Effect of spent engine oil on maize growth (Zea mays L.) in South – South, Nigeria

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Abstract: The cultivation of arable crops in an open vacant plots of land polluted with spent engine oil close to the workshop after services is now a common practice among automobiles mechanic and generator repairer as measure of food security in Nigeria. It is against this backdrop that a pot experiment was carried out in the Department of Crop and Soil Science Demonstration Plot, Faculty of Agriculture, University of Port Harcourt, Nigeria between the months of April and July 2011 to determine the effect of spent engine oil on the growth of two varieties maize (Zea mays L). The experimental design was a 2x4 factorial in a completely randomized design with three (3) replications. The treatments were two varieties of maize (Oba super II and Bende Local) and spent engine oil polluted soil viz: 0−15cm (control); 15−30cm (control); 0−15cm (polluted) and 15−30cm (polluted). The results showed that spent engine oil altered the soil chemical characteristic in the parameters assessed. At terminal period (12WAP) 0−15cm (control) soil performed best by producing the highest plant height (99.4cm), number of leaves (13.5) and fresh weight (33.5g) this was followed by 15-30cm (control) while the polluted soil (0−15cm) gave the lowest of the three vegetative traits mentioned. There was significant difference on the vegetative parameters of the two varieties maize and also on interaction. Oba super produced significantly the highest plant height (69.2 cm), number of leaves (9.6), and fresh weight (27.04g) while Bendel Local had lowest plant height (64.5cm), number of leaves (7.0) and 24.17g fresh weight. Although the value of Ni, Pb and Zn were within their critical limit in the soil, which may appears to support plant growth; it is not advisable to cultivate the soil polluted with spent engine oil as it may pose a threat to human health through bio magnification. Hence, further studies need to be carried out on the effect spent engine on maize grain or other edible crops before proper recommendation can be made. However, within the limit of this study, the unpolluted soil (control) obtained from the non-auto mechanic plot of Land appeared appropriate for the production of Oba Super II and is therefore recommended to maize growers.

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1.0 Introduction

Spent engine oil referred to as spent lubricant, waste engine oil, is defined as used lubricating oil obtained after servicing and subsequently draining from automobile and generator engines Jesubunm, (2014). The indiscriminate throwing away of spent engine oil (SEO) into exposed field plots and arable farmland and occasionally into channels is a common practice among motor mechanics in 'mechanic villages' in both rural and urban centers in Nigeria. Spent oil is mixture of several different chemicals including low and high molecular weight (C15− C20) aliphatic hydrocarbons, aromatic hydrocarbons; chlorodibenzofurans lubricate additives and decomposition products (Wang *et al.,* 2000). Spent oil contains heavy metal contaminants such as Aluminium (Al), Chromium (Cr) iron (Fe) Lead (Pb) Manganese (Mn), Nickel (Ni) and Tin (Sn) that come from engine parts as they wear down (ATSDR, 1997, Wang et al., 2000). Nitrogen (N) and Sulphur (S) other than Hydrogen (H) and Carbon (C). Naturally arable soils have heavy metals of low concentration background which is harmless to plants and animal unless when polluted from either natural or anthropogenic sources before they become harmful to the environment especially when they exceed their various critical levels in soil. Naturally occurring heavy metals in the atmosphere and those from weathering of parent materials (Vaaramaa et al., 2010), are attached to aerosol particle in the atmosphere, and deposited on the soil as wet and dry deposition. The anthropogenic sources occur as result of man's influence in the environment such as mining, smelting, waste disposal, urban effluent, and vehicle exhausts, sewage sludge, and agro chemical and these sources can greatly increase heavy concentrations in agricultural soil (Svendsen *et al.,* 2007).

