Study on the Effect of Waste Engine Oil on the Growth of Three Local Pepper Species *Capsicum frutescens, Capsicum chinense* and *Capsicum annum*

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ABSTRACT--- ***The effect of waste engine oil on germination, height and nutrient uptake of three species of pepper (Capsicum frutescens, Capsicum chinense and Capsicum annum) was studied. After growth in 0%, 1%, 3%, 6% and 9% w/v oil contaminated soil, the germination, growth and height of the pepper species were inhibited by the treatments of 3%, 6% and 9% concentrations and reduced growth in 1% treatment. Only the control (0%) had germination. Capsicum annum was the most affected pepper specie. Germination and growth of the pepper species was in the order C.annum < C.chinense < C.frutescens. Nutrient uptake was inhibited in the three pepper species in concentrations of 3%, 6%, 9% waste engine oil. There was decline in the bacterial population in soil with increasing concentration of waste engine oil.***

Keywords--- Waste engine oil, Soil, Pepper, *Capsicum frutescens, Capsicum chinese, Capsicum annum,* bacterial population.

1.INTRODUCTION

In Nigeria, crude oil pollution is of common occurrence in the oil-producing regions of the country. Used vehicle engine oil is disposed of indiscriminately; most especially by roadside mechanics and other allied workers (Anoliefo et al., 2001). Pollution from waste engine oil has been reported to be more widespread than that of crude oil (Odjegba and Sadiq, 2002). The increasing frequency of occurrence over a wide geographical spread constituents a severe environmental problem to the entire society. Spent lubricants contain metals that could cause unsatisfactory growth in plants, insufficient aeration of the plants, results in chlorosis of the leaves and dehydration of plants (Dejong, 1980). Also, the presence of petroleum hydrocarbons in the waste engine oil adversely affects the germination and growth of plants in soils (Samina and Adams, 2002). There is insufficient aeration due to a decrease in air-filled pore space in the soil and an ensuring increase demand for oxygen caused by oil-decomposing micro organisms (Gudin and Syratt, 1975).

Pepper (*Capsicum spp*) is a member of the solanaceae family that includes tomatoes, potato, tobacoo and petunia. It is one of the most important vegetables in Nigeria. They prefer a fertile loam soil with a high level of organic material reserves of essential elements. Good drainage is important since water logging is likely to cause leaf shedding. Those commercially cultivated include *Capsicum frutescens*, *C. annum* and *C. chinense*. Anoliefo and Vwioko (1995) reported that the treatment of soil with 4% and 6% spent oil conveniently inhibited germination of *Capsicum annum*. They found out that mean height of leaf area of *C. annum* in soil treated with 3% spent oil gave very low values. Soils contaminated by spent oil inhibited the growth of *Capsicum sp* .The pepper plant is of great importance. It is used in soups and stew and eaten raw in salads. The fruit of most species of *Capsicum sp* contains capsaicin which is a lipophilic chemical that can produce burning sensation in the mouth of unaccustomed eaters. Capsaicin is used in modern medicine as a circulatory stimulant and pain reliever. Aerosol extract of capsaicin usually known as pepper spray are used by the police as non-lethal means of incapacitating a person. The objective of this study is to investigate the susceptibility and tolerance level *Capsicum frutescens, C. chinense* and *C. annum* to waste engine oil pollution.

2.MATERIALS AND METHOD

Sample Collection

The plants seeds of *C. frutescens*, *C. chinense* and *C. annum* were obtained from New Benin market, in Benin City, Edo State. The spent engine oil was obtained from petrol engine vehicles that were five years and above at different mechanic workshops in Ishiohor, Oluku, Benin City, Edo State.

Plant Soil Treatment

The seed viability test was determined by putting the seeds in a bowl of water and left for twenty minutes. Submerged seeds were collected and assumed as viable seeds (Oludele and Ogundele, 2003). Soil samples were treated with 1%, 3%, 6% and 9% concentration of spent lubricating oil. Soil samples with water served as control (0%, no spent lubricating oil). Viable seeds of *Capsicum frutescens, C chinense and C. annum* were sown in the soils treated with spent lubricating oil and in the control before planting in 12cm by 25cm polythene bags. Twenty seeds were planted per bag for the three experimental plants (Anoliefo and Vwioko, 2001).

