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Effect of spent engine oil on the germination and growth of *Amaranthus hybridus* L.

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ABSTRACT: The susceptibility of *Amaranthus hybdridus* L. to spent engine oil was examined in soil treated with concentrations of oil ranging from 1 – 5%v/w (oil/soil). A relationship exist between the inhibitory effects and the treatment concentrations. Treatment of soil with 4 and 5% spent engine oil consistently inhibited germination. Fifty four days after sowing, the mean height and leaf area of plant in soil treated with 1% spent engine oil were 6.57 ± 0.01cm and 1.04 ± 0.01cm^2. These were significantly different at p = 0.05 from the respective values of 13.96 ± 0.00cm and 5.97 ± 0.01cm^2 for the control plants. However, plants grown in soil treated with 2 and 3% spent engine oil died prematurely.

Key words: *Amaranthus hybridus*, Engine oil, Pollution, Growth.

Introduction

Crude oil production and the use of its refined products have contributed immensely to the high level of environmental problems in many parts of the world. Engine oil is a petroleum product which aids in the reduction of friction between engine surfaces, and it is produced by vacuum distillation of crude oil (10). It is a complex mixture of petroleum hydrocarbons, they include long chain molecules, which result in relatively high viscousity and contribute to the difficulty in separation for chemical analysis. Spent engine oil is obtained after servicing and subsequent draining from automobile and power generator engines. Most monitoring of spills and experimental research has focused on crude oil and refined products such as jet fuel, Nos. 2 and 6 fuel oils and bunker C. It was reported that annual total of 180 million gallons of spent motor oil improperly disposed of not only pollutes terrestrial habitats and groundwater, but also accounts for 40% of the total pollution of the Mexican waterways (2).

Pollution from spent engine oil is one of the environmental problems in Nigeria and obviously more widespread than crude oil pollution. The ever increasing frequency of occurrence over a wide geographical spread will in no doubt cause severe environmental problems to future generations if not properly controlled. Nigeria accounts for more than 87 million litres of spent engine oil annually (2) and adequate attention has not been given to its proper disposal. Indiscriminate disposal of the spent lubricant into gutters, water drains, open fields, and farms is a common practice, especially among motor mechanics who change oil from motor vehicles, generators and other machines. This poor method of disposing spent

engine oil and metals present from engine wear, undoubtedly contribute to the pollution of the environment.

Despite the large quantity of engine oil used and their improper disposal in Nigeria, studies typically have not focused on its potential environmental effects, hence toxicity of discharged spent engine oils are poorly understood and documented. We undertook a study of the effects of spent engine oil on the germination and above ground growth of *Amaranthus hydridus* seeds and seedlings respectively.

Our focus was to determine:

(i) If there were negative effects of spent engine oil on germination and seedling survival or growth.
(ii) If there were differences in the magnitude of effects based on concentration differences.

In our experiment, we chose to use *Amaranthus hybridus* because it is a common leafy vegetable widely cultivated in domestic garden both in rural and urban areas in Nigeria. The leaves and young stems of the plant are consumed as vegetables.
Amaranthus hybridus L. belong to the family Amaranthaceae. The family is represented in West Africa by 14 genera and 37 species (9).

Materials and Methods

Seeds of *Amaranthus hybridus* L. were purchased as a single batch from a domestic garden at Idi-Araba, Lagos, Nigeria. Spent engine oil was obtained from three different auto mechanic workshops at Ikeja, Lagos. The mixture of the three was used for the study. The sandy-loam soil with pH 7.7 was collected from the botanical garden of the University of Lagos and was analysed for the presence of some heavy metals using the Atomic Absorption Spectrophotometer (AAS) ALPH 4 model.

Soil of known weight was treated with 1,2,3,4 and 5% v/w spent engine oil before placing in nursery bags, while soil devoid of oil served as control. Treatment of the soil was carried out by manual mixing of the soil with oil in plastic bowls. The mixing processes were gradually done to ensure thorough mixing. Viable seeds, determined by flotation were sown in nursery bags containing soil supplemented with water (control) and spent engine oil at different strengths. Each treatment had 10 seeds and was replicated three times. Individual seed served as an observation and after germination the number of seedlings per nursery bag was reduced to 2 to avoid over crowding. Water was added to all treatments when necessary in order to keep the soil moist.

Germination (%) records were monitored on a two-day interval up to 8 days and seeds, which failed to sprout after that time, were regarded as having not germinated. The height of the plants was measured from the soil level to the terminal bud. The leaf area was determined by comparing the weight of a cut out traced area with standard paper of known weight to area ratio (8). At the end of the field experiment, treated soils were collected and analyzed for the same heavy metals, the purpose of this was to ascertain whether changes in the level of the metals in the soil occurred with the treatment. One way analysis of variance (ANOVA) was carried out to compare the means.

Results and Discussion

Four days after sowing 100% germination of the control seeds was observed (Table 1). Compared with the control, a significant reduction ($p=0.05$) in percentage germination were observed in soil treated with 2 and 3% spent engine oil while no germination was recorded of the seeds sown in soil treated with 4 and 5% spent engine oil (Table 1). The mean heights of 36 day-old seedlings showed that the control plant (7.94 ± 0.00cm) were significantly greater than those sown in soil treated with 1% (3.53 ± 0.00 cm), 2% (1.94 ± 0.01 cm) and 3% 1.07 ± 0.01 cm) spent engine oil at $p = 0.05$ (Table 2). Seedlings in 2 and 3% oil treated soil grew rather slowly (compared with control) and later died prematurely after 45 and 38 days of seedling emergence respectively.

