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Growth Performance of Groundnut and Incidence of Foliar Diseases (*Arachis hypogaea* L) in Spent Engine Oil Polluted Soil Augmented with Cow Dung

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Abstract: In this study, the growth of groundnut (*Arachis hypogaea* L cv Samnut 10.) as well as incidence of foliar diseases as affected by different concentrations of spent engine oil (SEO) augmented with varying concentrations of cow dung was investigated. Generally, growth of *A. hypogea* in terms of plant height, number of leaves, stem girth and leaf area was significantly ($p<0.05$) enhanced in the control (unpolluted soil) and in those soils treated with 100g of cow dung, 25g spent engine oil augmented with 75g cow dung and 75g spent engine oil augmented with 25g cow dung compared to other treatments where soils were polluted with 50g spent engine oil augmented with 50g cow dung and 100g spent engine oil without augmentation. It was also observed that the performance of the crop improved as the period of study increased in those treatments where growth was enhanced. The incidence of leaf spot diseases was also observed to be checked in soils with high concentration of spent engine oil. It is being recommended that for better performance of the test crop adequate quantity of cow dung should be used in relation to the concentration of the contaminant.

Key words: Foliar disease · Pollution · Dung · Augmentation · Engine oil

INTRODUCTION

Pollution is the introduction of contaminant into a natural environment in an amount that can harm the living organisms. Pollution on plants, animals and micro-organisms has been reported by many researchers. For instance, oil spill in the area of Niger-Delta and indiscriminate disposal of spent engine oil into gutters, water drains, vacant plots among automobiles mechanics that change oil from vehicles have been found to retard plant growth and cause the death of most aquatic animals [1, 2]. Also, spill oil pollutes soil and make the soil to be less useful for agricultural activities with soil dependent organisms been adversely affected [3, 4]. It has also been observed that soil polluted with engine oil experience what can be described as physiological drought that affect plant water relation and root respiration that are necessary for plant growth and development [5]. Spent engine oil in soil has been found to interfere with plant nutrients uptake and where plant and soil microbes compete for little nutrient available in polluted soil, growth of the plant in such soil would be adversely affected [6]. Similarly, Olayinka and Arinde [7] had reported that spent engine oil at 25 mL concentration could be considered inhibitory to groundnut growth and that higher concentration of this contaminant could be phytotoxic.

It is a known fact that when soil not suitable for plant growth is augmented with manure, growth and performance of plants in such soil are enhanced. Merck *et al.,* [8] reported that addition of inorganic fertilizer in a crude oil polluted soil enhances the growth and performance of *Branchiaria brizantha* (Hochst.exA. Rich) Stapf. The use of inorganic fertilizer to enhance crop growth according to the authors of the test crop was not cost effective. Kelechi*et al.,* [9], in their study had found that cow dung (organic manure) apart from enhancing growth and performance of soya bean (*Glycine max*) grown in crude oil contaminated soil, it is relatively cheaper and more affordable to farmer than inorganic fertilizer.

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Groundnut (*Arachishypogaea* L.) is an annual legume crop. It belongs to Fabaceae family. It is both a pulse and oil crop better still the kingpin among oil producing crops. The crop was believed to have been introduced into Africa by the Portuguese [9]. It has a variety of uses such as vegetable cooking oil, livestock feeds and groundnut cake ("Kulikuli" in Yoruba and Nupe). It is also consumed as salted nut, roasted nut and boiled nut. The present investigation is therefore designed to determine the quantity of cow dung that could be added to soil polluted with varying concentrations of spent engine oil to make the soil favorable for the growth of groundnut. Also, the incidence of foliar diseases was also monitored.

MATERIALS AND METHODS

Source of Materials: Groundnut seeds (*Arachishypogaea L* cvSamnut 10) used for the experiment were obtained from College of Agriculture- Mokwa in Niger State. The seeds were cleaned to remove foreign particles and packed in paper envelop until they were used for experiment. Spent engine oil was obtained from different automobile workshop at Lafiagi in Edu Local government of Kwara state Nigeria. Cow dung was sourced from a cattle rearer in Lafiagi. Sandy and loamy soils were separately collected at farm belonging to Kwara state College of Education (Technical) Lafiagi. The soils were then mixed in the ratio 1:1 to obtain sandy-loam soil. The soil was sieved with 2mm wire mesh to obtain uniform particle used for experiment.

