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GROWTH AND YIELD PERFORMANCE OF COWPEA (*Vigna unguiculata*) (L.) WALP. POLLUTED WITH SPENT LUBRICATING OIL

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Abstract: The contamination of soil by used lubricating oil is rapidly increasing due to global increase in the usage of petroleum products. The effect of spent lubricating oil on the growth and yield response of cowpea *Vigna unguiculata* (L) Walp was investigated using potted plants in soil contaminated with different concentrations of spent lubricating oil. The 3kg of soil was mixed homogeneously with 50.0mL, 75.0mL and 100.0mL of spent lubricating oil and the control (0.0mL). The growth parameters shows that the application of spent lubricating oil had a significant reduction ($p<0.05$) on the plant height, leaf area, fresh weight, dry weight and the harvest index of the cowpea seedlings studied. The reductions and morphological effects in the growth characteristics measured shows that there was an increase as the concentration level of the contaminant increases compared to the control. The concentrations of copper, cadmium, iron, lead and nickel in soil contaminated with spent lubricating oil increased with the volume of treatment. Heavy metal concentrations in the shoot and root of treated plants were higher than that of the control. This could be responsible for the retarded growth of the plant, chlorosis of the leaves coupled with dehydration of the plant indicating water deficiency.
Keywords: Chlorosis; Harvest index; Heavy metal; Spent Lubricating Oil; *Vigna unguiculata*.
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INTRODUCTION

Soil is a vital component of the farming ecosystem and environmental sustainability largely depends on proper soil maintenance. Soil pollution by crude oil and petroleum products such as spent engine oil, fuel oils, and diesel fuels are presently a menace in Nigeria, particularly in big cities. Oil pollution in whatever form is toxic to plants and soil micro-organisms (Adedokun and Ataga, 2007). The presence of petroleum products in the environment poses danger to the growth of plants and the wellbeing of animals resident or dependent on the environment. The presence of spent lubricating oil in soil increases bulk density, decreases water holding capacity and aeration propensity (Kayode *et al*., 2009). Vwioko *et al*., 2008 and Kayode *et al*., 2009 also noted reduced nitrogen, phosphorus, potassium, magnesium, calcium, sodium and increased levels of heavy metals in soils contaminated with spent oil. When released into the soil, they constitutes havoc to life forms by reducing their growth, development, agricultural productivity and yield as well as affecting the natural ecological functions (Odum, 1981) leading to environmental degradation, health hazards and destruction of crop plants (Agbogidi *et al*., 2013; Ikhajiagbe *et al*., 2013). Cowpea *Vigna unguiculata* (L.) Walp is a leguminous plant belonging to the family Fabaceae. It is grown mostly for their edible beans. In Africa, it is the most popular legume and the largest part of world production originates from this continent (Lambot, 2002). It

is also used to control erosion and to improve soil properties. Cowpea provides a rich source of protein and calories, as well as mineras and vitamins. This study aimed at evaluating the ecological effects of spent lubricating oil on the growth and yield performance of cowpea *Vigna unguiculata*.

EXPERIMENTAL

A screen house experiment was conducted in the school farm of the Federal University of Technology, Akure, Ondo state, Nigeria. Seeds of *Vigna unguiculata* used were purchased from the Ministry of Agriculture, Ondo state. Nigeria. The spent lubricating oil was obtained from Motor Mechanics at Freeman area in Akure, Ondo state, Nigeria. Loamy soil was used for the experiment and the seeds were tested for viability. The experimental design was laid out in a completely randomized design (CRD) with three levels of spent lubricating oil concentrations of 50.0mL, 75.0mL, 100.0mL and 0.0mL which was the control. Each concentration had four replicates. The treatments were thoroughly mixed with hand to have a homogenous mixture and left for a period of five days without planting. This was done for uniformity of oil, moisture content, air content, temperature and effective activities of soil micro-organisms (Kayode *et al*., 2009). Hand weeding was done as necessary. The plants grew for ten weeks before the experiment was terminated. Several parameters were used in assessing the growth and productivity of the plant. The height of shoots was measured using a tape rule in (cm) from the soil level to the terminal bud. The measurements were taken in an interval of 2 weeks from the day the treatment commenced to the day of harvest. Leaf area was determined using a leaf area meter. The harvest index was determined by the method of Ekanayake (1994). Data obtained were subjected to analysis using the Statistical Package for Social Sciences, Version 21.0. Treatment means were separated using the New Duncan Multiple Range Test.

RESULTS AND DISCUSSIONS

The effect of spent lubricating oil on the plant height (cm), leaf area (cm) and fresh weight (g) of *Vigna unguiculata* are presented in Table 1. The height of the plant increased progressively in the control from week 2 to week 10. The plant had the highest plant height at the control (0ml) compared to the other treatments. At 4 weeks of transplanting, the leaves turned brownish, withered with 60% leaf abscission. The dropping and eventual collapse of leaves stretched over a period of 6-10weeks. The leaves were chlorotic and necrotic. At week 10, the plant became stunted and slender stems were observed in most of the treated plants especially at high volume. The reduction of the plant growth observed could be due to the reduction of mineral elements with increasing oil concentration in the soil.

