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Effect of Bonny Light Crude Oil Pollution of Soil on the Growth of dayflower (*Commelina benghalensis* L.) in the Niger Delta, Nigeria

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ABSTRACT: The effect of Bonny Light Crude oil pollution of soil and successive plantings in the same soil at 4 – week intervals on the growth of dayflower (*Commelina benghalensis* L.) was investigated. The factorial sets of treatments were two levels of oil pollution (0 and 50 mg/g) and 5 successive plantings. Characters assessed were mean plant height, leaf area per plant and mean dry matter weight. At each of the 5 croppings mean plant characters assessed were significantly higher (P = 0.05) at 0 mg/g oil pollution than at the 50 mg oil/g soil pollution level. In the Control treatments, a declining trend in plant growth was observed from the 1st to the 5th crop. In contrast, in the oil-treated soils, an increasing trend was observed. @JASEM

Between 1976 and 1990, oil companies in Nigeria reported a total of 2,796 oil spills. An estimated total quantity of 2,105,393 barrels of oil was spilled on land, coastal and offshore marine environments (Kontagora, 1991). In 1974, an extensive oil spillage occurred near Ebubu-Ochani area in Gokana LGA, Rivers State, Nigeria. It was from an oil delivery pipeline that bursted off a petroleum flow-station. The spilled oil caught fire. Incineration of the spill on soil surfaces resulted in the formation of tar mat oily scum. This may have prevented soil aeration and water infiltration into subsoil layers (Amadi *et al*; 1996). Even after 22 years following the spillage, oil has persisted in the area. The surrounding areas located around the high impact zone still remain unsuitable for farming (Amadi *et al*, 1996). They further stated that the persistence of oil in high amount would indicate that bioremediation operations to enhance oil removal from soil surface is still relevant. In May 2000, an oil pipe leakage occurred at the Diebu Creek Field, a freshwater environment in the Niger Delta area of Bayelsa State, Nigeria (Daniel-Kalio and Braide, 2004). They found that in the less heavily impacted areas, *Alstonia* and *Athocleista* spp showed the lowest stress ratings followed by plantain. The other plant species found in the area were more susceptible. These observations were made from field studies. They show that heavy oil pollutions do occur in the Niger Delta.

Amadi (1992) reported on the effect of remediation of oil polluted agricultural soil planted to maize. Low pollution levels (30 mg oil/g siol) were used. In Nigeria, there have been few reported works on the effects of oil pollution of soil on plants, using more than 40 mg oil/g soil pollution levels. (Udo and Fayemi, 1975; Anoliefo and Vwioko, 1995 and Daniel-Kalio and Tih, 2003) These had experimented on cultivated crops-maize, tomato, pepper and pawpaw. In a field survey investigation of oil-polluted sites, Odogwu and Onianwa (1987) found that dayflower (*Commelina benghalensis L.)* was one of the plant species colonizing an oil impacted zone. There had been no reported experimental study to find out the response of *C. benghalensis* to high oil pollution levels. This report is probably the first of such studies on *C. benghalensis.* The aim of the study was to find out the effect of high oil pollution of soil and successive plantings in the same soil at 4 – week intervals on the growth of *C. benghalensis.* Studies of this nature can help us to determine whether and when *C. benghalensis* can be utilized for the purpose of revegetating heavily oil-impacted zones in the Niger Delta, Nigeria.

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MATERIALS AND METHODS

The work was carried out in the Plant House of the Department of Biological Sciences, University of Science and Technology, Port Harcourt. The soil at the experimental site was an acidic sandy loam soil classified as typic paleudult. Top soil, rich in organic manure was collected to a depth of about 20cm from land that was under fallow for years, and sieved to remove large particles before use. An initial field survey was carried out to identify grasses, sedges and broad – leaved weeds found colonizing oil polluted sites (mostly sites close to motor mechanic workshops) in Port – Harcourt. One such weed was *C. bengalensis* L. which was found to be also common in the University campus. A large quantity of healthy uniform seedlings, assembled for use, had the following initial mean characteristics: Plant aspect – very good; Plant height – 12 cm; Number of leaves per plant – 4; Leaf area per plant – 24. 1 cm^2; Dry matter weight – 0. 6g.