Soil Pollution and Augmentation: The present study was carried out at Kwara State College of Education (Technical) Lafiagi situated in northern Guinea savanna zone of Nigeria (latitude 8°, 50^1N and longitude 5°, 25^1E.) Eighteen plastic containers measuring 17 by 17cm were filled with 3kg of the soil. Holes were drilled at the bottom to facilitate drainage. The containers were separated into six batches to accommodate the six treatments. Each treatment had three replicates fitted into completely randomized block design. The six treatments were established by mixing different concentrations of spent engine oil and cow dung in ratio 0:0; 0:1; 1:0; 1:1; 1:3; 3:1 as follows S(0) + C(0) = 0g spent engine oil + 0g cow dung (control), S(0) + C(1) = 100g cow dung alone; S(1) + C(0) = 100g spent engine oil alone; S(1)+ C(1)= 50g spent engine oil + 50g dung; S(1) + C(3) = 25g spent engine oil +75g cow dung and S(3) + C(1) = 75g spent engine oil + 25g cow dung.

Planting: Groundnut seeds were sown in the soil at the rate of five seeds per container at depth of 2cm. Watering was done at every other day up to field capacity to keep the soil moist for normal growth. Prior to sampling, the seedlings were thinned down to one healthy seedling per container.

Pathological Studies: Fungi associated with the soil samples were isolated using serial dilution method. One gram of soil sample was aseptically transferred into 9ml of sterile distilled water in test tubes and shaken properly to allow even distribution of microorganism present in the sample. A dilution factor 10^{-1} and 10^{-2} were used as stock solution. One ml of each dilution was aseptically taken from the suspension and transferred into sterile Petri dishes. Then Potatoes Dextrose Agar (PDA) was poured into the Petri dishes containing the suspension and 1ml of chloraphenicol. The plates were swirled gently to allow even distribution of the sample in the medium and were incubated at room temperatures (28 ± 2°C) for 24 hours. From the culture obtained, sub-culturing were made to get the pure culture of each fungus isolated. Fungi isolated were identified using Fungi Families of the world mycological monographs by Samsonand Reenen-Hoekstra, [10]. Stock cultures were also prepared using slant Potatoes Dextrose Agar in sterile McCartney bottles and preserved at 4°C in a refrigerator (Amadi and Adebola [11]. Incidence of foliar diseases was monitor throughout the period of the experiment.

Data Collection and Anlysis: A simple nondestructive method adapted from Wood and Roper [12] was employed to collect growth parameters like plant height, number of leaves, stem girth and leaf area. Plant height was measured using 30cm meter rule. This was achieved by measuring the plant from soil level up to the tip of terminal bud of the central axis. Leaf number was manually counted. Stem girth was measured by encircling the stem at 3cm above soil level with thread. The thread was then cut and measured on 10cm meter rule. Leaf area was determined by measuring the width and length of a fully opened leaf at the widest and longest point. The values obtained were then multiplied and divided by two and multiplied the result by total number of leaves of the corresponding treatment.

Data obtained were subjected to one way Analysis of Variance using Statistical Package for Social Science (SPSS). The means were separated using Duncan's Multiple Range Test [13].

RESULTS

Table 1 shows that *A. hypogaea* mean height in the control treatment at 56 days was 58.77cm and this was statistically ($p<0.05$) greater than those of *A. hypogaea* grown in soils polluted with 25g spent engine oil augmented with 75g cow dung, 50g spent engine oil augmented with 50g cow dung, 75g spent engine oil augmented with 25g cow dung, 100g spent engine oil and 100g cow dung with mean values of 36.93cm, 11.10cm 29.40cm and 48.63cm respectively. A marked reduction in plant height was observed in soil polluted with 50g spent engine oil augmented with 50g cow dung as well as those polluted with 100g spent engine oil without cow dung. All other treatments showed increase in mean plant height from 14 days after planting (DAP) till final day of sampling (56 DAP) (Table 1).

