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Growth and Yield Performance of Cassava *Manihot esculenta* (Crantz) Exposed to Spent Lubricating Oil

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ABSTRACT: The effect of spent lubricating oil on the growth and yield of cassava (*Manihot esculenta* Crantz) was investigated using plants planted in soil contaminated with different concentrations of spent lubricating oil. 4kg 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 on 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 study therefore shows that the presence of the spent lubricating oil has great implications on the sustainability of *M. esculenta* growth.

Keywords: chlorosis, heavy metal, harvest index, Spent Lubricating Oil, *Manihot esculenta*

INTRODUCTION

The disposal of Spent Lubricating Oil (SLO) into gutter, water drain, open vacant plots and farms are common practice in Nigeria especially by motor mechanics. Spent Lubricating Oil is usually obtained after servicing and subsequently draining from automobile and generator engines (Sharifi *et.*al., 2007). The spent lubricating oil gets to the environment due to discharge by motor and generator mechanics (Odjegba and Sadiq, 2002). 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 (Mohammed and Folorunsho, 2015) leading to environmental degradation, health hazards and destruction of crop plants (Agbogidi *et al*., 2013; Ikhajiagbe *et al*., 2013).

Cassava (*Manihot esculenta* Crantz) is a woody shrub that belongs to the family Euphorbiaceae (Nweke *et al*., 2002). It is a major source of food in Nigeria and is used also in the production of starch, beer, vinegar and alcohol. The tuber is used for human consumption in three processed forms, the roasted meal 'garri', the retted meal and the flour. Cassava being a stable food in Nigeria for millions of Nigerians can potentially be affected by spent lubricating oil. TMS 96/1672 cultivar was used for this research because it is a common cultivar found in Nigeria. In view of the importance of this plant in human diet and the adverse effect of spent lubricating oil, the present study was carried out to assess the effect of spent lubricating oil on this plant cultivar.

Source of plant material

Disease free stem cuttings from matured plant of TMS 96/1672 cultivar of *M. esculenta* were collected from the International Institute of Tropical Agriculture (IITA) Ibadan in Oyo State.

Planting procedure

A field experiment was carried out in the school farm of the Federal University of Technology, Akure, Ondo state, Nigeria. Stem cuttings of 30 cm long each of the cultivar of *M. esculenta* were planted horizontally with a spacing of 100 cm and four stem cuttings were planted on each row. The experimental

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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 soil was thoroughly mixed 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). Weeding was done as necessary. The plants grew for twenty four 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).

Statistical Analysis

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.

3. Results

The effect of spent lubricating oil on the plant height (cm), leaf area (cm) and fresh weight (g) of *M. esculenta* are presented in Table 1. The plant had the highest plant height at the control (0ml) compared to the other treatments. At 6 weeks of transplanting, the leaves turned brownish, withered with 60% leaf abscission. The dropping and eventual collapse of leaves stretched over a period of 10- 24weeks. The leaves were chlorotic and necrotic. At week 22, 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: Effect of spent lubricating oil (SLO) on the plant height (cm), leaf area (cm), fresh weight (g), of *M. esculenta*, 24 weeks after treatment.

Volume of SLO	Plant height (cm)	Leaf area (cm)	Fresh weight (g)
0ml (Control)	184.10 ± 2.20 a	241.42 ±4.78a	620.40 ± 6.30a
50.0ml	136.21 ± 1.24 b	193.08 ±3.60b	410.60 ± 4.80b
75.0ml	102.00 ±1.10 b	64.20 ± 2.38b	160.28 ±2.64c
100.0ml	40.11 ± 0.60c	10.03 ± 0.52c	58.12 ± 1.10d

Each value is a mean of ± standard error of four replicates. Means within the same column followed by the same letter are not significantly different at (P>0.05) from each other using New Duncan Multiple Range Test.

Table 2 shows the effect of spent lubricating oil (SLO) on the dry weight (g) and harvest index of *M. esculenta*, 24 weeks after treatment.

Volume of SLO	Dry weight (g)	Harvest index
0.0ml (Control)	284.60 ± 2.24a	0.5
50.0ml	156.40 ±1.12b	0.3
75.0ml	82.43 ± 0.96b	0.2
100.0ml	36.12 ± 0.31c	0.1

Each value is a mean of ± standard error of four replicates. Means within the same column followed by the same letter are not significantly different at (P>0.05) from each other using New Duncan Multiple Range Test.

Table 3: Heavy metal concentration (ppm) on the shoot of *M. esculenta* exposed to spent lubricating oil

CONCENTRATION	Cu	Cd	Fe	Pb	Ni
0.0ml	0.02	0.01	0.34	0.01	0.01
50.0ml	0.07	0.01	0.40	0.02	0.02
75.0ml	0.10	0.03	0.66	0.03	0.05
100.0ml	0.18	0.05	0.80	0.06	0.07

Table 4: Heavy metal concentration (ppm) on the root of *M. esculenta* exposed to spent lubricating oil

CONCENTRATION	Cu	Cd	Fe	Pb	Ni
0.0ml	0.09	0.01	2.10	0.03	0.01
50.0ml	0.12	0.02	2.24	0.08	0.02
75.0ml	0.17	0.05	2.96	0.22	0.14
100.0ml	0.28	0.09	3.20	0.34	0.26

DISCUSSION

The study of the growth and yield performance of *M. esculenta* exposed to spent lubricating oil shows that there was a reduction of the growth parameters observed which could 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 were 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; 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). They noted that as the hydrocarbons from the oil contaminated soils accumulate, the photosynthetic ability of the leaves become reduced. According to Iglesias *et al*., (1994), 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). 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 the *M. esculenta* grown in such environment due to heavy metals that they contain. Spent lubricating oil is capable of becoming destructive to *M. esculenta* 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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