Insight Ethnopharmacology 2 (1): 5-9, 2012
ISSN 2078-2069 / DOI: 10.5567/ETHNOPHARMA-IK.2012.5.9

Effects of Spent Engine Oil on Germination and Seedling Growth of Groundnut (*Arachis hypogaea* L.)

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Abstract: Objective: The indiscriminate disposal of used oil drain from engines 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 concentration of SEO (0, 25, 50, 75 and 100 mL). **Material and methods:** 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. Percentage germination was found to decrease from 100% in 0 mL to 60% in 25 mL and to 33% in 100 mL. **Results:** Seedling growth 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 increases compared to control (0 mL). Polluted soil with 100 mL of SEO was found to be phototoxic as shown by significant marked reduction in all the aforementioned growth parameters. The results of this study suggest that spent engine oil at 25 mL 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.

Key words: Groundnut, germination, inhibition, spent engine oil, contamination

INTRODUCTION

Oil spills in Niger-delta region of Nigeria and indiscriminate disposal of spent engine oil into gutter water drains, vacant plots among automobile mechanics that change oil from motor vehicles and generators have been found to be hazardous to both plants and animals (Anoliefo *et al*., 2001; Emmanuel *et al*., 2006). It has been shown that the existing mode of indiscriminate disposal of spent oil does not only increases pollution incidents in the environment but it is equally more prevalent than crude oil pollution (Odjegba and Sadiq, 2002). Reasons that could be adduced for this scenario is derived from upsurge of vehicles owners and epileptic power failure that necessitated the use of generators in most homes, shop owners and industries that make use of this lubricant (Anoliefo *et al*., 2001).

The environmental effect of oil on growth and performance of plants have been reported by many researches. Germination of *Amaranthus hybridus* seeds were significantly affected in spent engine oil polluted soil (Odjegba and Idowu, 2002). Agbogidi and Nweke (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 soy beans, respectively. Daniel-Kalio and Pepple (2006) reported a significant higher means plant height, leaf area and dry weight of *Commelina bengalensis* (day flower) at 0 mg g^{-1} oil pollution than at 50 mg oil g^{-1} 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 effects more adverse for tomato (*Lycopersicum esculentum* L.) than pepper (*Capsicum annum* L.) (Anoliefo and 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. It belongs to family Paplilonaceae. It is the kingpin among 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 a legume, it enriches the soil thus making it a bargain for poor farmers

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who cannot afford to purchase fertilizers (Khan *et al*., 2004; Opeke, 2006). The choice of this crop for the exercise was because the plant is one of the major crops widely grown in the study area (Obi *et al*., 2008). The present study is 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 as well as to enlighten people in the study area of its effect.

MATERIALS AND METHODS

Sample collection: The experiment was carried out in year 2010 between the months of June and July at College of Education (Technical) Lafiagi, Kwara State Nigeria (latitude 8°50'N and longitude 5°25'E. Seeds of *Arachis hypogaea* Linn. cv samnot 21 commonly grown in the study area were obtained from 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°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) we 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 (17 cm wide and 17 cm deep) were filled with soil to a depth of 12 cm. Holes were drilled at the bottom to facilitate drainage. The soil was polluted with the following volume of oil 0, 25, 50, 75 and 100 mL to establish five levels of treatments where 0 mL 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 2 cm sowing depth in sandy-loam soil treated with different concentrations of spent engine oil (SEO) (25, 50, 75 and 100 mL) and the control treatment (0 mL). Seeds that germinated from each treatment were added cumulatively for seven days. The percentage germination in each treatment was calculated as:

$$\text{Percentage germination} = \frac{\text{No. of germinated seeds}}{\text{No. of seeds sown}} \times 100$$

It should be noted that watering was undertaking at two days interval with 20 mL of water to maintain crop growth.

Data collection: A simple nondestructive technique adapted from Wood and Roper (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 30 cm ruler. Leaf numbers were manually counted. Stem girth was determined using thread to encircle the circumference of the stem at 2 cm above soil level.

The thread was then measured on 10 cm ruler and length covered recorded as stem girth. Leaf area was determined by measuring the length and width of an average leaf at the widest and longest point. The length and width recorded were multiplied and the resulting value was averaged. The total leaf area per plant was then obtained by multiplying the averaged result by the number of leaves of the corresponding treatment. These growth characters were assessed at four-day interval for period of 16 days.

