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PERFORMANCE OF MAIZE (*Zea mays* L.) IN CRUDE OIL TREATMENT

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ABSTRACT

The performance of maize (*Zea mays*) in crude oil treatment was investigated at the University of Port Harcourt botanical garden. Germination and growth responses of *Z. mays* were examined using various crude oil pollution treatments. There was no significant difference in the germination and development of *Z. mays* subjected to oiling at 1-3% compared to those of the control (0%), while 4-5% oiling showed a significant difference at P=0.05. Percentage germination decreased with increase in concentration of crude oil equilibrated with water. Germination rate decreased significantly with increased time of pre-soaking in crude oil. Crude oil spilled soil immediately after planting, increased the length of lag phase preceding germination from 48 hours to 96 hours and decreased percentage germination from 100% in the control to 58% in crude oil contaminated soil. This study shows that crude oil pollution has adverse effects on germination and development of *Z. mays.*

KEY WORDS: Performance, crude oil treatment, germination and development, maize (*Zea mays*)

INTRODUCTION

Zea mays L. of the family Poaeceae has a fibrous root system and produces bisexual flowers. The leaves are about 50-70cm in length and 8-9cm wide. It is however a short lived annual monocot species, with parallel leaf venation and can be grown in a wide variety of climates and on diverse kinds of soil, which is evident in its wide distribution (Udoh. e*t al.,* 2005).

Crude oil from different fields varies widely in their physical, chemical, and toxicological properties and it is important to know that the toxic ability of crude oil on flora depends to a large extent on its composition (Baker, 1984). Oil pollution has been reported to physically act by absorbing light wavelengths essential for photosynthesis (Baker, 1970; Odjegba and Sadiq, 2002). Oil penetration into a plant will cause disruption in the plant's physiological processes by interfering with metabolic processes such as photosynthesis, respiration and mineral uptake (Ekundayo, 2000, Amakiri and Onofeghara, 1983). Destruction of chloroplast membranes, in turn reduces photosynthesis, which will also bring about reduction in growth and development and changes in metabolic processes may lead to growth inhibition and plant death or even physical smothering (Baker, 1970). Also, the grain yield of *Zea mays* significantly reduced following crude- oil pollution (Edeme, 2001).

The objective of this study was to determine the germination and growth of *Zea mays* in crude oil 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.

Equilibration of crude oil and water: In preparing the different concentrations of crude oil equilibrated with water, a known volume of distilled water was added to a known volume of crude oil. This was carried out with the aid of a measuring cylinder calibrated in milliliters. It was mixed thoroughly with the help of a shaker. Various mixtures, that is, 5%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% concentrations were obtained.

Crude oil equilibrated with water on percentage germination of *Z. mays:* Fifty seeds from the batch already tested for viability were placed in five petri dishes lined with cotton wool. 30ml of different concentrations of crude oil equilibrated with water were added to the petri dishes. Three Petri dishes were used for each concentration and a control was set up which was irrigated with 30ml of distilled water. All these were placed on a laboratory bench at room temperature (29 ± 1^0C). Observation was made on the percentage germination of seeds and lag phase of seeds preceding germination.

Length of presoaking in absolute crude oil on percentage germination of *Z. mays:* A total of 105 seeds were presoaked in absolute crude oil for 2, 4, 6, 8, 10, 12 and 14 hours. At the end of two-hourly interval, the seeds were removed, cleaned and kept in a petri dish lined with cotton wool. There were three replicates for each set and a control, which was not presoaked in crude oil. 30ml of distilled water was added to each petri dish. They were kept on the laboratory bench at room temperature. Observations were made on the length of lag phase preceding germination and percentage germination.

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Presoaking of seeds in concentrations of crude oil equilibrated with water on the growth and development: *Z. mays* seeds were presoaked for 48 hours in 1-5% concentration of crude oil equilibrated with distilled water. At the end of 48 hours, the presoaked seeds were planted. The planted bags were filled with top soil from botanical garden. Observation was made on the percentage germination of seeds.

RESULTS

Effect of varying concentrations of crude oil equilibrated with water on percentage germination of *Zea mays:* The percentage germination decreased with higher concentrations of crude oil equilibrated with water. The highest percentage germination occurred at 5% concentration. Each of the concentrations showed significant reductions in percentage germination. No germination was observed for concentrations of 10-100% of crude oil equilibrated with water (Fig. 1).

Effect of pre-soaking in crude oil on percentage germination of *Zea mays*: The effect of presoaking seeds for 2, 4, 6, 8, 10, 12, and 14 hours on the percentage germination of *Z. mays* shows that the highest percentage occurred in the control (0 hour). The percentage germination decreased significantly as the length of presoaking hours increased (Fig. 3).