Appearance of cotyledon or epicotyl above soil level occurred eight days after sowing. Germination records were taken on daily basis up to 10 days. Seeds which did not germinate within this period were regarded as no growth .The height was measured from the soil level to the terminal bud. Measurements were taken on a 14 day interval up to fruiting at 84days after germination.

Physicochemical analysis

The soil pH was determined by the method of AOAC (1990) using a HANNA Combo pH meter. Organic carbon was determined by using Walkley and Black oxidation method (IITA, 1979). Total organic matter was determined by percentage loss in combustion. Total nitrogen was the Kjeldahl method as determined by Pearson (1973). Mineral contents of calcium, magnesium, zinc, lead and iron were determined by the method of AOAC (1990). Potassium and sodium contents were determined by the use of Flame Photometer (AOAC, 1990). Phosphorus was by colorimetric method based on reaction of phosphorus with molybdovanadate complex (AOAC, 1990).

Bacterial Analysis

Ten grams of soil sample treated with spent lubricating oil and the control were inoculated in 90ml of sterile water to give a 10^{-1} dilution and serial dilutions were prepared from the suspension to a range of 10^{-6}. From these dilutions 0.1 ml was cultured into nutrient agar determine the colony forming unit/ml.

Statistical Analysis data

The data were analyzed using one way analysis of variance and the significant means separated with the Duncan's multiple range tests (Ogbeibu, 2005)

3.RESULTS AND DISCUSSION

Table 1 shows percentage germination after 10 days of sowing seeds of the pepper species. For the control *C. frutescens* had 40 out of the 60 seeds germinated (66.70 % germination) and only 17 out of the 60 seeds germinated in the soil treated with 1% waste engine oil (28.8%) germination. *C. Chinese* had 37 out of the 60 seeds sown germinated for the control (61.7%) germination and 14 out of the 60 seeds germinated (23.3% germination) for the soil with 1% waste engine oil. For *C. annum*, only 15 out of the 60 seeds sown germinated for the control soil (25.0% germination) and 7 out of the 60 seeds grown germinated (10.9% germination) for the soil with 1% waste engine oil. Germination of the seeds of *C. frutescens C. Chinense* and *C. annum* was inhibited by 3%, 6 % and 9% treatment of soil with the waste engine oil. According to Anoliefo and Uwioko (1995), treatment of soil with 4% and 5% spent oil consistently inhibited germination of pepper (*Capsicum annum)* and tomato (*Lycopersicom esculentum)* with more adverse effect on tomato. This could have been due to the herbicidal and phototoxic properties of spent engine oil to organisms (Vwioko and Fashemi, 2005). Terge (1984) reported that germination and growth of different species of vascular plants were inhibited by toxic concentration of compounds in the soil leading to killing of the seeds. Evaluation of the seedling during this work showed defects such as twisted epicotyl, retarded growth and missing parts. Seedling evaluation is very important from the horticultural view as abnormal seedlings do not establish into healthy plants (Bekendem and Grob 1979). Gill *et al.* (1992) suggested that seedling ecology and evaluation may have considerable relevance to the selection of useful plants. From the findings of this study, C. *frutescens* had the greatest potential of survival.

Table 1: Percentage germination of *C. frutescens, C. chinense* and *C. annum* after 10days of sowing seeds

Variety of Pepper	Treatment of Waste engine in soil (%w/v)				
	0 (control)	**1**	**3**	**6**	**9**
C. frustescens	66.7	29.8	-	-	-
C. Chinense	61.7	23.3	-	-	-
C. annum	25.0	10.9	-	-	-

Note: - No growth

Table 2: Effect of Spent Engine Oil in soil on height of *C. frutescens, C.chinense, C. annum*

Variety of Pepper	Oil Treatment	14	28	42	56	70	84
		Treatment Time (Days)					
		Height (cm)					
C. frustescens	0%	2.433 ± 0.176	4.067 ± 0.176	6.067 ± 0.176	7.100 ± 0.153	11.633 ± 0.233	18.033 ± 1.200
	1%	1.500 ± 0.173	1.800 ± 0.153	2.167 ±0.120	2.267 ± 0.120	-	-
	3%, 6%,9%	-	-	-	-	-	-
C. Chinense	0%	2.100 ± 0.208	3.76 ± 0.240	5.833 ± 0.219	6.467 ± 0.255	10.33 ± 0.233	16.333 ± 0.521
	1%	0.933 ± 0.145	2.000 ± 0.173	2.100 ± 0.173	2.133 ± 0.145	-	-
	3%, 6%, 9%	-	-	-	-	-	-
C. annum	0	1.967 ± 0.145	4.100 ± 0.208	5.767 ± 0.145	6.233 ± 0.088	9.600 ± 0.361	5.333 ± 0.375
	1	0.933 ± 0.145	1.267 ± 0.145	1.633 ± 0.120	1.833 ± 0.120	-	-
	3%, 6%, 9%						

