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EFFECTS OF CRUDE OIL POLLUTED SOIL ON THE GERMINATION AND YIELD OF MUNGBEAN *(VIGNA RADIATA(L) WIL C.)* AND GROUNDNUT *(ARACHIS HYPOGAEA)*

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ABSTRACT: Potted experiment was carried out in 2009 cropping season at the Teaching and Research Farm of Imo State University, Owerri to evaluate the effect of crude oil polluted soil on germination and yield of mungbean and groundnut. The seeds were obtained from Imo ADP, while the crude oil was procured from NNPC, Warri. The soil in the buckets was polluted with the crude oil at three different levels (0ml, 200ml and 400ml). One week after polluting the soil with the crude oil, the seeds of mungbean and groundnut were sown. Evaluations for germination percentage, and yield were determined. The crude oil pollution had significant effects (P=0.05) on all the observed parameters. The number of days to 50% germination and flowering increased as the crude oil level increased, while the germination percentage decreased as the crude oil level increased. In mungbean, the number of pods per plant (360), pod weight per plant (4051.2g) number of seeds per plant (264.6) and seed yield (2541.1kg/ha) obtained from 0ml crude oil treated plots were significantly higher (P=0.05) than the number of pods per plant (4), pod weight per plant (362.3g) number of seeds per plant (30.60) and seed yield (362.3kg/ha) obtained from 400ml crude oil polluted soil. The same trend was applicable in groundnut, except that the seed yield per hectare (41.97.1kg/ha) produced by the plants from 0ml treated soil was statistically similar (P=0.05) to the values (3978.7kg/ha) obtained from 200ml treated plants.

KEY WORDS: Mungbean, groundnut, crude oil, germination, seed yield, effects

INTRODUCTION

Pollution is the introduction of contaminants into an environment due to human activity that causes harm or discomfort to humans or other living organism (Jose and Castanon 1995). Polluted soils and water pose major environmental and human health problems all over the world (Beckar and Hank, 2000). Pollution of the environment is one of the major effects of man's technological advancement. It results when a change in the environment harmfully affects the quality of human life including effects on animals, plants and micro-organisms. Odewumi (1987) defined pollution as the presence of significant amount of an extraneous material which may be solid, liquid or gas in a particular location.

It is estimated that 80% of oil pollution is as a result of oil spillage (Odu, 1977). Nigeria depends largely on crude oil for income earnings. Crude oil spillage is a very common problem in Nigeria. There is therefore a great need for continuous research on the problems associated with the pollution from the oil spillage and its effect on soil environment and the crops grown on it. The wide spread use of pollutants such as oil, chemicals and fertilizers pollute our water ways. Oil is harmful pollutant which can kill surface swimming animals, sea birds and once it settles on the bottom, can harm shell fish and other marine life. Oil spills also affects the soil and plants (Odu and Udo, 1975).

Becker and Hank (2000) reported that seed germination is adversely affected by pollution of the soil with crude oil and that the effect is proportional to the level or quantity as well as the concentration of the crude oil. Crude oil pollution also affects the growth of plants (Baeck *et al.,* (2004). Field and laboratory studies have demonstrated that oil deposited on the leaves normally penetrates the leaves and reduced transpiration and photosynthesis (Amakiri and Onefeghara, 1983). The effect of crude oil on the growth of Okro and fluted pumpkin seedlings were highly reduced with increase in crude oil concentration (Odu, 1977).

Some plants can tolerate the adverse growing conditions resulting from organic chemical contamination (Cunningham *et al.,* 1996). Microbial communities and ecto-mycorrihzal fungi associated with certain tree species have shown to play an important role in degradation of xenobiotic chemicals (Riser-Robert, 1998). The ability of plants to withstand the toxicity and resulting alteration of nutrient status associated with organic chemical contaminated soils have been evaluated in terms of above ground production (Bienacki *et al.,* 1995; Chianeau *et al.,* 1997).