The soil acts as long term sink for heavy metals which have residence times ranging from hundreds to thousands of years depending on the element and soil properties (Kaara, 1992). Spent engine oil can affect soil physical, chemical and biological characteristics. Decrease in level of Nitrogen and Phosphorous in polluted soil has been reported by several researchers

(Atlas and Bartha, 1993, Ogboghodo 2004). Amadi *et. al.,* (1993) studied the effects of heavy and moderate oil spill on soils, and reported that the pH status of the soils in contaminated zones ranged from acidic (4.0) to near neutral (6.0). The authors also reported reduction in the Carbon content of the soil from 3.6% at the heavily impacted to 2.84% at the moderately impacted zones and reduced exchangeable bases (Ca, Mg, K and Na) or Cation Exchange Capacity(CEC) 6.48% at the heavily impacted zones to 4.46% at the moderately impacted zones. Ekundayo et al. (1989) also noted reduced Nitrogen, Phosphorus, Potassium, Magnesium, Calcium, Sodium and increased levels of heavy metals in soils contaminated with spent oil. In contrast, Vwioko et al., 2006 noted that oil pollution of soil leads to build up of essential (organic C, P, Ca, Mg) and non-essential (Mn, Pb, Zn, Fe, Co, Cu) elements and the eventual translocation in plant tissues, heavy metal concentration in above critical levels could lead to agronomic and environmental problems. Heavy metals are needed for optimum crop production. Fernandes and Henriques, 1991) noted that some heavy metals at low concentrations are essential micronutrients for plants, but at high concentrations they may cause metabolic disorders and growth inhibition for most of the plant species. The degree in which plants response to soil pollution varies and this could be as a result of anatomical, morphological, biochemical and physiological features of adaptation as well as the genetic make-up of the plant, concentration of the pollutant and environmental variables.

Several researchers such as Anoliefo and Vwioko (1995); Anoliefo and Edegbai (2000) had reported the responses of some plants to soil polluted with spent engine oil and observed growth differences among plant species like: tomato (*Lycopersicon lycopersicum* L.) bell pepper (*Capsicum annum* L.) eggplant (*Solanum melongena* L.).

Maize is used as test crop in this study because of its multifarious uses among farmers in the study area (Port Harcourt). Although, some works have been done on spent engine oil pollution on the growth of maize by scientists in some states in Nigeria but information is not sufficient enough for proper documentation hence the objective of this study was to find out if spent engine oil affect maize growth in Alakahia's "mechanic village" of Port Harcourt in Rivers State.

2. Materials and method

2.1 Location

The experiment was carried out in the Department of Crop and Soil Science Demonstration Plot, Faculty of Agriculture, University of Port Harcourt, Nigeria between the months of April and July 2011. University of Port Harcourt is located at latitude 4°3" N to 5°N and longitude 60^0, 4"E to 70°E, with an average temperature of 27°C, relative humidity of 78% and average annual rainfall between March and November that ranges from 2500 to 4000mm.

2.2 Maize cultivar used

Two maize varieties were used viz: Oba super II and Bende Local. Oba super II was obtained from International Institute of Tropical Agriculture (IITA) at Onne, substation in Port Harcourt while Bende Local was obtained from Choba market in Port Harcourt, Rivers State.

2.3 Experiment Design, Treatment and Cultural Details

The experimental design was a 2x4 factorial in a completely randomized design with three (3) replications. The treatments were two varieties of maize (Oba super II and Bende Local) and spent engine oil polluted soil viz: 0−15cm (control), 15−30cm (control), 0−15cm (polluted), 15−30cm (polluted). The polluted soil with spent engine oil were obtained around the open plot of land at Alakahia "mechanic village" East West Road, Port Harcourt, Rivers State while the control (unpolluted soil) was obtained from non-auto mechanic plot of land that was 1000m (1km) distance from the "mechanic village" at Alakahia. Ten (10kg) of soil were collected at two profile depths of 0−15cm and 15−30cm in both control and spent engine polluted soils with an auger to fill each perforated plastic bucket and thereafter, a representative composite soil were taken from each bucket (replicate) per treatment before planting and after planting of maize for chemical analysis. A total of 24 buckets were used. Planting of maize varieties into the perforated plastic bucket was carried out on 13th May, 2011. Three seeds of maize were sown in each bucket. The seedlings were thinned down to one per bucket, one week after planting (1WAP). Emerged weeds were removed by hand pulling. The volume of water required to water the plant in each bucket to field capacity was calculated according to Udo *et al.*, (2009). The result obtained from the calculation was 300 ml and it was used to water one (1) bucket in each of the treatment five times daily.