Table 2 shows that mixture of spent engine oil and cow dung caused significant reduction in the number of leaves compared to the control at 56 DAP. Significant reduction in number of leaves was observed for *A. hypogaea* grown in soil polluted with 100g spent engine oil and those polluted with 50g spent engine augmented with 50g cow dung (17.33n/p and 10.67n/p respectively). However, leaf production was enhanced in soil polluted with 25g spent engine oil augmented with 75g cow dung and those polluted with 75g spent engine augmented with 25g cow dung with mean values of 46.0n/p and 36.3n/p respectively.

At 56 days of planting, the mean stem girth of control plant (1.50cm) was significantly greater than those from *A. hypogaea*grown in soil polluted with 50g spent engine oil augmented with 50g cow dung, 75g spent engine oil augmented with 25g cow dung and 100g spent engine oil (0.50cm, 1.06cm and 0.53cm respectively) (Table 3).

Further still, stem girth increment in soil polluted with 25g spent engine oil + 75g cow dung was in no way significantly different from those in the control and that of soil treated with 100g of cow dung without spent engine oil (Table 3).

Table 4 shows that *A. hypogaea* means leaf area of control at 56 days was 365.75 cm^2 and was significantly ($p<0.05$) greater than those of A. *hypogaea* in soil polluted with 75g spent engine oil augmented with 25g cow dung, 50g spent engine oil augmented with 50g cow dung, 25g spent engine oil augmented with 75g cow dung, 100g spent engine oil, and 100g cow dung with mean values of149.94cm^2 17.94cm^2 78.8cm^2, 32.48^{2}cm and 233.52cm^2 respectively. A significant reduction in leaf area was observed in *A. hypogaea* grown in 100g spent engine oil and those polluted with 50g spent engine oil augmented with 50g cow dung. From all other treatments studied, leaf area increased with increase in age of the plants (Table 4).

Table 1: Plant height of *A. hypogaea* as affected spent engine oil augmented with cow dung

	Mean plant height (cm)			
Treatment	14 DAP	28 DAP	42 DAP	56 DAP
S(0) + C(0)	24.40±0.97^{ab}	39.57±2.71^{b}	50.30±4.31^{a}	58.77±4.82^{a}
S(0) + C(1)	23.90±0.44^{ab}	43.20±2.09^{a}	43.20±2.09^{ab}	48.63±2.03^{ab}
S(1) + C(0)	21.47±0.68^{b}	26.80±2.78^{bc}	28.10±3.18^{c}	17.80±9.61^{de}
S(1) + C(1)	28.80±1.93^{a}	26.47±4.58^{bc}	24.30±8.46^{c}	11.10±6.05^{e}
S(1) + C(3)	17.23±0.90^{c}	25.00±0.87^{c}	32.60±0.78^{bc}	36.93±1.14^{bc}
S(3) + C(1)	19.70±1.33^{bc}	25.97±1.27^{bc}	28.90±2.78^{c}	29.40±3.51^{cd}

Table 2: Number of leaves of *A. hypogaea* as affected spent engine oil augmented with cow dung

	Mean number of leaves (n/p)			
Treatment	14 DAP	28 DAP	42 DAP	56 DAP
S(0) + C(0)	28.0±0.00^{abc}	39.00±1.15^{ab}	44.67±0.33^{ab}	60.33±6.33^{a}
S(0) + C(1)	34.670±3.53^{a}	45.00±5.51^{a}	55.00±7.94^{a}	67.67±7.17^{a}
S(1) + C(0)	22.33±2.33^{bc}	32.33±4.18^{bc}	32.33±4.18^{bc}	17.33±8.74^{cd}
S(1) + C(1)	20.6.7±0.67^{c}	24.33.2.33^{c}	22.33±6.81^{c}	10.67±7.45^{d}
S(1) + C(3)	30.67±3.53^{ab}	37.67±3.28^{ab}	42.33±4.48^{ab}	46.00±5.29^{ab}
S(3) + C(1)	23.67±3.67^{bc}	30.33±4.49^{bc}	33.33±7.42^{bc}	36.33±4.91^{bc}