Mungbean (*Vigna radiata* (L.) is a legume which belongs to the order Fabaless which is in the family of Fabaceae. Groundnut (*Arachis* hypogeae) is also a leguminous plant. Mungbean and groundnut have been found to be among those crops endowed with the potential of providing protein tofor man. Mungbean and groundnut are legumes that normally do best on fertile sand loam soils with good internal drainage. They have the ability to fix nitrogen in the soil. Most Nigerians cannot meet their body protein requirement without food legumes. The objective of this research is therefore to study the impact of crude oil pollution on the germination and yield of mungbean and groundnut.

MATERIALS AND METHODS

The potted experiment was conducted at Teaching and Research Farm of Imo State University, Owerri. The site lies between latitude 5^0, 10'N and 6^0, 0^1N, longitude 6^0, 35'E, and 7^0 30'E. The altitude is 91m above sea level. The average temperature, annual rainfall and relative humidity of Owerri are 27^0C, 2500mm and 75% respectively. (Meterological Unit, Ministry of Land and Survey, 2006).

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Mungbean *(Vigna radiate (L) WiL C.)* and groundnut *(Arachis hypogaea)* seeds were obtained from Imo State Agricultural Development Programme (ADP). Escravos light crude oil was obtained from the Nigeria National Petroleum Co-operation (NNPC) Warri. Thirty-six(36) buckets measuring 35cm x 30cm with perforation at the sides and bottom were used. Each of the plastic buckets was filled to $^2/_3$ volume (20kg) of the soil collected from the Imo State Teaching and Research Farm. The Soil in the plastic buckets were treated with the crude oil at three different levels; 0ml, 200ml and 400ml. Selected physical and chemical properties of the soil before pollution, planting and harvest were determined. One week after polluting the soil with the crude oil, the groundnut and mungbean seeds were planted. Randomized Complete Block Design (RCBD) was used with three replicates.

The observed parameters were:

Number of days to 50% germination
Percentage Germination
Number of days to 50% flowering
Number of pods per plant
Number of seeds per plant
Pod weight in (g) per plant
Groundnut and mungbean yield (kg/ha)

Days to 50% germination were recorded from the date of sowing till when 50% of the seeds in each plot germinated. Days to 50% flowering were also recorded from the date of emergence to the date when 50% of the plants in each plot produced flower. Pod weight was obtained by weighing the pods at harvest using Ecolab electronic balance after sun drying. Pods of four plants from each plot were counted and their average was calculated to record data regarding pods per plant. Seeds were obtained from each plot and their weight was recorded and then converted into seed yield per hectare.

The experimental data was subjected to analysis of variance (ANOVA). The treatment mean differences were separated using the Duncans Multiple Range Test as outlined by Steel and Torrie (1980).

RESULTS

Crude Oil had significant influence on the germination of mungbean and groundnut seeds (Table 2). The number of days to 50% germination obtained from 0ml (4 days) and 200ml (5 days) in mungbean were statistically similar (p=0.05) but significantly different (P=0.05) from the value (9 days) obtained from 400ml crude oil treatment (Table 2)

Table 2 shows that the highest germination percentage (66.6%) in mungbean was observed from plots that received 0ml (control) of crude oil which was significantly different (P=0.05) from the values, 35.0% and 15.0% obtained from 200ml and 400ml polluted plots respectively (Table 2).

In groundnut, the highest germination percentage (20.0) was recorded from the plots without any oil pollution. This value was significantly different (P=0.05)) from the germination percentage obtained from 200ml (13.3%) and 400ml (10.0%) treated plots, although, the germination percentage obtained from 200ml was statistically similar to that of 400ml treated plots.