Ten perforated black nursery bags with a surface area of 531 cm^2 (radius 13 cm) and a depth of 36 cm, served as experimental units (plots) for a completely randomized design trial of 10 factorial set of treatments (2 levels of crude oil-0 and 50 mg/g X 5 successive plantings in the same soil at 4- week intervals) and 5 replications. Ten nursery bags were needed to accommodate 2 oil levels replicated 5 times. Fresh unweathered Bonny Light Crude (BLC) oil (specific gravity 0.8343) obtained from Agabada–2 flow station of the Shell Petroleum Development Company (SPDC) was used to treat the soil at the 2 concentrations used. The treatments with 0 mg oil/g soil, served as Control. Oil in each plot was mixed with soil by hand, so as to ensure homogeneity. Each bag was filled with treated soil to a depth of 30 cm. Five *Commelina* seedlings were transplanted equidistantly into each bag (plot). The plants were watered to field capacity as and when necessary.

Table 1: Mean plant height (cm) as affected by crude oil addition to soil and successive plantings at 4 – week intervals.

B. L.C. Oil in Soil (mg/g)	Mean * Plant Height (cm) at Different Successive Plantings. 1st	2nd	3rd	4th	5th. Planting
O (Control)	33.0 a	27.6 a	26.2 a	25.2 a	26.8a
50	2.6 b	13.4 b	16.4 b	14.8 b	21. 0b
LSD (0.05)	6.2	8.8	4.3	3.3	2.8

* Average of 5 replications. Mean separation in a column by LSD at 5% P – level. In a column, means followed by a common letter are not significantly different at the 5% significance level.

Characters assessed 4 weeks after each planting (wap) and used to evaluate soil amelioration included plant height (cm), leaf area per plant (cm^2) and dry matter weight (g). Plant height (cm) was measured from the base of the plant at soil level to the terminal bud; leaf area (cm^2) per plant was determined non-destructively using the formula: ∑ (LB x 0.67), where ∑ or sigma = the summation of all the leaf areas per plant; L = leaf length; B = leaf breadth at its widest, and 0.67 is a correction factor which had been determined earlier empirically. Dry matter weight (g) was obtained by cutting the uprooted fresh plants from each bag. After putting each of them in a weighed container, they were dried to a constant weight at a temperature of 110^0C for about 5 hours. Statistical analysis was as described by Gomez and Gomez (1984) and Wahua (1999). The least significant difference (LSD) was used to compare treatment means.

Table 2: Average leaf area (cm^2) per plant as affected by crude oil in soil and successive plantings at 4 – week intervals.

B.L.C Oil in Soil (mg/g)	Average * Leaf area (cm^2) per plant at Different Successive Plantings. 1st	2nd	3rd	4th	5th.
O (Control)	20.9a	64.3a	87.0a	37.2a	47.0a
50	6.4 b	28.1b	21.7b	24.8b	27. 8b
LSD (0.05)	9.5	16.9	9.4	5.2	6.3

- Average of 5 replications. Mean separation in a column by LSD at 5% P – level. In a column,
- means followed by a common letter are not significantly different at the 5% significance level.

RESULTS AND DISCUSSION

Mean Plant Height (cm): Data presented in Table I show that at each of the 5 croppings, the mean plant height (MPH) was significantly higher (P = 0.05) in the control (0 mg oil/g soil) than in the oil-treated (50 mg/g) plots. In the control, MPH declined from 33.0 cm in the 1st planting to 26.8 cm in the 5th. However, in the 50 mg/g treated soil, the reverse was the case. Here, MPH increased from 2.6 cm in the 1st planting to 21.0 cm in the 5th. Expressed in terms of percentages, MPH increased from 7.9% of the Control in the 1st crop to 78.4% of the Control in the 5th planting.