Table 3: Stem girth of *A. hypogaea* as affected spent engine oil augmented with cow dung

	Mean Stem girth (cm)			
Treatment	14 DAP	28 DAP	42 DAP	56 DAP
S(0) + C(0)	1.20±0.06^{a}	1.50±0.00^{a}	1.50±0.00^{a}	1.50±0.00^{a}
S(0) + C(1)	1.37±0.44^{a}	1.43.±0.07^{ab}	1.22±.0.61^{ab}	1.47±0.03^{a}
S(1) + C(0)	1.13±0.07^{a}	1.13±0.07^{c}	1.13±0.07^{bc}	0.53±0.29^{b}
S(1) + C(1)	1.10±0.10^{a}	1.00±0.10^{c}	0.93±0.18^{c}	0.50±0.26^{b}
S(1) + C(3)	1.20±0.12^{a}	1.27±012^{abc}	1.27±0.12^{abc}	1.27±0.12^{a}

Table 4: Leaf area of *A. hypogaea* as affected by spent engine oil augmented with cow dung

	Mean Leaf area (cm^2)			
Treatment	14 DAP	28 DAP	42 DAP	56 DAP
S(0)+C(0)	90.37±2.39^{a}	198.80±19.24^{a}	252.08±11.88^{a}	365.75±16.47^{a}
S(0)+C(1)	100.76±13.85^{a}	223.18.±37.90^{a}	245.19±.66.49^{a}	247.52±6.17^{b}
S(1)+C(0)	47.12±3.15^{bc}	68.59±6.64^{bc}	64.34±6.80^{b}	32.48±17.60^{de}
S(1)+C(1)	35.55±5.42^{c}	51.88±8.80^{c}	41.15±15.90^{b}	17.94±13.77^{a}
S(1)+C(3)	58.99±1.53^{b}	125.08±6.73^{b}	120.09±15.98^{b}	149.09±21.09^{c}
S(3)+C(1)	33.77±0.83^{c}	68.55±7.22^{bc}	74.74±14.97^{b}	78.82±13.14^{d}

Legend: DAP= Days After Planting; S(0) +C (0)= 0g spent engine oil + 0g cow dung (Control);

S(0) + C(1)= 100g cow dung alone; S(1) + C(0)= 100g spent engine alone; S(1) + C(1)= 50g spent engine oil + 50g cow dung; S(1) + C(3)=25g spent engine oil +75g cow dung and S(3) + C(1)= 75g spent engine oil + 25g cow dung.

Results are expressed as mean ± S.E (N=3)

Values with the same superscripts are not significantly different at $p<0.05$.

Fungi Isolates: Nineteen species (19) of fungi from nine different genera (Table 5) were isolated from the soil

Table 5: Fungi isolated from the treatment plots

	Treatment					
Fungi isolated	S(0)+C(0)	S(0)+C(1)	S(1)+C(0)	S(1)+C(1)	S(1)+C (3)	S(3)+C(1)
Aspergillusniger	+	+	+	+	+	+
Aspergillusflavus	+	+	+	+	+	+
A. repens	+	+	+	+	+	-
A. terreus	+	+	+	+	+	-
A. Fumigates	+	+	+	+	+	+
Penicilumnotatum	+	+	+	+	+	-
P. italicum	-	+	-	+	+	-
P. digitatum	-	+	+	+	+	+
Trichodermaviride	+	+	+	+	+	-
T. harzianum	+	+	+	+	+	-
Fusariumsolani	-	+	+	-	-	-
F. oxysporium	+	+	+	-	-	-
Rhizopusstolonifer	+	+	+	+	+	+
Rhizoctoniasolani	-	+	-	-	+	+
Armillariasp	+	+	+	+	+	_
Armillariasp	+	+	+	+	+	+
Phytophthorainfestan	-	+	-	-	+	+
Cercosporaarachidicola	+	+	+	+	+	-
Cercosporapersonata	+	+	+	+	+	_

