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The Effects of Used Engine Oil Pollution on the Growth and Early Seedling Performance of *Vigna uniguiculata* and *Zea mays*

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Abstract: The ability of *Vigna unguiculata* and *Zea mays* to thrive in soils supplemented with varying concentrations of used engine oil ranging from 150-250 mL in a green house as well as extracts derived from these soils in Petri dishes in the laboratory was investigated. The parameters considered in the green house were heights and numbers of leaves while those of the laboratory were radicle and plumule lengths. In both species seedlings in the non-polluted soil grow better than those in the polluted soil sample samples. The growth inhibition in the seedlings increased with the increase in the concentration of the used oil pollutants. There were gross reductions in the number of leaves obtained in the seedlings of both *V. unguiculata* and *Z. mays* from the polluted soils. Treatments with extracts derived from used oil polluted soils resulted in the inhibitions of the radicle and plumule growths in both species at all the extract concentrations. It could be inferred from the results that used engine oils have inhibitory effects on the growth and early seedling performance of *Vigna unguiculata* and *Zea mays*.

Key words: Used engine oil, pollution, *Vigna uniguiculata*, *Zea mays*

INTRODUCTION

Soil pollution especially through the spillage of oil had been identified to cause unsatisfactory growth in plants (Dejong, 1980). Previous studies had revealed that the crude oil pollutants often resulted to insufficient aeration of the soil due to the displacement of air from the spaces between the soil particles, retard growth of plants, results in chlorosis of leaves and dehydration of plants (Rowell, 1977).

In Nigeria, crude oil pollution is of common occurrence in the Niger-Delta region, which constitutes the oil-producing region of the country. In the non-oil producing areas, such as Ekiti State, used vehicle engine oil are spilled indiscriminately most especially by the roadside mechanics and other allied workers.

The present study was undertaken in order to determine the effects of used vehicle oil pollution on the growth of cowpea [*Vigna unguiculata* (L.) Walp.] and maize (*Zea mays* L.), which are widely, cultivated food crops in Ekiti State of Nigeria.

MATERIALS AND METHODS

The study was carried out at the greenhouse and laboratory of the Department of Plant Science, Faculty of Science, University of Ado-Ekiti, Ado-Ekiti (7°40 N, 5°15 E), Nigeria. Kayode and Faluyi (1994) had earlier provided the detailed ecological description of the study area. Seeds of *V. unguiculata* and *Z. mays* used in this study were collected from the International Institute for Tropical Agriculture, Ibadan, Nigeria.

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The Greenhouse Experiments

The soil samples were collected from a fallowed land at the back of the Greenhouse of the Department of Plant Science, University of Ado-Ekiti, Ado-Ekiti, Nigeria. The soil samples were fed into twenty-four planting pots. The planting pots were divided into two groups (A and B) with each group consisting of twelve pots. A was used for the experiment on *Vigna unguiculata* and B for *Zea mays*. Each group was further sub-divided into four sub-groups. (A_1, A_2, A_3 and A_4: B_1, B_2, B_3 and B_4) with each sub-group consisting of three planting pots.

A_1 and B_1 were polluted by soaking with 150 mL of used engine oil, A_2 and B_2 polluted with 200 mL and A_3 and B_3 polluted with 250 mL of used engine oil. A_4 and B_4 were not polluted and served as the controls. The soaked soil samples were left for six days after which 3 seeds each of *V. unguiculata* and *Z. mays* were planted in the respective pots. Each pot was watered daily at 6.00 GMT. The rate of germination, seedling heights and the number of leaves at 6 Weeks After Planting (WAP) were determined.

Laboratory Experiments

Three planting pots labeled X, Y, Z were filled with soil samples collected from the location stated above. 150, 200 and 250 mL of used engine oil were poured into X, Y and Z, respectively. The pots were left to drain for six days. Two hundred milligram each of X, Y and Z were then measured out and poured into three separate beakers also labeled X, Y, Z for the respective soil samples. Two hundred milliliters of distilled water was poured into each of the beaker, stirred and left for 24 h after which the solutions were then filtered and the filtrates used as aqueous extracts. Distilled water served as a control.