Flowering of mungbean was also influenced by crude oil pollution. The number of days to fifty percent flowering increased as the level of pollution increased. The lowest mean number of days (30 days) to 50% flowering was observed from the plots without any crude oil treatment and it was significantly different from the mean number of days to 50% flowering (41.3 days) observed from plot that received 400ml of crude oil pollution and the ones that were treated with 200ml (35.6 days). In groundnut, the highest (31.3 days) mean number of days to 50% flowering was observed from plots that received 400ml of crude oil pollution which was significantly different from the 28.6 mean number of days observed from the control plots and 200ml treated plots (Table 2).

Table 1: Selected physical and chemical properties of the soil before pollution and planting.

Treatment	pH (H_20)	pH (Kcl)	Organic Carbon (%)	Organic matter (%)	Total Nitrogen (%)	Exchangeable Acid (Meq/100g)	Ca (Meq/100g)	Mg (Meq/100g)	K (Meq/100g)	P (ppm)	Bulk Density (g/cm^3)	Sand (%)	Silt (%)	Clay (%)	Porosity	pb (Meq/100g)	Cr (Meq/100g)	Total Hydrocarbon (%)
Before Pollution	6.73	6.17	1.90	3.28	0.120	0.1500	21.4	1.03	0.0149	9.80	1.55	87.52	4.00	8.48	41.51	0.0869	0.1105	0.002
Before planting 0ml	6.73	6.17	1.90	3.28	0.120	0.1500	21.4	1.83	0.0149	9.80	1.55	87.52	4.00	8.48	41.51	0.0869	0.110.	0.002
200ml	4.44	4.65	2.03	3.50	0.120	0.1500	21.5	2.83	0.0251	9.40	1.24	87.52	4.00	8.48	45.66	0.1590	0.3261	0.002
400ml	4.29	4.41	2.51	4.35	0.124	0.1250	22.5	3.67	0.0256	9.76	1.44	87.52	4.00	8.48	46.79	0.2141	0.4481	0.046

Table 2: The effects of crude oil pollution on the germination and flower development of mungbean and groundnut.

Crops	Crude Oil Levels	Days to 50% Germination (days)	Germination Percentage (%)	Number of Days to 50% Flowering (days)
	0ml	4.0^{b}	66.6^{a}	30.0^{c}
Mungbean	200ml	5.0^{b}	35.0^{b}	35.6^{b}
	400ml	7.0^{a}	15.0^{b}	41.3^{a}
Groundnut	0ml	8.0^{b}	20.0^{a}	28.6^{b}
	200ml	9.0^{b}	13.3^{b}	29.3^{b}
	400ml	13.3^{a}	10.0^{b}	31.3^{a}

Means in the same column having the same letter(s) as superscript are not significantly different at P? 0.05 according to Duncans Multiple Range Test.

Table 3: The effects of crude oil pollution on the yield and yield components of mungbean and groundnut

Crops	Crude Oil Levels	No. of Pods/Plant	No. of Seeds/Plant	Pod Weight per Plant(g)	Seed Yield (Kg/ha)
	0ml	36.0^{a}	269.6^{a}	4051.2^{a}	2541.1^{a}
Mungbean	200ml	30.0^{b}	141.0^{b}	2473.4^{b}	990.2^{b}
	400ml	4.0^{c}	30.6^{c}	603.9^{c}	362.3^{c}
Groundnut	0ml	18.6^{a}	32.0^{a}	6443.0^{a}	4197.1^{a}
	200ml	14.3^{b}	29.3^{b}	5017.0^{b}	3978.7^{a}
	400ml	13.0^{c}	22.0^{c}	4100.0^{c}	3194.1^{b}

Means in the same column having the same letter(s) as superscript are not significantly different at P? 0.05 according to Duncans Multiple Range Test.

The number of mungbean pods per plant were observed to be highest (36.0) in the plots that received 0ml (control) of crude oil pollution, while the lowest (4.0) number of pods per plant was observed from plots that was treated with 400ml of crude oil pollution. There was significant difference (p=0.05) between the highest (36.0) and the lowest (4.0) number of pods per Mungbean plant at p= 0.05. Also, there was significant difference between 0 ml (36.0) and 200 ml (30.0) (Table 3).

