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Physicochemical and Morphological features of *Talinum triangulare* (water-leaf) exposed to hydrocarbon polluted soil

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ABSTRACT

Investigations were made on the effect of Bonny light crude oil on stem sprouting of *Talinum triangulare.* Five concentrations of crude oil viz, 2.5mls, 5.0ml, 7.5ml, 10.0mls and 12ml were applied to 7kg of dry soil in perforated polyethene bags. The experiment was carried out on a completely randomized design (CRD) and replicated 6 times. Data on the number of days to sprouting, number of branches, number of leaves, leaf area and plant height were collected. It was observed that the different concentrations of crude oil significantly ($p<0.05$) affected the number of leaves. Although there was no significant difference ($p> 0.05$) for number of days to sprouting, plant height and number of branches between the plants in the treated soil and control group, there were physical effect of stunted growth and death of plants. The concentrations of crude oil, however significantly affected soil properties like Ca, Mg, ECEC, soil pH, available phosphorus and Total hydrocarbon content.

Key words:

Introduction

The growing demand and supply of fuel oil and new chemicals by the industrialized society of the 21st century has placed increasing higher stress on the natural environment (Jaffe, 1991). Large amount of diverse chemical enters the environment via industrial discharge and other anthropogenic activities. The hydrophobic organic compounds are of great concern because of their toxic characteristics and their ability to accumulate in the environment (Adoki and Orugbani, 2007). Soil and water represent the first lines of oil pollution. Contamination of land is of paramount importance to man in that it is on this portion that man's existence depends. The oil mineral producing areas in Nigeria are in danger because the land is damaged and made infertile due to oil spills and other factors, and this prevents growth of crops for varying period of time. The damaging effects are due to suffocation and toxicity of the crude oil (Odu, 1970). Crude oil also contains constitutes of hydrocarbons that exert adverse effect on soil conditions, microorganisms and plants when beyond three percent concentration; oil becomes increasingly deleterious to soil biota and crop growth (Udo and Fayemi, 1975). Crude oil makes it unsatisfactory for plant growth (Dejong, 1980). This is due to insufficient aeration of the soil because of displacement of the soil particles by crude oil (Rowell, 1977). A study carried out by Udo and Fayemi, (1975) showed the effect of crude oil spillages on growth, productivity and nutrient intake of maize. The result of this experiment provided that in crude oil contaminated soils, germination was delayed and the germination percentage was significantly affected by oil pollution. Odu (1981) reported the impact of oil contaminated soils among other less availability of plant nutrients, reduction in microbial population and deterioration of soil structure. Odjegba and Sadiq (2002) reported on the effect of spent engine oil on growth parameters, chlorophyll and protein levels of *Amaranthus hybridus*, applied the oil in different concentrations ranging from 1-5% v/w. the result shows inhibitory effect of the oil on *Amaranthus hybridus* in all the selected parameters checked.

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Plate. 1: Water leaf (*Talinum triangulare*)

Talinum triangulare (water leaf) is a cosmopolitan weed that belongs to the family portulaceae. Water leaf cultivation is one of the occupations of the Efik and Ibibio in Nigeria. Lump sum of money is generated each year from the cultivation of water leaf. Waterleaf was long considered as a vegetable for the poor and not highly valued. Since the increased popularity of afang (*Gnetum africana*) in Cameroon, Southern and Eastern part of Nigeria, from around 1990 onwards, the demand for waterleaf has steadily risen. It is now a common product in local market in Nigeria. However this important plant is believed to have originated in South America and it has been recorded for several countries in west and central Africa. The waterleaf plant is an erect, glabrous, perennial herb up to 80-100cm tall, usually strongly branched. The roots are swollen and fleshy, the stems succlulent, obtuse-angular to erect. The leaves alternate, simple, almost sessile and succulent. The flowers are bisexual, regular, pedicel, 1cm long, recurring in fruits. Fruits are globose to ellipsoid capsule 4-7mm long, 3 valved, elastically dehiscent with many seeds. Seeds are compressed globose-reinform, 1mm long, tuberculate shinning black. Waterleaf is eaten as vegetable throughout the tropics.