Note: - no growth

After 84 days of planting, fruit production was highest in *C. frutescens* with height of 18.033 ± 1.200 cm and *C. Chinense* had 16.333 ± 0.521 cm and *C. annum* had the lowest height with 5.333 ± 0.375 cm (Table 2). After 56 days, the plants in 1% treatment withered. For the three varieties, *C. frutescens* had 2.267 ± 0.120 cm, *C. Chinense* had 2.133 ± 0.145 cm and *C. annum* had 1.833 ± 0.120 cm in 1% pollution after 56 days germination. Gills and Sandota (1976) reported growth retardation as an effect of environmental pollution and that there existed a strong correlation between concentration of these pollutants and height of plants. This agreed with this study where the three varieties of pepper had reduced growth in heights at low level of pollution (1%) with waste engine oil compared to the control plants. There is significant difference ($p < 0.05$) between the germination rates, height of seedlings in soils contaminated with waste engine oil. This is due to decrease in oxygen in soil which affects plant growth (Esenowo *et al*., 2006).

In Table 3 are the physicochemical properties of the control and various treatments of the soil polluted with waste engine oil before planting. There was a slight decrease in pH with oil contamination when compared with control. Atuanya (1987) reported that soil contaminated with waste engine oil have lower pH values, types of soil and amount of soil notwithstanding. Soil pH is a major factor influencing the availability of elements in the soil for plant uptake (Marschner, 1995). The nitrogen, magnesium, calcium, iron, zinc, lead, organic carbon and organic matter contents of soil increased with oil contamination as compared with the control. This corroborated with the study of Okonokhua *et al.* (2007). The observed increase could to be due to activities of microorganisms in converting hydrocarbons and atmospheric nitrogen into organic matter (Atuanya, 1987).

Table 3: Soil Physicochemical Properties of Control and Various Soil Treatments with Waste Engine Oil before Planting

Physicochemical Properties	Unit	Oil Treatments (%)				
		0	1	3	6	9
Nitrogen (N)	%	0.13	1.14	1.12	1.14	0.14
Phosphorus (P)	Ppm	1.68	1.44	1.56	1.23	1.14
Potassium (K)	Ppm	1.73	1.52	1.43	1.41	1.13
Sodium (Na)	Ppm	1.54	1.40	1.34	1.26	1.08
Magnesium (Mg)	ppm	4.31	4.44	4.64	4.90	5.11
Calcium (Ca)	ppm	1.75	2.01	1.86	2.10	2.10
Iron (Fe)	ppm	1.86	1.86	1.89	1.92	2.03
Lead (Pb)	ppm	0.10	0.14	0.19	0.21	2.28
Zinc (Zn)	Ppm	2.03	2.04	2.03	2.05	2.05
Organic Carbon	%	1.34	1.82	1.95	1.95	2.10
Organic matter		1.36	2.1	2.6	2.6	2.9
pH		5.0	4.7	4.6	4.8	4.7

There was a decline in the number of bacterial population with increasing concentration of pollution with waste engine oil (Figure 1). Shadow (2002) observed a decline in bacterial count and diversity and prevalence of genus *Pseudomonas* in oil contaminated soils.