Table 1. Plant height (cm), leaf area (cm), fresh weight (g), of *Vigna unguiculata*, polluted with spent lubricating oil (SLO),10 weeks after treatment

Volume of SLO	Plant height (cm)	Leaf area (cm)	Fresh weight (g)
0mL (Control)	68.20 ± 12.20 a	41.42 ± 6.70a	140.60 ± 16.30a
50.0mL	46.23 ± 11.24 b	33.08 ± 5.60b	110.40 ± 10.80b
75.0mL	35.10 ± 06.10 b	24.20 ± 2.38b	60.28 ± 7.20c
100.0mL	20.41 ± 03.01 c	10.63 ± 1.52c	46.00 ± 2.10d

Mean values with the same letter are not significantly different at (P>0.05) using New Duncan Multiple Range Test.

Table 2. Dry weight (g) and harvest index of *V. unguiculata* polluted with spent lubricating oil (SLO), 10 weeks after treatment

Volume of SLO	Dry weight (g)	Harvest index
0.0mL (Control)	82.64 ± 8.24a	0.6
50.0mL	56.40 ± 4.12b	0.4
75.0mL	42.73 ± 3.6 b	0.3
100.0mL	28.62 ± 2.51c	0.1

Mean values with the same letter are not significantly different at (P>0.05 using New Duncan Multiple Range Test.

Table 3. Heavy metal concentration (ppm) on the shoot of *Vigna unguiculata* polluted with spent lubricating oil

CONCENTRATION	Cu	Cd	Fe	Pb	Ni
0.0mL	0.02	0.01	0.45	0.01	0.01
50.0mL	0.09	0.02	0.62	0.03	0.02
75.0mL	0.11	0.03	0.78	0.04	0.04
100.0mL	0.22	0.06	0.85	0.07	0.05

Table 4. Heavy metal concentration (ppm) on the root of *Vigna unguiculata* polluted with spent lubricating oil

CONCENTRATION	Cu	Cd	Fe	Pb	Ni
0.0mL	0.11	0.01	2.11	0.04	0.01
50.0mL	0.14	0.02	2.36	0.07	0.04
75.0mL	0.18	0.04	2.91	0.20	0.13
100.0mL	0.31	0.08	3.14	0.30	0.20

All the growth parameters were significantly reduced by the spent lubricating oil. This is in agreement with the findings of Nwoko *et al.,* 2007 that the presence of spent lubricating oil in the soil-microenvironment appears to have affected normal soil chemistry where nutrient release and uptake as well as the amount of water have been reduced. The reduction of the growth parameters observed could also be due to the reduction of mineral elements with increasing oil concentration in the soil as reported by Odjegba and Atebe (2007). Spent lubricating oil at 100.0ml caused chlorosis and necrosis on the plant leaves. It is well reported by many workers that plants sensitive to spent lubricating oil can present changes in their morphology, anatomy, physiology and biochemistry (Agbogidi and Ejemete, 2005). All plant growth parameters studied the plant height, leaf area and fresh weight were decreased significantly at all concentrations with respect to the control and the highest reduction was observed at 100.0mL (Table 1). The adverse effects of spent lubricating oil on the plant growth parameters on several crops were observed by (Anoliefo and Vwioko, 2001; Osubor and Anioliefo 2003; Agbogidi *et al*., 2006; Ogbuehi and Ezeibekwe, 2010, Mohammed and Folorunsho, 2015).

Dry weight and harvest index was highest at 75.0ml and 100.0ml compared to the control plants (Table 2) and this have also been reported by a number of authors (Agbogidi and Ejemete, 2005; Agbogidi and Eshegbeyi, 2006; Adewole and Moyinoluwa, 2012). According to Iglesias *et al*., 1994 and Dietmar *et al*., 2014, harvest index of 0.5- 0.6 is the optimum level for crops because at higher values of harvest index, root production decreases due to reduced leaf area, light interception and photosynthesis. The most common heavy metals found on the root and shoot of the cowpea seedlings studied were Copper (Cu), Cadmium (Cd), Iron (Fe), Lead (Pb) and Nickel (Ni) (Table 3 and 4). Fernandes and Henriques, 1991, Agbogidi *et al.,* 2007, Mohammed and Folorunsho 2015, Ruqia *et al*., 2015 discovered that some heavy metals at low concentrations are essential micro-nutrients for plants, but at high concentrations, they may cause metabolic disorders and growth inhibition for most of the plant species.

CONCLUSION

Spent lubricating oil is one of the petro-chemicals reported to be a major and most common contaminant in Nigeria. The contamination of soil by spent lubricating oil is an important environmental issue. It is evident from this study that soil contamination with spent lubricating oil can affect the tissues of *Vigna unguiculata* grown in such environment due to heavy metals that they contain. Spent lubricating oil is capable of becoming destructive to *Vigna unguiculata* growth, the soil components, human and animal health and to the environment in general. There is therefore the need of government to enact strict laws and public awareness on the detrimental effects of spent lubricating oil on our environment.

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