Materials And Methods

Experimental Site:

The experiment was carried out at the green house located inside the Botanical Garden of the University of Calabar.

Source of Materials:

Bonny light crude oil used for the study was collected from the Nigerian Agip Oil Company, Port-Harcourt, Rivers State, while waterleaf sticks were collected from Goldie market Calabar, Cross River State, Nigeria. Top soil (0-20cm depth) was randomly collected from four points around Biological Science Experiment Farm bulked to form composite soil samples.

Treatment:

Five concentrations of crude oil 25ml, 5ml, 7.5ml, 10ml and 12.5ml of crude oil where mixed thoroughly with the soil (7.0kg) dry weight measure into 36 polythene bags and allowed for 3 days before planting.

Date collection and analysis:

Data were collected on the following number of days to sprouting, percentage sprouting per bag, plant height, number of leaves per plant, leaf area and number of branches per plant. Data obtained were analyzed using analysis of variance (ANOVA) and where means were significantly different, they were separated using least significance difference (LSD) test.

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Result And Discussion

Table 1: Physicochemical properties of soil

Parameters	Control	2 weeks	4 weeks	6 weeks
EC (ds/m)	0.17^{a}±0.01	0.20^{a}±0.01	0.18^{a}±0.01	0.18^{a}±0.01
pH	5.97^{b}±0.15	5.98^{b}±0.35	6.04^{b}±1.00	6.99^{a}±1.02
Avail.P (mg/kg)	3.16^{d}±0.89	19.77^{c}±1.04	21.28^{b}±0.57	23.00^{a}±1.23
THC (mg/kg)	0.00^{d}±0.00	51.13^{a}±2.04	43.10^{b}±1.24	38.7^{c}±2.10
Ca	2.53^{a}±0.24	2.21^{b}±0.03	2.13^{c}±0.05	2.22^{b}±0.02
Mg	1.00^{a}±0.01	0.93^{b}±0.01	0.73^{d}±0.01	0.82^{c}±0.01
Na	0.06^{a}±0.01	0.05^{a}±0.01	0.04^{a}±0.01	0.03^{a}±0.01
K	0.08^{a}±0.01	0.07^{a}±0.01	0.06^{a}±0.01	0.06^{a}±0.01
EA	3.16^{a}±0.11	2.20^{a}±0.12	2.32^{a}±0.10	2.32^{a}±0.12
ECEC	5.76^{a}±0.12	5.41^{b}±0.22	5.12^{c}±0.01	5.46^{b}±0.15
BS	63.54^{a}±2.45	59.96^{a}±1.34	57.90^{a}±2.02	57.31^{a}±1.26

Mean with the same case letter on the horizontal array indicate no significant difference ($p>0.05$)

