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ORIGINAL ARTICLE

EFFECTS OF CRUDE OIL POLLUTED SOIL ON THE SPROUTING AND GROWTH OF SWEET POTATO (*IPOMOEA BATATA L.*)

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ABSTRACT: The study examined the effect of crude oil on the morphological features of sweet potato. Forty (40) plastics buckets were polluted with varying concentration of crude oil and mature stems of sweet potato were planted and watered every 3 days to the end of the experiment. Data were collected based on the following parameters: Days to sprouting, number of leaves, leaf length, leaf width and plant height. The result shows that the crude oil did not have any significant ($p>0.05$) effect on all the parameters examined. This thus, indicates that the plant is tolerant to crude oil pollution.
KEYWORDS: Crude Oil, Soil, Sprouting, Growth, Sweet Potato.

INTRODUCTION

Petroleum hydrocarbon exploration and exploitation have been with Nigerians for decades and their concomitant effects on the oil producing communities have been quite problematic. These activities, though developmental, have elicited all kinds of impact, ranging from the barely tolerable ones to utterly disastrous effects. However, oil production activities have led to biodiversity lost both in terrestrial and aquatic environment. Contamination of the soil with petroleum hydrocarbon affects soil microflora and microfauna, underground water and plants, depending on the degree and magnitude of contamination, such soil may remain unsuitable for crop growth for a long time. The environmental consequences of soil pollution include adverse effect on the soil microflora all of which assist in soil fertility (Torstensson *et al.*, 1998). Soil fertility may be defined as the capacity of the soil to support the growth of plants on sustained basis under given conditions of climate and other relevant properties of land (Aina and Adedipe, 1991). Loss of soil fertility through loss of soil organic matter, leaching of nutrients, loss of the nutrient laden topsoil, changes in soil pH, reduction in cation exchange capacity, salinization, water logging and other forms of soil degradation are major problems associated with agricultural productivity in the oil producing areas of Nigeria. Sweet potato (*Ipomoea batatas* L.) is a member of the convolulaceae family (Purseglove, 1972). Approximately 900 different species of convolvolaceae in 400 genera have been identified around the world. However, the historical evidence suggests that sweet potato originate from the new World i.e. central or South American lowlands. South American indigenous communities have probably cultivated the crop since 3000BC (Woolfe, 1992). Sweet potato (*Ipomoea batata* L.) is one of the world highest yielding crops and is grown over a wide range of environmental condition throughout the world. Among food crops, the sweet potato ranks fifth in both economic importance and contribution to the calories and protein intake in developing countries, which produce the major portion of this crop (FAO, 1985). The storage roots of sweet potato are used as staple food, raw material for alcohol production and animal feed. Sweet potato is sometime regarded as a poor person crop or food due to it cheap way of cultivation and its widespread but recently this crop is being recognized as a crop with potential for high productivity and energy out-put consumed both in the fresh and processed form. Sweet potato plays an important role in food security and nutrition in Africa. The plant is considered a food security crop in sub-saharan Africa where it is mainly grown on subsistence scale and provides compliant of food before other crops mature. Laurie (2004) wrote that in some African countries, starchy crops such as sweet potato are the staple food whereas other countries utilize it as an additional or security food crop. This work is expedient to screen the sweet potato genotype for tolerance to crude oil polluted

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agricultural land, for food productivity and food security programme of the federal government.

MATERIALS AND METHODS

The experiment was carried out at the University of Calabar experimental farm behind Biological Science Block, University of Calabar.

Mature and viable stems of sweet potato were obtained from the National Root crops Research Institute (NRCRI) Umudike, Abia State. Crude oil (Bonny light) was purchased from the Nigerian Agip oil Refinery, Warri, Delta State.

Top soil (0-2cm depth) was randomly collected from five points around biological science farm, bulked to form composite soil sample. Twenty kilogramme each of the composite soil sample was then weighed into 40 plastic buckets. The plastic buckets containing the soil samples were then polluted with the different concentrations of crude oil (control (0ml), 50ml, 100ml, 150ml and 200ml). Eight replications were made from the treatment groups to ensure precision of the experiment.

Planting was done after two weeks of pollution of the soil. Planting was achieved by stem cutting of about 8-10cm of the sweet potato plant. The stems were sowed 8cm depth in the soil. Staking was done using Indian bamboo. The plastic buckets used were perforated at the base and sides to allow for aeration and adequate drainage of excess water (water logging). Watering was done every two days.

Data were obtained from the plant from the fourth week after germination and subsequently every fourth weeks, up to the twelve weeks after planting. Observations on plant morphology were collected based on the following parameters: Days to sprouting, Leaf area, Plant height, Leaf width, Number of leaves per plant. Data collected were subjected to a 3x5 factorial experiment in a complete randomized design while the significant means were separated using least significant difference (LSD) test.

