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GROWTH AND DEVELOPMENT RESPONSE OF MAIZE (*Zea mays* L.) IN CRUDE OIL POLLUTION TREATMENT.

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ABSTRACT

Growth and development response of *Zea mays* were investigated at the University of Port Harcourt botanical garden. Crude oil pollution effects of direct spray on foliage or spill on soil on the growth changes and chlorophyll content of *Z. mays* were examined, alongside a control. There were significant (p = 0.05) reductions in chlorophyll content in treatments with crude oil sprayed on foliage or spilled on the soil in comparison with the control. Visual symptoms of crude oil contamination effects on *Z. mays* showed gross damage on the growth and development of the crop. This study shows that crude oil pollution has adverse effects on growth and development of *Z. mays.*

KEY WORDS: Growth, development, response, crude oil treatment, maize (*Zea mays*)

INTRODUCTION

Maize (*Zea mays* L.) belongs to the family Poaceae and is utilized worldwide for both industrial and food purposes (Udoh *et al*., 2005). The environmental consequence of crude oil pollution on soil fertility and plant growth has been a major cause for concern in the Niger Delta region (Adedokun and Ataga, 2007). Damages due to soil contamination may be extensive and its effects may be long term (Ogbo, 2009). The adverse effects of crude oil pollution has been shown to be proportional to the level and concentration of pollution (Onuh *et al.,*2008). The adverse effects of petroleum oil on germination of seeds, growth and development of plants, and the soil medium for plant growth, have been reported (Pezeshski *et al*., 2000; Odejimi and Ogbalu, 2006). This study therefore, was conducted to examine the growth and developmental changes of *Z. mays* to crude oil pollution treatment.

MATERIALS AND METHODS

The seeds of maize (*Zea mays*) were collected from the Rivers State Agricultural Development Project (RSADP) Port Harcourt, Rivers State. Crude oil was collected from the Shell Petroleum Development Company of Nigeria Limited (SPDC), Oyigbo flow station.

Crude oil spill on *Z. mays* immediately after planting: A total of ten planting bags with known surface area of 531cm^2 were used. They were filled with top soil from the botanical garden. The planting bags were perforated to avoid water logging. Four seeds of maize (*Z. mays*) were planted in each bag. Each bag was spilled with 50ml of crude oil immediately after planting. The plants were watered twice daily. Observation and measurements were taken.

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Crude oil spill and spray on the growth and development of *Z. mays:* A total of 20 planting bags with surface area of 531cm^2 were used. Ten planting bags were used for each method. The planting bags were filled with top soil from the botanical garden. The planting bags were also perforated to avoid water logging. In both the spill and the spray experiment, the seedlings were up to 3 weeks before treatment. In the spill experiment 50mls of crude oil was spread evenly on the surface soil of each planting bag, while in the spray treatment, a manual sprayer was used. The sprayings were done in such a way that the foliage of the plants was covered with crude oil. The plants were watered twice daily. Observations were taken on the chlorophyll content.

Crude oil spill and spray on the chlorophyll content of *Z. mays:* In both spilling and spraying experiment, the seeds were left to germinate and the seedlings left to grow for two weeks before treatment. In the spilled experiment, 50ml of crude oil was evenly spread on the surface of the soil around the plant stand of each planting bag and proper irrigation of the soil was ensured. In the spray experiment, manual sprayer was used. The spraying was done in such a way that both the abaxial and adaxial surfaces of the plant were soaked with crude oil. The whole plants were watered twice a day. The chlorophyll content was measured after treatment with crude oil using Comar and Zscheille (1942) method.

RESULTS

Effects of spilling and spraying of absolute crude oil on chlorophyll content: It was observed that the spilled and sprayed treatment on the plants had significant effect in comparison with the control (Fig. 1). Crude oil sprayed on the abaxial and adaxial surfaces of the plant caused the loss of chlorophyll content, thereby making the whole plant decolorize; there was also cell maceration and eventual death of the plant tissues. For the soil surface crude oil spillage, the plant also showed a reduction in the chlorophyll content in comparison with the control. However, spilled treatment showed high chlorophyll content when compared with spray treatment.

Effect of crude oil spill and spray on plants 3 weeks after planting: After two days of spill, the plants began to show signs of chlorosis and reduction in average leaf area. After 5 days of spill the plants appeared to have completely withered, while the control increased in both leaf area and height while after two days of treatment, the plants had completely withered; the effect of the spraying appeared to be more drastic, than that of the spill. The plants used as control continued to have normal growth and development.

Effect of presoaking for 48 hours in varying concentrations of crude oil equilibrated with water on growth and development of *Zea mays*: There was a significant difference in height between the control and pre-treated plants. There was no significant different between the control and the plants pre-treated in 1% concentration of crude oil equilibrated with water. The control plants had an average height of 11.2cm, which is a reduction of 42% in height.

Observations on growth and development: Table 1 and 2 shows the visual observation of the effect of crude oil on plant growth and development. It was observed that the plants at 3 weeks were very susceptible to crude oil in both spill and spray experiments. 48 hours after spraying there was an acute maceration of plant foliage, after 120 hours wilting of collapsed plants was observed. The basal stem showed some dark brown colour. It was observed that plants wilted from the basal stem to the buds while in the spray experiment the plants appeared to be more affected. After 48 hours there was large-scale death and browning of foliage and stem. The foliage turned chlorotic and necrotic. There was abscission of necrotic and discoloured leaves after 96 hours, this continued until complete defoliation occurred.