Environmental pollution has been shown to have adverse effect on plant growth and these may range from morphological aberrations, reduction in the biomass to stomata abnormalities (Sharma 1980). Similar reports have been made by Gill and Sandota (1976), Ghouse and Zaidi (1980) and Wallace (1951). Atuanya (1987) reported waste oil to cause a breakdown of soil textu€re followed by soil dispersion. However, during the present study, crude oil rather showed a coagulatory effect on the soil, binding the soil particle into a water impregnable soil block which seriously impair soil drainage and oxygen diffusion. This present study was carried out using stem propagation rather than seeds and the result showed that stem sprouting was not significantly affected ($p>0.05$). The general characteristics observed in the plant at different concentrations of crude oil and controls were forest green coloration of the leaves. This is an indication of normal well-being of the plants. Sprouting of stems were observed to be at the stem interval of time (7-9days) except for one plant in the 12ml of crude oil that took 15 days to sprout. There was no noticeable effect in coloring of the leaves as the leaves remained green until the end of the experiment. However, there was effect on other parameters physically, although, no significant difference was observed from the data analyzed. Plants in the different concentrations of crude oil showed varying levels of stunted growth as compared to the control plants. In different levels of crude oil after three weeks of growth, the plant gradually began to die. This poor growth of the plant was also observed by Udo and Fayemi (1975) in their research using *Amaranthus hybridus* and this was attributed to suffocation of the plant caused by exhaustion of oxygen due to increased microbial activities which results in interference with plant soil water relationship (Udo and Fayemi, 1975). It was also observed that they all died in the same pattern (the roots under the ground softened and then the plants falls). This mode of dead could be attributed to the fact that crude oil clumps the soil particle together preventing sufficient aeration of the soil because of displacement of soil particles by crude oil (Rowell, 1977). Other parameters like plant height and number of branches showed no significant effect ($p>0.05$). this could be attributed to the fact that the crude oil concentrations used were not sufficiently high to cause harmful effect to the stems. It is believed that petroleum oil in a contaminated soil may not be directly toxic to the plant but may exert adverse effect indirectly by creating certain conditions which makes nutrients unavailable to the plants (Odjegba and Sadig, 2004), analysis of crude oil was carried out on the soil at different concentrations within intervals of 2 weeks, 4 week and 6 weeks. The result of the analysis showed that there were some significant differences among different parameters from the soil analysis carried out. For the exchangeable bases in the soil, significant differences ($P< 0.05$) between crude oil were found for ECEC, Mg and Ca. K, EA and BS showed no significant different ($p>0.05$). For other parameters of the soil, significant differences ($p<0.05$) between crude oil concentrations was also found for THC, pH and available phosphorus . Sandy and silt particles of the soil showed no significance difference ($p>0.05$) throughout the 6 weeks study period. but clay significantly increased in size at the 12.5ml/500g level of crude oil concentration. It was also observed that the soil showed no significance in electrical conductivity (E.C) though clay significantly increased in quantity. Also, as the pH of the soil increased at all levels of crude oil pollution, Ca and mg also significantly increased this conform with the report of Isirimal (2003).

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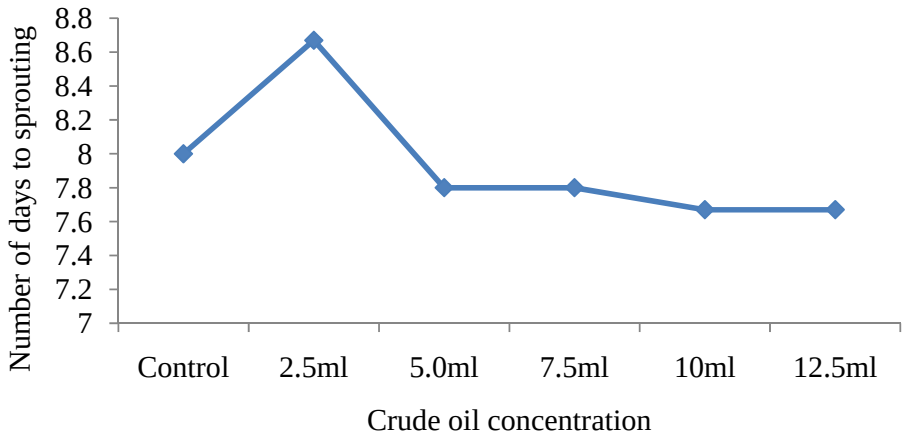