2.4 Data Collection

Soil samples were analyzed using the procedure of Mylavarapus and Kennelley (2002).Maize growth parameters recorded were: plant height, number of leaves and fresh weight. Plant height and number of leaves were collected at biweekly interval. Plant height was measured with a meter rule from the base of the plant at the soil surface to the apex leaf. The number of leaves was determined by counting. Fresh weight was determined at end of the experiment by uprooting the entire plant; the contaminated roots were washed with water and weighed with an electronic weighing balance.

Statistical Analysis

Data collected were analyzed using the analysis of variance procedure while the means were separated by the least significant differences (LSD) at 5% level of probability.

3. Results

3.1 Chemical characteristics of the soil before planting

The effects of spent engine oil on some of the chemical characteristics of the soil before planting maize are presented in Table 1. There were significance differences ($p < 0.05$) in all the soil chemical parameters assessed except soil P^H. Soil PH though not significant but was slightly higher in the control (6.27-6.29) than (5.97 -6.00) observed in spent engine oil (polluted) pot. Percent organic carbon (OC) was significantly higher in the spent engine oil (3.00-4.33%) than 1.50 –2.33% observed in control pots, Total hydrocarbon (THC) ranged from 41.33–49.00mg/kg in spent engine oil soil and 31.00 –44.00mg/kg in control; N ranged from 0.16–0.17% in control and 0.08 –0.10 % in spent engine oil soil; P ranged from 19.00 – 20.67mg/kg in control and 6.57–7.19mg/kg in spent engine; K ranged from 0.29 –0.31cmol/kg in control and 0.10 –0.12 cmol/kg in spent engine oil soil; Ca ranged from 3.60–3.80cmol/kg in control and 0.10–0.12 cmol/kg in spent engine oil soil; Mg ranged from 2.32 –2.40 cmol/kg in control and 0.88 –0.96 cmol/kg in spent engine oil soil; Na ranged from 0.030 –0.040cmol/kg in control and 0.017–0.019cmol/kg in spent engine oil soil. The concentrations of the 3 heavy metals were in order of Zn> Pb>Ni. The value of Ni ranged from 16.30 –22.30mg/kg in spent engine oil and 14.92-15.56 mg/kg in control; Pb ranged from 172.33 –177.33mg/kg in spent engine oil and 20.43-25.37mg/kg in control and Zn ranged from 398– 400 mg/kg in spent engine oil soil and 300-335 mg/kg in control.

Table 1. Some chemical properties of the soil before planting maize

Depth	pH	OC (%)	THC (mg/kg)	N ((%)	P (mg/kg)	K cmol/kg	Ca cmol/kg	Mg cmol/kg	Na cmol/kg	NI (mg/kg)	Pb (mg/kg)	Zn (mg/kg)
0–15cm (control)	6.29	2.33	44.00	0.17	20.67	0.31	3.80	2.40	0.040	15.56	25.87	335
15–30cm (control)	6.27	1.50	31.00	0.16	19.00	0.29	3.60	2.32	0.030	14.92	20.43	300
0–15cm (polluted)	6.00	4.33	49.00	0.10	7.19	0.12	1.70	0.96	0.019	22.30	177.33	400
15–30cm (polluted)	5.97	3.00	41.33	0.08	6.57	0.10	1.50	0.88	0.017	16.30	172.33	398
LSD (P=0.05)	NS	1.013	3.460	0.005	5.961	0.093	1.325	0..789	0.013	1.004	0.914	2.2