Twenty four sterilized Petri dishes were double-lined with Whatman No. 1 filter papers. The Petri dishes were divided into two groups (A and B) for the *V. unguiculata* and *Z. mays* experiments, respectively. Three cowpea seeds were placed in each of the Petri dish in Group A and 3 maize seeds in each of the Petri dish in Group B. Each group was further sub-divided into four sub-groups (A_1, A_2, A_3 and A_4; B_1, B_2, B_3 and B_4).

Petri-dishes in A_1 and B_1 were moistened daily for 7 days with aqueous extract X, A_2 and B_2 with extract Y and A_3 and B_3 with extract Z. A_4 and B_4 were moistened daily with distilled water to serve as the controls. The Petri dishes were kept at room temperature in a growth chamber where germination measurements were recorded at 24 h interval for 7 days. Both the greenhouse and the laboratory experiments were replicated thrice and the data obtained from the experiments were compared statistically (t-test, 5% level) to those obtained from the controls.

RESULTS AND DISCUSSION

In both species seedlings in the non-polluted soil (i.e., controls) grow better than those in the polluted soil sample samples. The growth inhibition in the seedlings increased with the increase in the concentration of the used oil pollutants. In 1 Week After Planting (WAP), while the seedling height of *V. unguiculata* was 15.2 cm in the control experiment (i.e., non-polluted soil) the heights were 8.0, 7.2 and 7.0 cm in the 150, 200 and 250 mL used oil treated soils (i.e., polluted soils).

Similarly, in *Z. mays* seedlings, while the height was 5.7 cm in the non-polluted soil, the heights were 2.4, 2.3 and 2.0 cm in the 150, 200 and 250 mL used oil treated soils. At 6 WAP, the seedling height of the *V. unguiculata* in the non-polluted soil was 31.6 cm whereas the heights were 14.0, 12.9 and 12.0 cm in the 150, 200 and 250 mL used oil treated soils. Also at 6 WAP, the seedling height of *Z. mays* in the non-polluted soil was 18.1 cm while the heights were 11.1, 10.5 and 10.44 cm in the 150, 200 and 250 mL used oil treated soils (Table 1). Statistical analyses (t-test, 0.05 level) revealed that there were significant differences in the heights of the seedlings in the used oil polluted soils and those of the non-polluted soils. There were gross reductions in the number of leaves obtained in the seedlings of both *V. unguiculata* and *Z. mays* from the polluted soils. At 6WAP, the mean numbers of leaves in the non-polluted soils were 14 and 6, respectively in both plants but 7 and 4, respectively in all concentrations of the used oil treated soil. These constituted 50 and 33% reductions, respectively.

Treatments with extracts derived from used oil polluted soils resulted in the inhibitions of the radicle and plumule growths (Table 2, 3) in both species at all the extract concentrations. In both plants, the inhibitions increased with the increase in the concentrations of the used engine oil. Thus while the radicle lengths of *V. unguiculata* and *Z. mays* were 4.1 and 13.3 cm, respectively at 7 DAP, the radicle lengths were 3.7 and 5.9 cm, respectively in the 150 mL extract, 3.6 and 5.0 cm, respectively in the 200 mL extract, 3.6 and 4.8 cm, respectively in the 250 mL extract (Table 2). Similarly while the plumule lengths of *V. unguiculata* and *Z. mays* were 2.2 and 4.6 cm, respectively at 7 DAP, the plumule lengths were 1.0 and 1.9, cm, respectively in the 150 mL extract, 1.0 and 1.5 cm, respectively in the 200 mL extract, 1.0 and 1.2 cm, respectively in the 250 mL extract (Table 2).