Fig. 1: Effect of crude oil on days to sprouting of *Talinum triangulare*

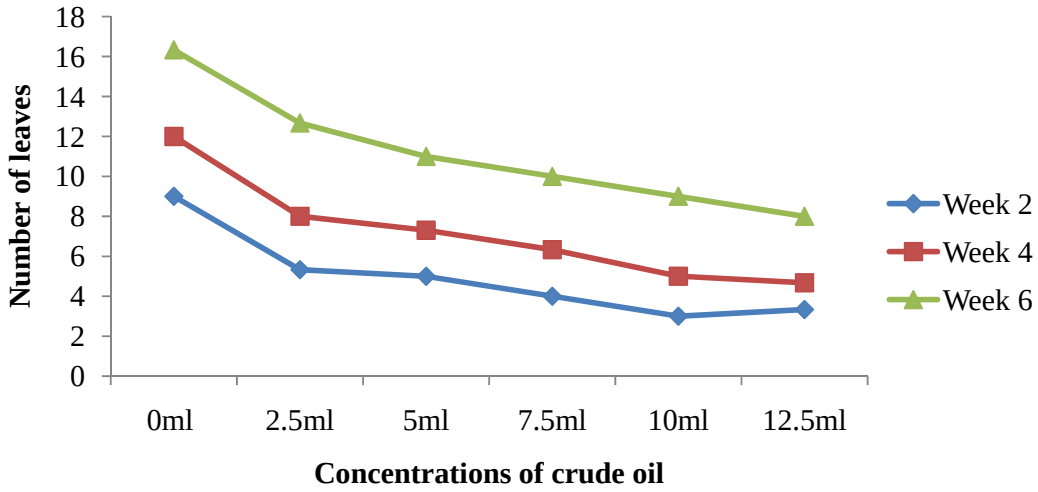

Fig. 2: Effect of crude oil on number of leaves of *Talinum triangulare*

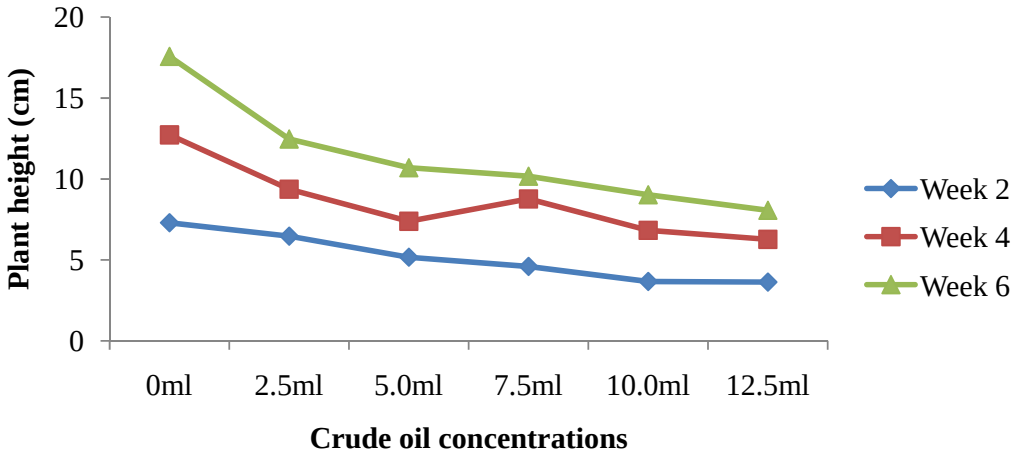

Fig. 3: Effect of crude oil on plant height of *Talinum triagulare*

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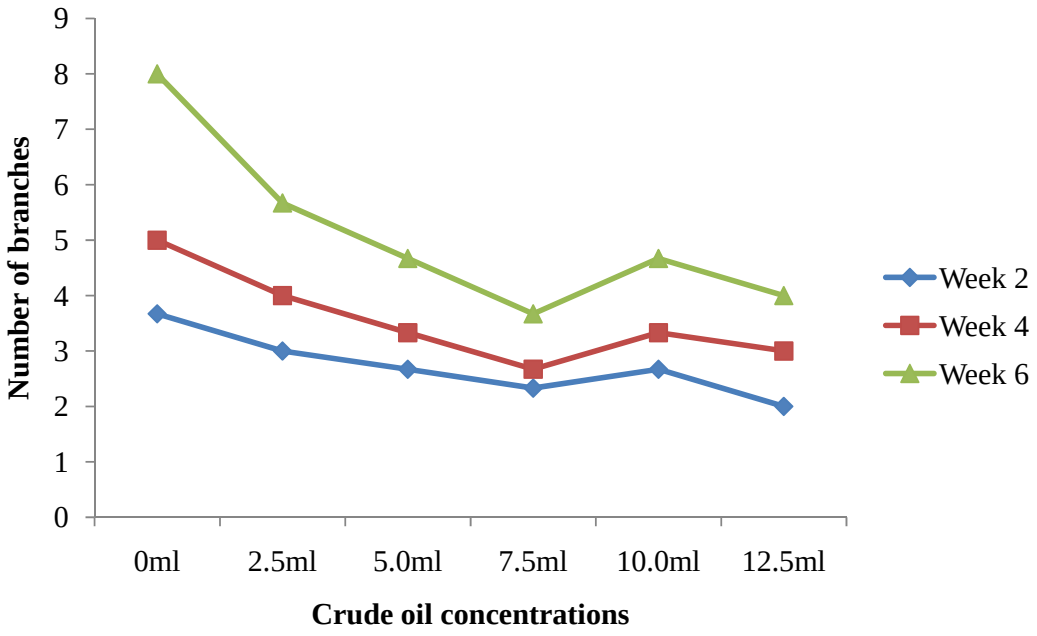

Fig. 4: Effect of crude oil on number of branches of *Talinum triangulare*