3.2 Chemical characteristics of the soil after planting

The effect of spent engine oil on some of the chemical characteristics of the soil after planting is presented in Table 2. There was no significance difference ($p > 0.05$) between the two varieties of maize in the soil chemical parameters assessed after harvest. There was reduction in value of all the parameters assessed after harvest when compared to before planting maize. Soil P^H though not significant but was slightly higher in the control (5.96–6.00) than (5.58–5.61) observed in spent engine oil (polluted) pots. Percent organic carbon (OC) was significantly higher in the spent engine oil (3.41–4.88%) than 1.70-2.42% observed in control pots, Total hydro carbon content (THC) ranged from 16.00–20.50mg/kg in spent engine oil soil and 5.50–7.00mg/kg in control; N ranged from 0.15–0.16% in control and 0.06 –0.07 % in spent engine oil soil; P ranged from 17.50 –18.50mg/kg in control 6.02–6.15mg/ in spent engine oil soil; K ranged from 0.18–0.19 cmol/kg in control and 0.06 –0.08 cmol/kg in spent engine oil soil; Ca ranged from 3.20–3.33 cmol/kg in control and 1.37–1.43cmol/kg in spent engine oil soil; Mg ranged from 0.22 –0.24cmol/kg in control and 0.10 –0.12 cmol/kg in spent engine oil soil; Na ranged from 0.009 –0.010cmol/kg in control and 0.003–0.005cmol/kg in spent engine oil soil. The concentrations of the 3 heavy metals were in order of Zn> Pb>Ni. The value of Ni ranged from 5.76 –6.79mg/kg in spent engine oil and 5.25–5.78mg/kg in control soil; Pb ranged from 166.83mg/kg–174.50mg/kg in spent engine oil 15.67–24.75mg/kg in control soil and Zn ranged from 309.93–319.12 mg/kg in spent engine oil and 239.67–259.67mg/kg in control. The interaction between variety x depth was significant in the parameters except in soil P^H.

3.3 Maize growth

3.3.1Plant height

The effect of spent engine oil on plant height of two varieties of maize is presented in Table 3. There was progressive increased in plant height throughout the observation periods in all the treatment. Throughout the growth periods assessed, maize plants grown under 0-15cm (control) consistently recorded the highest plant height with values ranging from 32.3 to 99.4cm at 2 and 12 weeks after planting (WAP). At terminal period (12WAP) the effect of spent engine became more pronounced on plant height with 0 –

15cm (control) producing the tallest plants (99.4cm) while the spent engine oil 0–15cm (polluted) had the shortest plants (54.3cm) though it was statistically similar with engine oil 15– 30cm (polluted) 56.0cm. There was significant difference between the two varieties of maize in plant height throughout the periods of observation except at 2WAP and 4WAP. At 12WAP, Oba super II produced the tallest plant (69.2cm) while Bende Local had the shortest plant (64.5cm). There was no significant p> (0.05) interaction between variety and depth throughout the sampling intervals except at 4WAP and 12WAP.

Table 2. Some chemical properties of the soil after planting maize

Factor	pH	OC (%)	THC (mg/kg)	N ((%)	P (mg/kg)	K cmol/kg	Ca cmol/kg	Mg cmol/kg	Na cmol/kg	NI (mg/kg)	Pb (mg/kg)	Zn (mg/kg)
Variety												
Oba Super 11	6.68	3.13	12.0	0.11	12.05	0.13	2.33	0.17	0.006	6.00	96	282.70
Bende Local	6.56	3.07	12.5	0.10	11.60	0.12	2.30	0.15	0.005	5.79	95	281.33
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Depth												
0–15cm (control)	6.00	2.42	7.00	0.16	18.50	0.19	3.33	0.24	0.010	5.78	24.75	259.67
15–30cm (control)	5.96	1.70	5.50	0.15	17.50	0.18	3.20	0.22	0.009	5.25	15.67	239.67
0–15cm (polluted)	5.61	4.88	20.50	0.07	6.15	0.0 8	1.43	0.12	0.005	6.79	174.5	319.12
15–30cm (polluted)	5.58	3.41	16.00	0.06	6.02	0.0 6	1.37	0.10	0.003	5.76	166.83	309.93
LSD (P=0.05)	NS	1.15	1.224	0.057	7.97	0.064	1.166	0.085	0.0033	NS	2.744	1.182
Interaction (V×D)	NS	*	*	*	*	*	*	*	*	*	*	*