RESULTS

3.1. Days to Sprouting of Sweet Potato

It was observed from the result obtained that there were no significant difference ($P>0.05$) to the days to sprouting of sweet potato using different concentrations of crude oil. The mean values obtained were as follows: 7.00±0.60, 7.00±0.56, 8.5±0.09, 8.25±0.24 and 8.13±0.32 for control, 50ml, 100ml, 150ml and 200ml of crude oil respectively.

3.2. Plant Height (cm)

The result for plant height shows that there significant difference ($p<0.05$) in the duration of the experiment. It was observed that week 4 had a mean value of plant height of 15.69±3.61, week 8 had a mean value of 32.76±5.08 and week 12 had a mean value of 47.36±4.52. The result indicates that week 12 produces the highest plant height; this implies that the longer the duration of an experiment the higher the plant height. While, the results presented in table 2 show that there were no significant difference ($p>0.05$) in the plant height of sweet potato using different concentrations of crude oil in the pollution of the soil. The mean values obtained were as followed: 36.99±5.03, 29.63±3.41, 28.88±3.10, 30.74±2.99 and 33.43±3.21 for control, 50ml, 100ml, 150ml and 200ml of crude oil respectively.

3.3. Number of Leaves

The result for number of leaves also indicated significant difference ($p<0.05$) based on the duration of the experiment, the number of leaves increases with duration. The mean values obtained were as follows: 8.35±1.57, 13.70±2.62, 20.75±2.93 for 4^{th} week, 8^{th} week and 12^{th} week respectively. While no significant difference ($p>0.05$) in the number of leaves of sweet potato cultivated in different concentrations of crude oil polluted soil. The mean values obtained are as follows: 15.08±1.65, 13.58±1.25, 14.46±1.82, 13.92±1.13 and 14.25±0.98 for control, 50ml, 100ml, 150ml and 200ml of crude oil polluted soil respectively (Figure 1).

3.4. Leaf Length (cm)

The result for leaf length shows that there were significant difference ($p<0.05$) in the leaf length of sweet potato obtained during the timing of the experiment, 12^{th} weeks had the highest leaf with a mean value of 11.24±1.82 followed by 8^{th} weeks 10.16±1.65 and 4^{th} weeks 7.85±2.08. While the length obtained from the different groups of crude oil polluted soil shows no significant difference ($p>0.05$) in the leaf length of the plant. The mean values obtained are as follows: 9.82±2.01, 9.56±2.06, 9.62±2.00, 9.78±1.93, 9.96±2.20 for control (0ml), 50ml, 100ml, 150ml, and 200ml of crude oil polluted soil respectively (Figure 2).

3.5. Leaf Area (cm)

The result for leaf area also shows that significant difference ($p<0.05$) exist in the timing of the experiment. It was observed from the result that

12th weeks had the highest leaf area with a mean value of 67.20±3.68, followed by 8th weeks with a mean value of 60.34±4.08 and 4th week had a mean value of 45.14±3.83 (Table 1). While the result for leaf area of sweet potato obtained from the different groups treated with varying concentrations of crude oil in the soil was significantly different ($p<0.05$). It was observed that the means obtained from 150ml, 200ml and the control were significantly different from the mean values obtained in 50ml, and 100ml of crude oil polluted soil (Table 2, Figure 3).

Table 1: Effect of duration on morphological feature of sweet potato (*Ipomoea batata*)

Parameters	4th week	8th week	12th week	LSD
Plant height	15.69^{c}±3.61	32.76^{b}±5.08	47.36^{a}±4.52	3.03
Number of leaves	8.35^{c}±1.57	13.70^{b}±2.62	20.75^{a}±2.93	0.80
Leaf length	7.85^{c}±2.08	10.16^{b}±1.65	11.24^{a}±1.82	0.29
Leaf area	45.14^{c}±3.83	60.34^{b}±4.08	67.20^{a}±3.68	2.53

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

Table 2: Effect of crude oil concentrations on growth of sweet potato

Parameters	Control	50ml	100ml	150ml	200ml	LSD
Plant height	36.99^{a}±5.03	29.63^{a}±3.41	28.88^{a}±3.10	30.74^{a}±2.99	33.43^{a}±3.21	3.91
Number of leaves	15.08^{a}±1.65	13.58^{a}±1.25	14.46^{a}±1.82	13.92^{a}±1.13	14.25^{a}±0.98	1.03
Leaf length	9.82^{a}±2.01	9.56^{a}±2.06	9.62^{a}±2.00	9.78^{a}±1.93	9.96^{a}±2.20	0.38
Leaf area	58.99^{a}±3.23	55.69^{b}±3.60	55.10^{b}±2.68	59.01^{a}±2.43	58.99^{a}±3.04	2.53