In groundnut, the highest number of pods per plant (18.6) was observed from the control plots and this was significantly different from the number of pods (13.0) observed from the 400ml treated plots. There was also a slight difference in number of pods per plant between 200ml (14.3) and 400ml (13.0) polluted plots (Table 3).

Crude oil pollution had significant effect on the number of seeds per plant (Table 3). The highest number of mungbean seeds per plant (269.6) was obtained from the control plots. This value was significantly higher (P=0.05) than others. Also the least number of seeds per plant (30.60) was derived from the plots that were treated with 400ml of crude oil, which was significantly different (P=0.05) from others (table 3). The same trend was applicable in groundnut plants. The groundnut plants that were treated without any crude oil gave the highest number of seeds per plant (32.0) which was significantly higher than that of 200ml (29.3) and 400ml (22.0) treated plots.

The pod weight per plant is summarized in table 3. The weight of the pods per plant obtained from mungbean polluted with 0ml, 200ml and 400ml of crude oil were 4051.2g, 2473.4g, and 603.9g respectively. The value obtained from 0ml was significantly higher (P=0.05) than others.

In groundnut the highest pod weight per plant (6443g) was also obtained from control (0ml), which was significantly higher than others.

The level of Crude Oil Pollution had significant influence (P=0.05) on the yield of the test crops. The highest yield (2541.1kg/ha) in the mungbean was observed from the control plots (0ml), while the lowest (362.3kg/ha) was obtained from 400ml, which was significantly different from others (Table 3). For the groundnut, the highest seed yield was recorded as 4197.1kg/ha from the control) plots but statistics shows that it was not significantly different (P=0.05) from the 200ml treated plots (Table 3). The yield of (3194.1kg/ha) 400 ml was significantly lower than others.

DISCUSSION

The results showed increased in number of days to 50% germination in mungbean and groundnut seeds as the level of crude oil increased. Also the same trend was observed in number of days to 50% flowering. Similar observation was reported by Baek and His (2004) who stated the effects of crude oil concentrations on the growth of red beans and corn. In terms of germination percentage, the value obtained from the plots without any crude oil treatment was significantly higher (P=0.05) than the values obtained from 200ml and 400ml crude oil levels. Decreased in germination percentage as the crude oil level increased was also observed. This finding is in agreement with that of Becker and Hank (2000) who reported that crude oil pollution has adverse effect on seed germination and that the effect is proportional to the concentration.

In mungbean and groundnut, the yield attributes (number of pods per plant, number of seeds per plant and pod weight per plant) that were obtained from 0ml crude oil treated plots were significantly higher (P=0.05) than the ones obtained from 200ml and 400ml treated plots. But the values produced by 200ml crude oil treated plants where higher than the values obtained from 400ml oil treated plants. This result is in conformity with (Becker and Hank, 2000).

The result indicated that crude oil pollution exhibited significant effects (P=0.05) on seed yield per hectare mostly in mungbean. The seed yield per hectare that were gotten from mungbean without any crude oil was significantly higher than the value that was produced by 200ml crude oil polluted plots. But in groundnut, there was no significant difference (p=0.05) between the seed yield per hectare obtained from 0ml and 200ml crude oil polluted plots. This indicates that groundnut plant might have more inherent ability to tolerate the adverse growing condition resulting from crude oil polluted soil. The groundnut plants had higher seed yield than the mungbean might be due to the fact that groundnut seeds are bigger than mungbean seeds.

CONCLUSION

Seed germination was impaired by crude oil pollution and the effects increased with increase in level of pollution. It also affected the yield and yield components of mungbean and groundnut, but groundnut has higher yield record than mungbean. This still shows that planting of groundnut and mungbean at oil producing areas where oil spillage is a great problem will be encouraged.

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