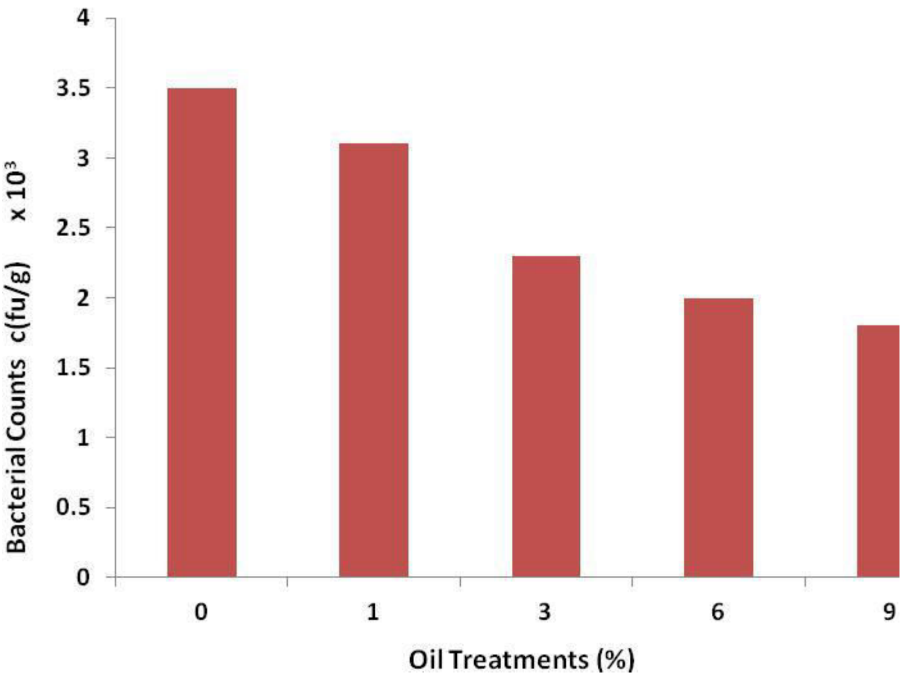

Figure 1: Changes in Bacterial Population in Soil with Waste Engine Oil Treatments

The nitrogen, calcium, magnesium, iron, lead and zinc contents increased with 1% soil treatment with waste engine oil after planting with the pepper species (Table 4). Lead, iron and zinc are heavy metals which have toxic effect on plants. From this study, the oil contaminated soils contained more heavy metals than the control. Plants exhibiting zinc toxicity have smaller leaves than control plants (Ren *et al.,* 1993). Lead has been found to cause changes in leaf epidermis structure with reduction in cell size and increased number of stomata per unit area with simultaneous reduction in the size of guard cell (Weryszko – Chmielewska and Chmil, 2005). The pH was observed to have stabilized with time ranging from 5.0 to 4.99 for 1% treatment for the 3 pepper varieties. This is agreement with the study of Okonokhua et al. (2007).

Table 4: Soil Physicochemical Properties of Control and Various Soil Treatments with Waste Engine Oil Sown with *C. frutescens, C. Chinense* and *C. annum*

	Species of Pepper								
	C. frutescens			*C. chinense*			*C. annum*		
Physicochemical Properties / Unit	Oil Treatments (%)								
	0	1	3,6/9	0	1	3,6,9	0	1	3,6,9
Nitrogen (N) %	0.20	0.27	-	0.21	0.24	-	0.22	0.24	-
Phosphorus (P) ppm	2.70	1.86	-	2.78	2.42	-	2.80	2.00	-
Potassium (K) ppm	1.86	0.60	-	1.89	1.03	-	1.70	2.94	-
Sodium (Na) ppm	0.86	0,64	-	0.98	0.52	-	0.12	0.16	-
Magnesium (Mg) ppm	4.33	4.34	-	4.38	0.39	-	4.45	4.67	-
Calcium (Ca) ppm	2.20	3.32	-	1.90	2.14	-	1.87	2.10	-
Iron (Fe) ppm	2.03	2.23	-	2.10	2.50	-	2.13	2.45	-
Lead (Pb) ppm	0.29	0.31	-	0.30	0.33	-	0.27	0.30	-
Zinc (Zn) ppm	2.06	2.10	-	2.10	2.14	-	2.08	2.16	-
Organic Carbon (C) %	2.62	3.40	-	2.86	2.94	-	2.94	2.01	-
Organic matter	3.62	4.76	-	3.7	3.8	-	3.7	2.4	-
pH	5.0	5.0	-	5.0	4.9	-	5.0	4.9	-

4. CONCLUSION

This was a study on the effect of waste engine oil on the three species of pepper *Capsicum frutescens, Capsicum chinense* and *Capsicum annum.* The effect of waste engine oil on the germination and growth of the pepper species was such that *C. annum* < *C. chinense* < *C. frutescens*. For the higher percentages of soil pollution with waste engine oil (3%, 6% and 9%), there was complete inhibition of germination and growth of the three pepper varieties. At 1% waste engine oil pollution, the pepper varieties grew but died before fruiting. Therefore, waste engine oil should not be indiscriminately poured on the soil but properly disposed off to avoid pollution.

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