Statistical analysis: One way analysis of variance was used to analysis growth characters assessed (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 AND DISCUSSION

Effect of spent engine oil on germination: In this laboratory exercise *A. hypogaea* was grown for 4 weeks in soil polluted with 0-100 mL of SEO. Germination count carried out for seven days as shown in Table 1 revealed that percentage germination decreases with increased levels of contaminant. The control treatment (0 mL) had the highest percentage germination (100%). The percentage germination reduced from 60% in 25 mL to 40% in 50 and 75 mL and 33% in 100 mL of SEO. The failure of some of the seeds to germinate may be

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

Treatment (mL)	No. of seed sown	No. of seed germinated	Germination (%)
0	15	15	100
25	15	9	60
50	15	6	40
75	15	6	40
100	15	5	33

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 soil. Some black coal mining wastes and dark colored oil-shale residues reached temperature of 65-70°C, which are phytotoxic to many plants that would otherwise grow in those soil (Donahue *et al*., 1990). Also, Anoliefo and Edegbai (2000) observed that polluted soil with SEO experienced what can be described as physiological drought in terms of disruption of plant water relation and root respiration that are necessary for growth and development.

Effect of spent engine oil on seedling growth of *A. hypogaea*

Plant height: Mean plant height decreased significantly with an increase in the concentrations of spent engine oil (Table 2). The mean height of the control of *A. hypogaea* (14.4 cm) was significantly greater than that of plants grown in soil polluted with 50, 75 and 100 mL of spent engine oil (9.6, 7.9 and 5.2 cm. respectively) $p<0.05$. However, no significant mean plant height difference was found between the control and soil polluted with 25 mL (12.5 cm) (Table 2).Within the polluted soil, significant differences in plant height were not found with respect to *A. hypogaea* grown in soil polluted with 25, 50 and 75 mL of spent engine. As observed in this study plant height of *A. hypogaea* in soil polluted with 100 mL of 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 reduction in plant height and the effect was concentration dependents. The findings are in congruent with the data presented for *Glycine max, Vigna unguiculata* and *Zea mays* (Njoku *et al*., 2008; Kayode *et al*., 2009). Similar findings have been reported by Al-Qahtani (2011), where significant reduction in plant height and dry matter contents of *Vinca rosea* in soil contaminated with oil refinery sludge was observed compared with control treatment.

Number of leaves: 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 25, 50, 75 and 100 mL of spent engine oil (26.2, 24.8, 19.7 and 12.4 n/p) (Table 2). Significant marked reduction in leaves production was observed in *A. hypogaea* grown in soil polluted with 100 mL compared to other treatments (Table 2). This goes further to say 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 Wang *et al*. (2000).

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

Treatment (mL)	Plant height (cm)	No. of leaves $plant^{-1}$	Stem girth (cm)	Leaf area (cm^2)
0	14.40^{a}	37.60^{a}	1.420^{a}	294.70^{a}
25	12.30^{ab}	26.20^{b}	1.150^{b}	116.30^{b}
50	9.60^{bc}	24.80^{b}	1.090^{bc}	73.20^{c}
75	7.90^{bc}	19.70^{bc}	0.930^{bcd}	56.40^{cd}
100	5.20^{c}	12.40^{cd}	0.850^{cd}	28.60^{d}
F-value ($p<0.05$)	24.83	6.290	21.780	33.28
LSD ($p<0.05$)	4.65	7.701	0.098	18.37
SD	2.50	11.080	0.820	24.10
SE	1.12	4.990	0.370	10.75

Mean within vertical columns followed by the same letter(s) are not significantly different at $p<0.05$ as determined by LSD values

Stem girth: Table 2 shows that *A. hypogaea* mean stem girth of control was 1.42 cm and this was significantly higher compared to that obtained from soil polluted with 25, 50, 75 and 100 mL of spent engine oil with mean values of 1.15, 1.09, 0.93 and 0.85 cm, respectively (Table 2). Mean stem girth *A. hypogaea* grown in soil polluted with 100 mL of spent engine was adversely affected a pointer to the fact that the contaminant at this level is phytotoxic. The findings are at variance with data presented for *Zea mays*, where Okonokhua *et al*. (2007) reported no significant difference in maize stem girth at all 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 pollutant (Adenipekun and Kassim, 2006).

Leaf area: The mean leaf area also declined with increase in application of spent engine oil (Table 2). The mean leaf area of the control plants (294.7 cm^2) was significantly ($p<0.05$) greater than that of plants grown in 25, 50, 75 and 100 mL of spent engine oil (116.3, 73, 56.4 and 28.6 cm^2, respectively). Among the polluted soil, mean leaf area in plants grown in 25 mL ofspent engine differed significantly compared to other treatment studied (Table 2). Like other growth parameters assessed, plants receiving 100 mL of spent engine showed the least mean leaf area development. The findings supported the data presented for *Chromolaena odorata* and *Arachis hypogaea* (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. Spent engine oil affect plant growth at all concentrations studied because it interferes with factor such as soil aeration, mineral availability, plant water relation and suitable warmth that are suitable for plant growth and development (Rowell, 1977; Amakiri and Onofeghara, 1983; Esenowo *et al*., 2006).

CONCLUSION

From the findings of this study, it is crystal clear that spent engine oil as low as 25 mL 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.

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