*significant at 0.05 level of probability, NS = Not significant, WAP=Weeks after planting, VD=Variety×Depth

Table 3: Effects of spent engine oil on mean plant height (cm) of two varieties of maize

Factor	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
Variety						
Oba super ii	26.0	42.0	52.4	59.1	64.55	69.2
Bende local	25.9	41.3	48.6	54.0	58.8	64.5
LSD (P=0.05)	NS	NS	11.12	4.37	4.49	4.56
Soil depth						
0–15cm (control)	32.3	68.6	83.1	87.3	97.2	99.4
15–30cm (control)	28.7	37.2	44.6	52.3	55.4	57.7
0–15cm (polluted)	20.4	29.1	35.4	41.5	47.8	54.3
15–30cm (polluted)	22.4	31.8	39.0	44.9	50.4	56.0
LSD (P=0.05)	4.45	4.22	5.55	3.08	7.75	6.44
Interaction (VXD)	NS	*	NS	NS	NS	*

*Significant at 0.05 level of probability NS = Not significant, WAP=Weeks after planting; V×D=Variety× Depth

Table 4: Effects of spent engine oil on mean number of leaves of two varieties of maize

Factor	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
Variety						
Oba super II	4.5	5.3	8.3	10.8	9.8	9.6
Bende local	4.25	5.0	7.8	9.0	8.5	7.0
LSD (P=0.05)	NS	NS	NS	0.52	0.46	0.41
Depth						
0–15cm (control)	5	7.5	8.5	16.5	15.5	13.5
15–30cm (control)	4	7.0	8.0	10.5	9.5	8.5
0–15cm (polluted)	4	5.5	6.0	6.5	5.5	5.0
15–30cm (polluted)	4	6.0	7	7.5	7.0	6.0
LSD (P=0.05)	NS	NS	NS	0.98	0.75	0.53
Interaction (VXD)	NS	*	*	*	*	*

*Significant at 0.05 level of probability, NS = Not significant, WAP=Weeks after planting;
V×D=Variety × Depth

3.3.2 Number of leaves

The effect of spent engine oil on number of leaves of two varieties of maize is presented in Table 4. There was a progressive increased on number of leaves throughout the observation periods except at 10WAP and 12WAP. Optimum number of leaves was recorded at 8WAP. The value of number of leaves at 8WAP ranged from 6.5 – 16.5 and beyond 8WAP there was significant decreased in number of leaves. At 12WAP, control soil (0–15cm) produced significantly the highest number of leaves (13.5) while the lowest (5.0) in 0–15cm spent engine oil (polluted). The varieties differ significantly with Oba super II producing the highest number of leaves (9.6) and Bende Local the lowest (7.0). There was significant interaction between variety and depth throughout sampling weeks except at 2 WAP.

3.3.3 Fresh weight

The effect of spent engine oil on fresh weight of two varieties of maize is presented in Table5. There was a significant difference between the two varieties of maize with Oba super II having the highest fresh weight (27.04g) while Bende local the lowest(24.17g).There was significant treatment effect of spent engine oil on fresh weight with 0-15cm producing the highest fresh weight (33.50g) and 0-15cm polluted soil the lowest (16.95g). The two polluted soil depth with spent engine oil did not differed significantly from each other although 15-30 cm (polluted) soil tends to have the highest fresh weight. Similar trend was observed in 0–15cm (control) and 15–30cm (control) on fresh weight respectively as that of polluted soil. The interaction between variety and depth was significant.