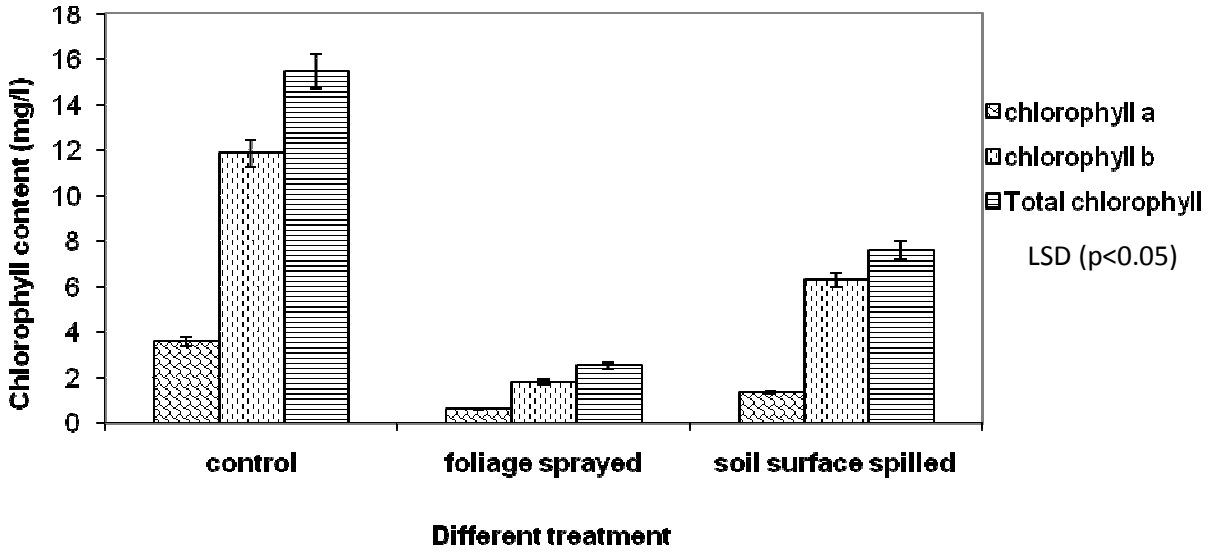

Fig. 1 Effect of crude oil spilled and sprayed treatment on chlorophyll content of *Zea mays*.

Table 1: Visual observation of crude oil effects on plants sprayed with oil

Age of plant	Volume	Time before plant response	Observed effect
3 weeks	50ml	24hrs	Observed oil soaking on entire plant foliage. Blotched areas where observed
		72 hrs	Large scale browning of foliage and stem, leaves became chlorotic
		96 hrs	Abscission of chlorotic leaves
		144 hrs	Abscission of dead leaves continues, until plant was completely defoliated

Table 2: Visual observation of crude oil effects on plants grown on oil spilled soil

Age of plant	Volume	Time before plant response	Observed effect
5 weeks	50ml	24hrs	Absorption of oil into plant and collapse of stems
		72 hrs	Basal stem show a dark brown colour
		120hrs	Wilting and plant death

DISCUSSION:

Growth and development was inhibited in both the spray and spill experiment. The reduction in growth and development may be attributed to loss of photosynthetic ability; Plants grow well only when they are able to carry out photosynthesis efficiently. The loss of the ability of the plants to photosynthesize can be largely attributed to the destruction of the chloroplast membranes (Amakiri and Onofeghara, 1984).

Differential changes in the rate of leaf growth may be associated with anatomical and morphological change caused by the oil (Agbogidi *et al*., 2005). Plants have the need to respire, but when they are covered with crude oil the stomata closes and therefore reduces gaseous exchange. The inhibitory effect of crude oil in plants is attributed to stomata closure, which causes reduction in gaseous exchange and cessation of water uptake, thus this effect is associated with the hydrophobic nature of crude oil (Amakiri and Onofeghara, 1983). After four days of treatment the sprayed plants showed a greater reduction in the chlorophyll, than the spilled plants in comparison to the control. This results agrees with the work of Amadi *et al*. (1993) who reported that maize grown in soil contaminated with hydrocarbon (3% v/w) and treated with sawdust experienced die-back and necrosis of leaves, and the work of Chaîneau *et al*. (1997) who reported that bean and wheat grown in soils contaminated with fuel oil (up to 12 g kg^{-1}) showed symptoms of chlorosis. Although the spill and spray treatments showed different levels of damage, it was generally observed that crude oil treatment reduced chlorophyll content of *Zea mays*. This is probably attributable to tissue penetration, membrane destruction and leakage of cell content (Amakiri, 1981).

CONCLUSION:

Crude oil application on plant either by spraying or spilling caused reduction of plant chlorophyll content, growth retardation, defoliation, damage of plant tissue and eventual death of the plant. Thus, *Zea mays* showed sensitivity to crude oil pollution treatment.

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