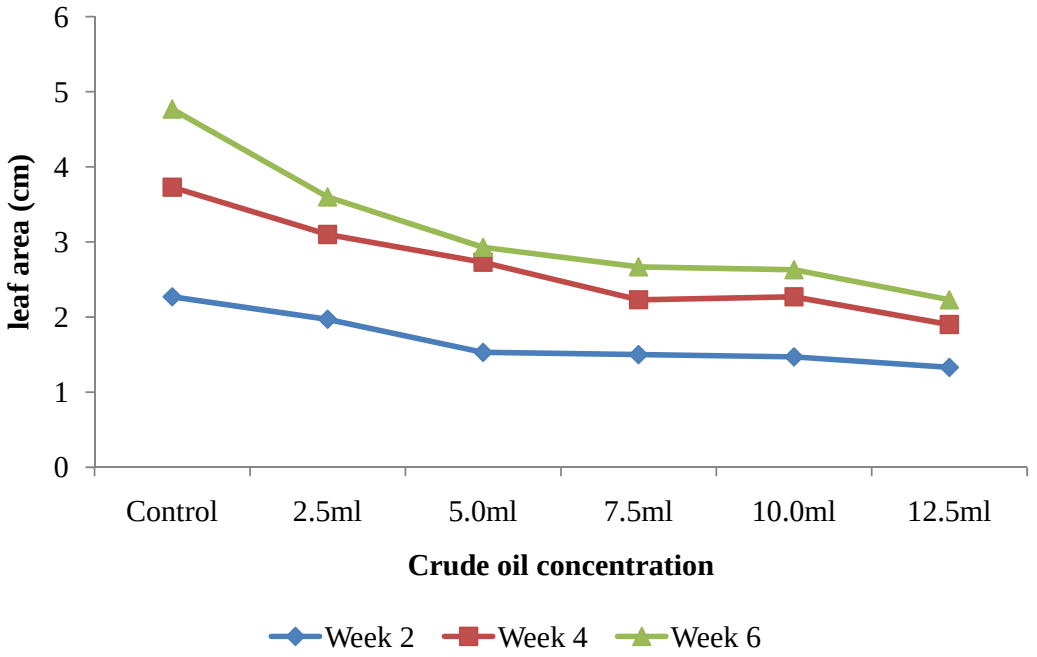

Fig. 5: Effect of crude oil on Leaf area of *Talinum triangulare*

Conclusion:

From the result of these study it can be concluded that crude oil have a synergistic effect on soil physicochemical properties which thus affected the performance of waterleaf. In situation where there is oil pollution remediation measures should be carried out before any planting.

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