Table 5. Effect of spent engine oil on mean fresh weight of two varieties of maize

Factor	Fresh weight (g)
Variety	
Oba super ii	27.04
Bende Local	24.17
LSD (P=0.05)	1.52
Soil depth	
0–15cm (control)	33.50
15–30cm (control)	29.83
0–15cm (polluted)	16.95
15–30cm (polluted)	22.10
LSD (P=0.05)	9.89
Interaction (V×D)	*

*Significant at 0.05 level of probability, V×D=Variety Depth

4.0 Discussions

The initial P^H of control and spent engine oil soil was slightly, moderately acidic respectively and fell between the pH values required for maize production before planting. This assertion is in agreement of that of Enwezor *et al.,* (1990) who noted that the optimum soil pH range for producing maize in Nigeria is between 5 and 7.The probable reason for high increased in P^H at both 0-15cm and 15-30cm of the two control soil could be adduced to evapotranspiration of exchangeable bases while the slight decreased noticed in spent engine oil soil could be as a result of nutrient immobilization caused by the production of organic acid from the spent engine oil. Similar findings were reported by Osuji and Nwoye, (2007) who noted that carbon mediated decrease in soil pH as a result of the production of organic acids through microbial metabolism. The reduced P^H values noticed in both control and spent engine soil after planting may be attributed to nutrient uptake by maize plant. The organic carbon of the control and treated soil were adequate and fell within 3% critical level established by (Agboola and Corey, 1972). The high organic carbon content recorded in spent engine oil before the experiment when compared to the control soil might be attributed to Carbon substances coming from spent engine oil coupled with the existing ones present in the soil. Selly, (1998) noted that spent engine oil which is a component of crude oil contained main elements such as Carbon, Hydrogen, Oxygen, and Nitrogen. Uptake by maize plants and mineralization of organic matter might have contributed for the slight decreased that was noticed in both the control and treated soil. The THC of control and treated soil fell below the critical level of 50 mg/kg (D PR, 2002). The increased noticed in the spent engine oil soil compared to control before planting might be attributed to the presence of hydrogen and carbon in spent engine oil while that of the control is due to inherent THC present in the soil. The reduction of the THC in both control and spent engine soil after planting might be due to maize growth and microbial degradation (Ekpo and Ekpo 2006). The nitrogen content of the control before planting was quite adequate as they fell within the critical level of 0.15% –2% established for Nigerian soil by (Sobulo and Osiname1981) while that of the treated soil was inadequate. The inherent natural high fertility status of the soil in control could have contributed to its adequacies while the treated soil might be due to immobilization of nutrient by microbes. Nutrient immobilization subsequent to crude oil pollution of soil has also been reported for cereal crops by De Jong (1980). The decrease after planting in both the control and treated soil may also be due to uptake of Nitrogen during growth period of the two varieties of maize. The value of available Phosphorous before the planting of maize in the two controls soil were adequate and fell within the established the critical level of 10-16 mg/kg (Adeoye and Agboola, 1985) while that of the treated soil was below the critical level suitable for maize production. The significant reduction of available Phosphorus could be due to harmful effect of spent engine oil treatment on soil. Spent engine oil in soil could inhibit microbial transformation of organic matter thus leading to low mineralization of Phosphorus (Nwite and Alu 2015) Ogboghodo *et al.*, (2004) noted that available P (Phosphorus) was low in soil treated with lubricant oil. The decrease noticed after planting in Phosphorus (P) in treated soil and in control could be attributed to mineralization of organic matter and uptake by maize plants during the growth period.