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

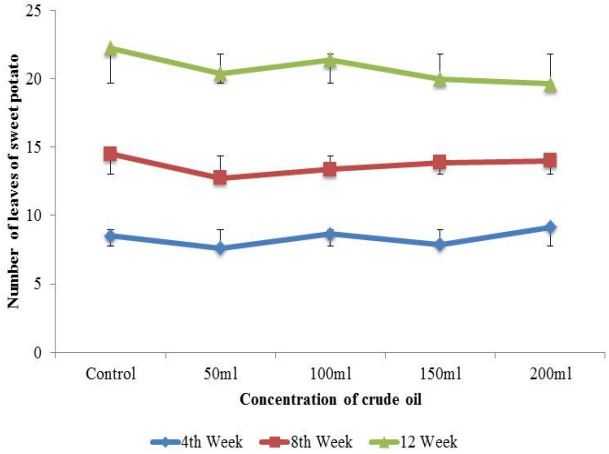

Figure 1: Effect of crude oil on number of leaves of sweet potato.

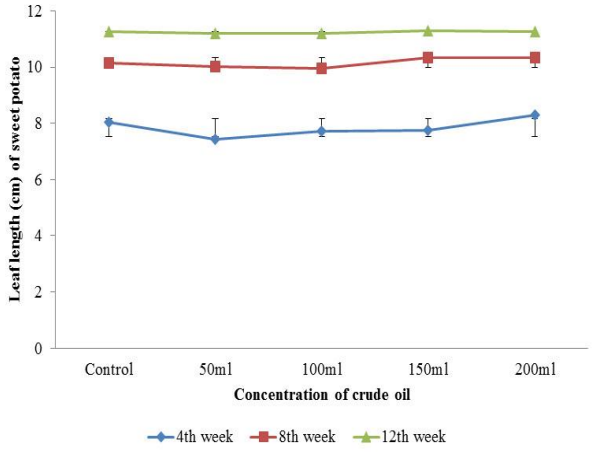

Figure 2: Effect of crude oil on the leaf length of Sweet potato.

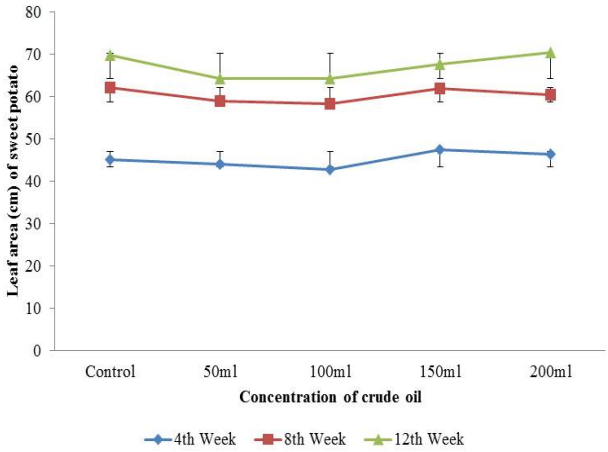

Figure 3: Effect of crude oil on leaf area of sweet potato.

DISCUSSION

Environmental pollution is one of the major challenges affecting human growth and development. However, since the beginning of crude oil exploitation and exploration in Nigeria especially in oil rich Niger Delta region it has affected the soil physicochemical properties and microorganism thus leading to poor crop productivity. Agbogidi and Ofuoku (2005) stated that the effect of oil in soil and plants is influenced by the oil level as modified by innate genetic characters of the plant. Anoliefo and Vwioko (2001) maintained that oil contains some toxic compounds which may be injurious to plant and their seeds. The investigation of *Ipomea batata* for

tolerance to crop oil pollution have shown that the crop could be used as a phytoremediation plant since it was able to tolerant the effect of crude oil at a high pollution level. The tolerance of the plant to oil polluted soil may implies that *Ipomoea batata* posseses some nutritional properties and hydrocarbon utilizing microorganisms that has the potentials of degrading or breaking down the hydrocarbons present in the crude oil. According to Walker *et al.* (2001), availability of nitrogen in soil directly affects the relative growth rate of plants. Proper growth of any plant is dependent on the amount of available nutrients in the soil. Ekpo *et al.*, (2012a) reported that *Thaumatococcus daniellii* could be used for phytoremediation experiment due to it tolerance to crude oil pollution. The duration of the planting as observed in this study indicated that more morphological attributes of the plant may develop or improve with timing. The plant height, number of leaves, leaf length and leaf area were improved during the timing of these study. Zana and Stanley (1990) reported that the plant density effects were significant for number of branches formed and timing of branch formation of sweet potato and that additional branch with the modification of branching pattern increases as the season progressed. Ekpo *et al.*, (2012b) in a related study using soybean reported that duration or timing of an experiment influences the growth and productivity of crops. The leaf area of the plant was significant reduce as a result of the interference of the hydrocarbon with the normal photosynthetic activity that is need for the development of this feature. The limitation in the nitrogen or phosphorus level could however result in poor productivity of crops. A large leaf area of a plant affirmed the productive output or yield of the plant.

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