Legend: + = Present; - Absent; S(0) +C (0)= 0g spent engine oil + 0g cow dung (Control); S(0) + C(1)= 100g cow dung alone; S(1) + C(0)= 100g spent engine alone; S(1) + C(1)= 50g spent engine oil + 50g cow dung; S(1) + C(3)=25g spent engine oil +75g cow dung and S(3) + C(1)= 75g spent engine oil + 25g cow dung.

ninety days after planting. Majority of these fungi were soil borne. Only *Aspergillus* and *Rhizopus* species were isolated from treatments with high concentration of spent oil (75g spent engine oil + 25g cow dung). Incidence of early and late leaf spot diseases was observed in all the treatments but more pronounced in treatments without spent oil (0g spent engine oil + 0g cow dung and100g cow dung alone). Symptoms observed at the lower leaf surface were light-brown spots surrounded by yellow halo and black spot without yellow halo. However, no other visible symptom aside these two were noted.

DISCUSSION

In the present study, it has been observed that soil polluted with spent engine oil and augmented with cow dung enhanced the growth of the test crop (*A. hypogaea*)at certain treatment levels and this is to say that the performance of the *A. hypogaea* is a function of the quantity of cow dung that was added as soil amendment in relation to the concentration of the contaminant [6]. In this study, It was found that *A. hypogaea* plant height, number of leaves, stem girth and leaf area in soil polluted with 100g of spent engine oil alone were adversely affected after 42 days of sampling. Mayer and Polyakoff-Mayber [14] reported that the growth of plants could be affected by the chemical content of the growth medium. Growth behaviours as observed in this study, in *A. hypogaea* grown in soil polluted with 50g spent engine oil augmented with 50g cow dung and in those plants polluted with 100g of spent engine oil alone could be linked to inability of plants in these treatments to metabolize carbon that form the bulk of both the contaminant and the cow dung. Ang *et al.,* [15] reported that large amount of hydrocarbons in used oil, including the highly toxic poly aromatic hydrocarbon (PAHs) could become inhibitory to plant growth.

In soil polluted with 25g spent engine augmented with 75g cow dung or soil polluted with 75g spent engine oil augmented with 25g cow dung growth parameters (plant height, number of leaves, stem girth and leaf area) were significantly enhanced with increase in age of *A. hypogaea.* The plausible explanation that could be adduced is that the mixture at these concentrations is not inhibitory to plant growth due to increase in the quantity of cow dung as soil amendment. Thus, making it possible for plants in these treatments to tolerate and metabolize the carbon content of both the contaminant and the augment for better growth. Obire *et al.,* [16] had earlier observed that the addition of nutrients such as cow dung and poultry droppings to the environment where oil is spilled will enable microorganisms to regain enough ability to overcome the limitation of inability to detoxify petroleum products. Generally, *A. hypogaea* of the control and those treated with 100g of cow dung alone showed better growth with respect to all the parameters assessed when compared to other treatments studied. The findings are in congruent with the data presented for *Glycine max* [6]. All the fungi isolated were soil borne and the early and late leaf spots diseases observed were probably caused by *Cercospora arachidicola* and *Cercospora personata* [17,18]. The absence or reduction in number of fungi isolates and little incidence of the diseases observed in treatments with spent oil may probably be due to the fact that spent oil is an organic solvent which probably prevent the entrance of air into the pore spaces of the soil. Thus inhibiting the germination of fungi spores or preventing the proliferation of the mycelium in the soil.

CONCLUSION

The results from this study, revealed that cow dung could be used to augment soil polluted with spent engine oil. Also, for better performance of the groundnut the amount of cow dung to be added to reclaim soil depends on the concentration of the contaminant. In spite of growth retardation caused by spent engine oil, evidence from this study revealed that the used oil has the advantage of preventing leaf spot diseases caused *Cercospora* species.

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