Table 1: Mean weekly heights and number of leaves of *V. unguiculata* and *Z. mays* seedlings growing on soil treated with different concentrations of used engine oil

Treatment (mL of used engine oil)	Species	Seedlings heights/WAP 1	2	3	4	5	6	No. of Leaves at 6 WAP*
Control	*V. unguiculata*	15.2	16.7	19.5	21.9	25.2	31.6	14
	Z. mays	5.7	7.8	10.5	13.1	16.2	18.1	6
150	*V. unguiculata*	8.0	9.1	10.9	12.4	12.9	14.0	7 (5)
	Z. mays	2.4	3.8	5.6	9.6	10.7	11.1	4 (33)
200	*V. unguiculata*	7.2	7.9	8.5	11.2	11.3	12.9	7 (50)
	Z. mays	2.3	3.8	5.5	9.0	10.0	10.5	4 (33)
250	*V. unguiculata*	7.0	7.2	8.3	9.3	9.9	12.0	7 (50)
	Z. mays	2.0	3.6	5.3	8.5	9.5	10.5	4 (33)

*: Values in brackets are the % reductions

Table 2: Mean daily lengths of *V. unguiculata* and *Z. mays* radicles following different treatments with extracts of different concentrations of used engine oil

Extract treatment (mL of used engine oil)	Species	Radicle length (cm) /DAP 1	2	3	4	5	6	7
Control	*V. unguiculata*	-	-	-	0.7	1.7	3.7	4.1
	Z. mays	-	-	-	2.4	5.0	9.8	13.3
150	*V. unguiculata*	-	-	-	0.5	1.3	3.2	3.7
	Z. mays	-	-	-	1.8	2.8	4.4	5.9
200	*V. unguiculata*	-	-	-	0.3	1.2	3.1	3.6
	Z. mays	-	-	-	1.1	2.7	4.2	5.0
250	*V. unguiculata*	-	-	-	0.2	1.2	3.0	3.6
	Z. mays	-	-	-	1.0	2.2	4.1	4.8

Table 3: Mean daily lengths of *V. unguiculata* and *Z. mays* plumule following different treatments with extracts of different concentrations of used engine oil

Extract treatment (mL of used engine oil)	Species	Plumule length (cm) /DAP 1	2	3	4	5	6	7
Control	*V. unguiculata*	-	-	-	-	-	1.5	2.2
	Z. mays	-	-	-	-	1.5	3.1	4.6
150	*V. unguiculata*	-	-	-	-	-	0.8	1.0
	Z. mays	-	-	-	-	0.5	1.6	1.9
200	*V. unguiculata*	-	-	-	-	-	0.8	1.0
	Z. mays	-	-	-	-	0.3	0.9	1.5
250	*V. unguiculata*	-	-	-	-	-	0.6	1.0
	Z. mays	-	-	-	-	0.2	0.7	1.2

Results obtained from this study agreed with the previous assertion Adenipekun and Kassim (2006) that used engine oil affect plant height, stem girth, moisture content, leaf area and number of leaves in *Celosia argentea.* A number of researchers had revealed that crude oil inhibits plant growth (Cook and Westlake, 1974), reduces germination due to toxic effects on seeds (Udo and Fayemi, 1975; Udo and Opara, 1984) and leads to decrease in biomass productivity (Amakari and Onofeghara, 1983; Odejimi and Ogbalu, 2006). It could be inferred from the results obtained in this study that both the crude and used engine oils have similar effects on plants.

Previous studies had revealed that the crude oil penetrate the pore spaces of terrestrial vegetation (Bossert and Bartha, 1984) and subsequently impedes photosynthesis and other physiological processes of the plant (Odu, 1977, 1981). Plants on such soil become suffocated due to the exclusion of air by the oil (Udo and Fayemi, 1999). The exhaustion of oxygen in the soil increases the microbial activity and thus interferes with the plant-soil-water relationship (Esenowo *et al.*, 2006). This affects plant growth (Essien *et al.*, 1995), has toxic effects on seeds and caused morphological and anatomical aberrations in the leaf, stem and roots (Gill *et al.*, 1994). In conclusion, oil polluted soils becomes unsuitable for growth of plants for a long time until it degrade to a tolerable level (Udo and Opara, 1984). Used engine oil might also exhibit similar effects on plants. Thus, efforts should be made to enlighten all stakeholders on the need to properly dispose of used engine oil.

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