The value of the Ca, Mg and Ca in the control soils of 0–15cm and 15– 30cm before the planting of maize was adequate for maize production in Nigeria. The critical levels of Ca, Mg and K for soils in Nigeria have been established by Agboola and Ayodele (1987) to be 3.8, 1.9 and 0,24cmol/kg respectively. Sodium values were slightly higher than the established critical level of 0.02cmol/kg (Amalu,, 1991) in the two controls (unpolluted l) which can also be adjudged adequate. However, Ca, Mg, K and Na values were inadequate in spent engine oil soil at 0–15cm and 15–30cm respectively when compared to their critical levels which also implied that low soil fertility. The probable reasons for the decrease of these cations in spent engine oil soil could be attributed to low pH of the soil as well as other enhancing nutrients such as available P (Nwite and Alu 2015). Many Scientists such as Kayode *et al.,* 2009 and Uhegbu *et al.,* 2012 had reported decrease of exchangeable bases (Ca, Mg, K and Na) in soils treated with spent lubricant oil. The reduction observed in Cation Exchange Capacity (exchangeable bases) after planting of maize in both the treated and control soil could also be attributed to plant uptake and mineralization of the organic matter.

The heavy metals, Ni, Pb and Zn fell within the critical limit of 100mg/kg, 100–400mg/kg and 70–400 mg/kg respectively given by Kabata – pendias and Pendias (1984) in both control and spent engine oil soil. The values obtained in control imply that some amount of Ni, Pb and Zn were naturally present in the soil. The high value of the treated soil could be as result of additional amount of these metals emanating from the dispose spent engine oil coupled with the naturally existing value in the soil. Agbogidi and Egbuchua (2010) also noted the observed buildup of trace metals in the spent engine oil contaminated soil. The amount of Ni, Pb and Zn left in the control and treated soil were reduced as a result of plant uptake after planting. The reduced plant height observed in spent engine oil soil could be attributed to treatment effect. This finding is in conformity with that of Adenipekun et al 2008 who noted that spent engine oil soil reduced plant growth. Amakiri and Onofeghara (1980) reported that the physical properties of oil impose stressful conditions in the soil, which interfere with water uptake and gaseous exchange thereby creating a condition of physiological drought in reducing plant growth. Odu (1987) also noted that oil in soil is not toxic to plant; however, it exerts its influence on plant indirectly by creating certain conditions which make essential nutrients needed for plant growth unavailable to plants. This could be another probable reason that accounts for the reduced plant height throughout the sampling periods.

The decreased in the number of leaves observed in both control and spent engine soil at 10WAP and 12 WAP could be attributed to leaves senescence. However, reduction in number of leaves was more pronounced in spent engine oil soil probably due to blockage of conducting tissues which prevent water and nutrients into the plant which further hinders the plant potential to produce more number of leaves. Quantity of Ni, Pb and Zn extracted by the maize plants through uptake which might had exert toxic effect could be responsible for decreased in maize fresh weight recorded in this study. The result of this finding is in agreement with that of Oyin and Kassim (2006) who noted that spent engine oil soil reduces number of leaves in potato plant. The observed difference in both varieties of maize at terminal period (12WAP) on number of leaves, plant height and fresh weight could be attributed to genetic factors. The significant differences noticed in interaction between variety and depth in both growth and soil parameters indicated that the response of maize to spent engine oil depends on the levels of soil depth.

5.0 Conclusion and recommendation

This study was designed to assess the effect of spent engine oil on maize growth. The findings from this study indicated that spent engine oil reduces maize growth judging from the reduction in plant height, numbers of leaves and fresh weight. Some of the chemical characteristics of the soil were altered by spent engine oil. The value of Ni, Pb and Zn were within their critical limit in soil. Oba super II performed better than Bendel Local from the growth parameters assessed. Although the value of Ni, Pb and Zn were within their critical limit in the soil, which may support plant growth, it is not advisable to cultivate soil polluted with spent engine oil as it may pose a threat to human health through bio magnification hence, further studies are needed to be carry out on effect of spent engine on maize grain or other edible crops before it can be recommended. However, within the limit of this study the unpolluted soil (control) obtained from a depth of 0-15cm from the non-auto mechanic site appeared appropriate for the production of Oba Super ii and is therefore recommended to maize growers.

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