Effect of pre-soaking in varying concentration of crude oil equilibrated with water on lag phase preceding germination of *Zea mays*: The effect of the varying concentrations of crude oil equilibrated with water on the lag phase preceding germination of *Z. mays* shows that the control had a normal lag phase of two days (48 hours). The seeds treated with 10-100% of crude oil equilibrated with water did not germinate even after two weeks, while those treated with concentrations of 1-5% of crude oil equilibrated with water had a prolonged lag phase (Fig. 2).

Effect of pre-soaking in absolute crude oil at 2 hours intervals on lag phase preceding germination: The effect of the length of presoaking on the lag phase preceding germination of *Zea mays* shows that the control had normal lag phase of 48 hours while the length of the lag phase increased as the length of presoaking increased, though the seeds pre-soaked for 2 and 4 hours showed the same lag phase as the control (Fig. 3).

Effect of crude oil on *Zea mays* grown immediately after spilling soil with crude oil: Crude oil spilled soil immediately after planting, increased the length of lag phase preceding germination and reduced the percentage germination. Percentage germination decreased from 100% in the control to 58% that is a reduction of 42%. The lag phase was increased from 48 hours to 96 hours.

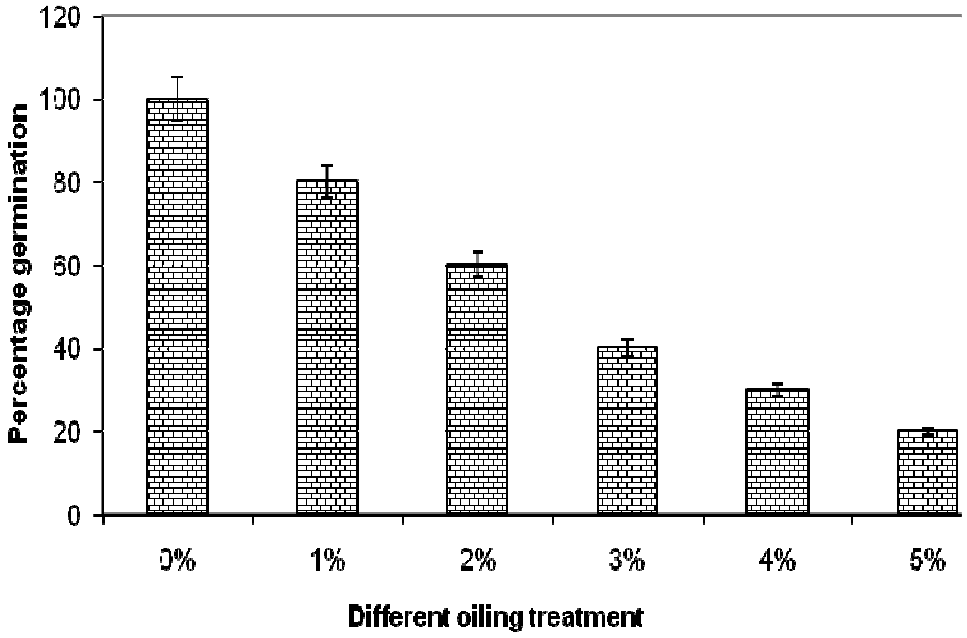

Fig. 1 Effect of varying concentrations of crude oil equilibrated with water on percentage germination of *Zea mays*

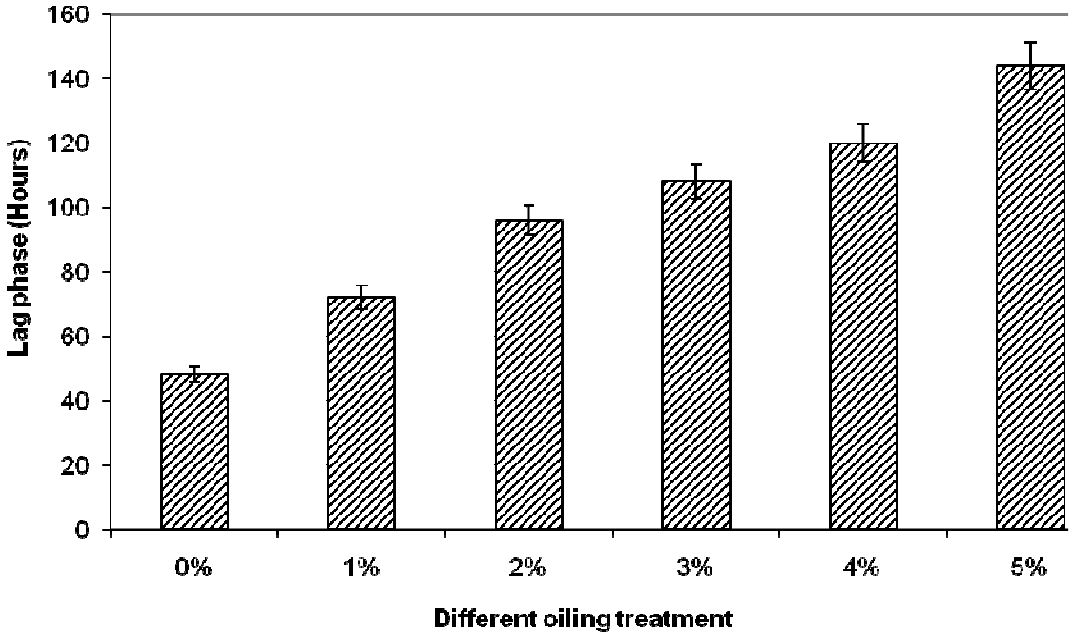

Fig. 2 Effect of presoaking maize (*Zea mays*) seeds in varying oiling treatment on the lag phase preceding germination.