Table 1: Percentage germination of *Amaranthus hybdridus* seeds 8 days after sowing in soil treated with water (control) and spent engine oil (mean ± standard error). n = 30.

% Concentration	% Germination
0	100.00 ± 0.00
1	90.00 ± 0.58
2	46.67 ± 0.33
3	13.33 ± 0.33
4	0
5	0

Table 2: Effect of spent engine oil on height (cm) of *Amaranthus hybridus* (mean values ± standard error). n = 3.

Conc. (%)	Time (Days)						
	8	15	22	29	36	43	50
0	1.44 ± 0.00	2.75 ± 0.01	3.93 ± 0.01	5.71 ± 0.01	7.94 ± 0.00	10.67 ± 0.00	13.96 ± 0.00
1	0.61 ± 0.00	1.93 ± 0.00	1.96 ± 0.01	2.83 ± 0.00	3.53 ± 0.00	4.14 ± 0.00	6.57 ± 0.01
2	0.36 ± 0.00	0.62 ± 0.00	0.91 ± 0.00	1.36 ± 0.01	1.94 ± 0.01	2.34 ± 0.01	–
3	0.33 ± 0.00	0.52 ± 0.00	0.71 ± 0.00	0.97 ± 0.01	1.07 ± 0.01	–	–
4	–	–	–	–	–	–	–
5	–	–	–	–	–	–	–

– = No growth.

Table 3: Effect of spent engine oil on leaf area (cm^2) of *Amaranthus hybridus* (mean values ± standard error). n = 3.

Conc. (%)	Time (Days)						
	8	15	22	29	36	43	50
0	–	–	2.04 ± 0.01	2.92 ± 0.01	5.20 ± 0.01	5.58 ± 0.01	5.97 ± 0.01
1	–	–	–	0.21 ± 0.01	0.48 ± 0.01	0.86 ± 0.01	1.04 ± 0.01
2	–	–	–		0.21 ± 0.00	0.38 ± 0.01	–
3	–	–	–		–	–	–
4	–	–	–	–	–	–	–
5	–	–	–	–	–	–	–

Fifty days after seedling emergence, control plants were 13.96 ± 0.01 cm tall and 3.97 ± 0.01 cm^2 leaf area. These values were significantly greater (p=0.05) than those sown in soil treated with 1% spent engine oil which were 6.57 ± 0.01 cm tall with 1.04 ± 0.01 cm^2 leaf area (Table 2and 3). The result of the soil analysis before the spent engine oil treatment indicated high level of copper (9.98mg/kg soil), while lead, aluminium, nickel and iron were below detection level (Table 4). However, a high value of 33.6 mg/kg of lead was detected in oil treated soil (Table 4).

Table 4: Metal concentrations (mg/kg) of both untreated and treated soils (5% w/v spent engine oil/soil) at the end of the experiment.

Metal	Concentration (mg/kg)	
	Untreated	Treated
Lead	Below detection	33.60
Aluminium	Below detection	Below detection
Nickel	Below detection	Below detection
Copper	9.98	Below detection
Iron	Below detection	Below detection

The inhibitory effect of oil on seed germination may be due to the unfavourable soil conditions. The waxy texture of the soil contaminated with oil contribute to a reduced oxygen content of the soil (4). It was observed in this study that high concentrations of spent engine oil in soil inhibited germination and this agreed with the findings of Anoliefo and Vwioko (1995). Results obtained from the present study also indicated that spent engine oil of different concentrations adversely affected the growth of *Amaranthus hybridus*.

Plants in soils treated with 2 and 3% spent engine oil died prematurely. This observation also agreed with the report of Anoliefo and Vwioko (1995) that *Lycopersicon esculentum* Miller grown in soil treated with 1, 2 and 3% spent lubricating oil died prematurely.

Metals present in spent lubricating oil are not necessarily the same as those present in the unused lubricant (7). The findings in the present study agreed with this. It was found in the present study that lead, which was below the detection in the untreated soil, gave a value of 33.6 mg/kg in soil treated with 5% v/w engine oil. The study had shown that spent engine oil has a high inhibitory effect on the germination, growth and survival of *Amaranthus hybridus*.

Quite a volume of spent engine oil are being disposed of indiscriminately into water canals and open fields in this country and other developing nations with little or no regard to its environmental implications. The conservation of the environment *viz*: water, soil, air, vegetation and space in Nigeria should be given the necessary priority in order to preserve the quality of life. Any policy that will achieve this requires a framework that links other element of government policies, such as Public Health, Economic and Territorial Development and Technology.

Considering this line of thought and bearing in mind the ever increasing level of pollution from engine oil in Nigeria, three things are essential:

(i) Public awareness about the danger of environmental pollution.
(ii) Bringing the present indiscriminate disposal system under control through the formulation of policies and legislation on codes of conduct for future disposal or collection of spent lubricants.
(iii) The need to consider the economic value of recycling the spent lubricants.

The results from the study indicated that spent engine oil that were not properly disposed of had significant effects on plant growth and survival. It is the opinion of the authors that in a developing country like Nigeria, spent engine oil can at least be disposed of in an environment friendly manner, if they can not be recycled. Let us save the environment, to live a healthy life.

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