A. & Refdan, M. (2011). Effect of oil refinery sludge on plant growth and soil properties. *Research Journal of Environmental Science, 5(2),187-193.*

Amakiri, J. O. & Onofeghara, F. A. (1984). Effect of crude oil pollution on the growth of *zea mays, abelmoschus esculentus* and c*apsicum frutescans. Oil Petroleum and Pollution, 1,199-206.*

Andrew, J. W. & Janson, R. (2000). A simple and nondestructive technique for measuring plant growth and development. *Am. Biol. Teacher, 62, 215-217.*

Ang, J., Jia, C. R., Wong. C. K. & Wong, P. K. (2000). Characterization of polycyclic aromatic hydrocarbons created in lubricating oils. *Water, Air and Soil Pollution, 120, 381-396.*

Anoliefor, G. O. & Isikhuemhen, O. S. A. (2001). Small scale industrial village in Benin City, Nigeria: establishment failure and phytotoxicity assessment of soil from the abandoned site. *Water, Air, and soil pollution, 131,169-183.*

Anoliefor, G. O., Vwioko, D. E. & Mpamah, P. (2003). Regeneration of *chromolaena odorata* (L.) K&R.in crude oil polluted soil: A possible phytoremediating agent. *Benin Science Digest 1,9-16.*

Anoliefo, G. O. & Vwioko, D. E. (1995). Effects spent lubricating oil on the growth of <I>*Capsicum annum*</I> L. and <I>*Lycopersicon esculentum*</I> Miller. *Environ. Pollut.*, *88, 361-364.*

Anoliefo, G.O. & Edegbai, B.O. (2001). Effect of spent engine oil as a soil contaminant on the growth of two egg plant species, *Solanum melongena L. and Solanum incanum L.* *Journal of Agriculture, Forestry and Fisheries*,*1,21-25*.

Daniel- Kalio, L A; & Pepple, S. F. (2006). Effect of bonny light crude oil pollution of soil on the growth of day flower (*Commelina bengalensis*) in the Niger Delta, Nigeria. *J. Appl Sci Environ Mgt., 10(2),111-114.*

Donahue, R. L., Miller, R. W. & Shickluna, J. C. (1990). *An introduction to soils and plants growth.* USA: Prentice-Hall Inc. P. 667.

Emmanuel, I. O., Gordon, O. D. & Nkem, A. F. (2006). The effect of oil spillage on crop yield and farmincomein Delta State, Nigeria. *J. Centra Eur. Agric.,7,41-48.*

Esenowo, G. J., Sam, S. M. & Etuk, A. I. (2006). *Effect of crude oil on germination and early seedling growth of Telfaria occidentalis,* In: Botany and Environmental Health, Akpan, G. and C.S.J. Odoemena (Eds ). University of Uyo. Uyo, Nigeria. 93-96

Ibemesin, R. I. (2010). Effect of salinity and wytch crude oil on *Paspalum conjugation Bergius* (sour grass). *J. Bio Sci. 10, 122-130.*

Kayode, J., Olowoyo, O., & Oyedeji, A. (2009). The effects of used engine oil pollution on the growth and early seedling performancy of Vigna unguiculata and Zea mays. *Research Journal of soil biology, 10, 15-19.*

Khan, M. M. Ashari, Q. & Siraj-Ud-Din. A. (2004). Chemical Control of weeds in soybean. *Pakistan Journal of Weed Science Research,10(3-4),161-168.*

McGill, W. B. & Nyborg, M. P. (1975). *Reclamation of well forested soil subjected to oil spill.* Report on Contract No. OSP3-0073 for *Northern Forest Research Centre*, Edmonton. DIP Publication No. G-75-1. University of Alberta, Edmonton. 122.

Njoku, K. L., Akinola, M. O. & Oboh, B. O. (2008). Growth and performance of <I>*Glycine max*</I> L. (Merrill) grown in crude oil contaminated soil augmented with cow dung. *Natural Sci., 6 (1),48-56.*

Obi, J. C., Ogunkunle, A. O. & Meludu, N. T. (2008). Effect of termite infestation on the farming system and characteristics of an Endemic Area in the Guinea Savanna Region of *Nigeria.American.Eurasian Journal of Scientific Research, 3(1),1-6.*

Okonokhua, B. O., Ikhajiagbe, G.O. Anoliefo, B.& Emede, T.O. (2007). The effects of spent engine oil on soil properties and growth of maize *(<I>Zea mays</I>* L.*). J. Applied Sci. Environ. Manage,11(3), 147 – 15.*

Odjegba, V. J. & Idowu, F. S. (2002). Effects of spent engine oil on the germination and growth of <I>*Amaranthus hybridus*</I>*. Biosci. Res. Comm., 14,101-105.*

Odjegba, V.J. & Sadiq, A. O. (2002). Effects of spent engine oil on the growth parameters, chlorophyll and protein levels of <I>Amaranthus hybridus</I> L. *Environmentalist, 22,23-28.*

Ogbo, E.M. (2009). Effects of diesel fuel contamination on seed germination of four crop plants <I>*Arachis hypogaea*</I>, <I>*Vigna unguiculata*</I>, <I>*Sorghum bicolor*</I> and <I>*Zea*

Opeke , L. K. (2006). *Essential of crop farming* . Spectrum book limited Spectrum house ring road. USA: 5612, X.184- 193.

Osubor C. C. & Anoliefor, G. O. (2003). Inhibitory effect of spent lubricating oil on growth and respiratory function of Arachis hypogaea L. The official journal of the Faculty of Science, University of Benin, Nigeria.1(1),73-79.

Rowell, M. J. (1977). The effect of crude oil spills on soils: A review of literature. In: *The reclamation of agricultural soils after oil spills*. Toogood, J.A. (Ed.). University of Alberta, Edmonton, 1-33.

Steell., R. G. & Torrie, J. H. (1980). Principles and procedure of statistics, a biometric approach 2nd End. New York: Mcgram Hill. Pp.633.