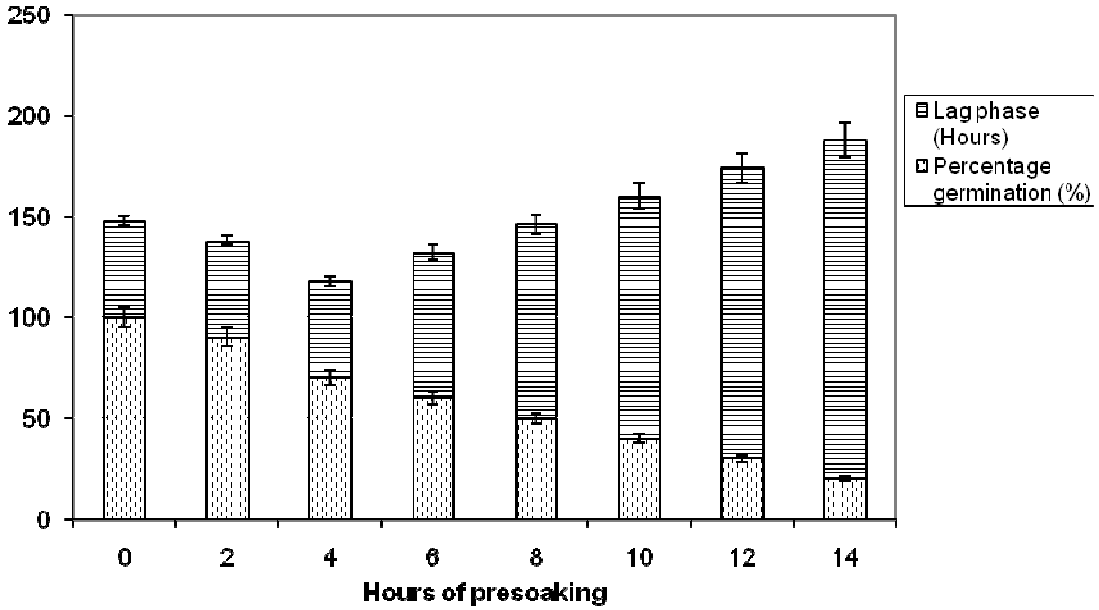

Fig. 3 Effect of presoaking *Zea mays seeds* in crude oil on the percentage germination and lag phase preceding germination.

DISCUSSION

The decrease in percentage germination and consequently increased lag phase preceding germination of *Z. mays* seeds exposed to concentrations of crude oil equilibrated with water, could be attributed principally to physical constraints. Crude oil has been observed to cause physical and chemical damage to seeds (Amakiri and Onofeghara, 1984). It has also been hypothesized that hydrocarbon reduces plant growth by coating plant roots (Baker, 1970; Xu and Johnson, 1997), and thus reducing plant water and nutrient uptake. Furthermore, the longer the period of presoaking of seeds in concentrations of crude oil equilibrated with water, the more pronounced the inhibitory effect. Percentage germination was also found to reduce with time of exposure. This is possible since the rate of penetration and damage due to crude oil is dependent on time of exposure (Amakiri and Onofeghara, 1984). This trend of reduced percentage germination with increase in the level of crude oil contamination was also recorded for perennial rye grass, wheat, alfafa, hairy vetch and soy bean by Issoufi *et al.*, (2006). A similar effect was observed by Adam and Duncan (2002) who reported reduction in germination rate in several plant species mainly in commercial crops caused by petroleum contaminants.

However, seeds presoaked in varying concentrations of crude equilibrated with water showed hardly any difference in the growth and development of the plants subjected to oiling at 1-3% compared to those of the control, while the plants subjected to 4-5% oiling showed a significant difference at p=0.05. There appeared to be a relationship between the intensity of spill and the degree of the effect observed on growth and development of the plant. Thus, the higher the volume and concentration of crude oil the greater the effect (Udo, 1975).

CONCLUSION

Crude oil was found to delay and in some cases inhibited germination of *Zea mays*. The lag phase preceding germination increases as the concentrations of crude oil equilibrated with water while percentage germination reduces. Thus, adverse effects were recorded on the germination and growth of *Zea mays* in crude oil pollution treatments.

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