Average Leaf Area (cm^2): Data presented in Table 2 show that at each of the 5 croppings, the mean leaf area (MLA) was significantly higher (P = 0.05) in the Control than in the oil-treated (50 mg/g) plots. In the Control, MLA declined from 20.9 cm^2 in the 1st planting to 47.0 cm^2 in the 5th. However, in the 50 mg/g treated soils, the opposite was the case. Here, MLA increased from 6.4 cm^2 in the 1st planting to 27.8 cm^2 in the 5th. Expressed in terms of percentages, MLA increased from 30.6% of the Control in the 1st crop to 59.1% of the Control in the 5th planting.

Table 3. Effect of oil pollution and successive plantings at 4 – week intervals on mean dry matter weight (g) of ***C . benghalensis*.**

B. L.C. Oil in Soil (mg/g)	Mean * dry matter yield (g) at Different Successive Plantings				
	1st	2nd	3rd	4th	5th.
O (Control)	6.7a	5.6a	5.2a	4.6a	5.1a
50	0.1b	1.1b	1.7b	1.8b	2. 8b
LSD (0.05)	0.9	1.3	1.9	0.7	0.5

*Average of 5 replications. Mean separation in a column by LSD at 5% P – level. In a column, means followed by a common letter are not significantly different at the 5% significance level.

Mean Dry Matter Weight (g): Data presented in Table 3 show that at each of the 5 croppings, the mean dry matter weight (MDMW) was significantly higher (P = 0.05) in the Control than in the oil-treated (50 mg/g) plots. In the Control, MDMW declined from 6.7 g in the 1st planting to 5.1 g in the 5th. However, in the 50 mg/g treated plots, the contrary was the case. Here, MDMW increased from 0.1 g in the 1st planting to 2.8 g in the 5th. Expressed in terms of percentages, MDMW increased from 1.5% of the Control in the 1st crop to 54.9% of the Control in the 5th planting. The results on the overall growth performance of *C.benghalensis* in heavy oil contamination of soil agree with those of Udo & Fayemi (1975) and, Daniel-Kalio and Tih (2003), even though they experimented on different plant species. Udo and Fayemi (1975) worked on maize (*Zea Mays L.),* using oil pollution levels of 0 to 106 mg oil/g soil. They planted in the same soil at 6-week intervals and raised 3 successive crops. They also found that the MDMW of plants in the Control (O mg/g) declined from the 1st crop to the 3rd. On the other hand, in plots receiving oil pollution levels of 42 to 85 mg oil/g soil, MDMW increased from the 1st crop to the 3rd. Daniel-Kalio and Tih (2003) worked on pawpaw (*Carica papaya L.),* using oil pollution levels of 0 and 60 mg oil/g soil. They also planted in the same soil successively at 6-week intervals and raised 5 crops. They found that the MPH and MDMW of plants in the Control (0 mg/g) declined from the 1st crop to the 5th, whereas, in plots receiving 60 mg oil/g soil, both the MPH and MDMW increased from the 1st crop to the 5th. However, unlike the results obtained in the present study, both MPH and MDMW in the Control were significantly higher (P = 0.05) than plants in 60 mg oil/g soil only in the 1st and 2nd crops, and not in the other successive plantings. The declining trend of measured parameters in the Control, and increasing trend of same in the oil-treated plots observed in this study, would mean that if more successive crops were raised in the same soil, there will come a time when no significant mean differences would be observed among the treatments compared.

The declining trend of measured parameters in the control treatments was likely due to the fact that at each harvest, plant nutrients were taken away from the soil. As a result, the soils became more impoverished with each successive harvest. The initial poor performance of plants in the oil-treated plots was due to the toxicity of the unweathered crude used. With passage of time, the crude became weathered; natural rehabilitation processes were going on; petroleum hydrocarbons were degraded; litter from killed plant parts decomposed. All these assist in the release of plant nutrients into the soil and thereby, stimulated plant growth. This process continued from one cropping to another, thus releasing more nutrients for plant use, into the oil-treated soils. The challenge to bioremediation of oil polluted land lies more in heavy oil pollutions of soil than in slight pollutions.

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