Effect of Spent Oil and Kerosene (DPK) Polluted Soil, Amended with Poultry Droppings and Urea on Maize Growth

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Abstract
Studies to investigate the potentials of poultry manure and urea as bioremediations in soil polluted with spent oil and kerosene on maize growth was carried out in the green house of the Department of Plant Science and Biotechnology, University of Port Harcourt. A completely randomized experimental design comprising of 6 treatments and 4 replicates was used. Treatment (T) 1 with 100ml of spent oil T_2 with 200ml of spent oil, T_3 with 100ml of DPK, T_4 with 200ml of DPK, T5 had no pollutant but was remediated, T_6 had no pollutants and no remediation thereby serving as control. 10kg of soil sample was weighted into experimental polythene bags and pollutants were applied at different concentrations. A total of forty eight (48) bags were used for this experiment. Amendments with poultry droppings and urea were done 14 days after application and planting was carried out after 1 month of remediation. The soil sample used was analyzed for chemical and microbial components before and after pollution and harvest. Plant parameters were measured at intervals of 3 weeks for 12 weeks, chlorophyll contents, fresh and dry weights were determined after harvest. Soil analysis showed high levels of soil chemical properties and total hydrocarbon contents on the polluted soil. Result of microbial content was greatly reduced after the addition of the amendments. Results showed that fresh weight of maize in soil with organic amendment was higher except in the control plots than plants in the inorganic amended soils. Dry weight of maize was lower in the inorganic amended plots than plants from organic amended plot which had a very high value. The chlorophyll content of maize was higher in the organic amended plots. In general growth parameters of maize considered in the study were greatly enhanced following soil amendment with poultry manure and urea.

Keywords: *Spent Oil, Kerosene, Pollution, Amendment Maize.*

Introduction

Pollution simply refers to the introduction of contaminants into the natural environment which causes adverse change (Webster, 2010). It has also been viewed as the production and the release through human activities of any substance into the environment, in quantities that are harmful to man and other living things or in some way reduce the quality of human life (Ndukwu *et al*., 2012). There substances which make the environment impure are called pollutants.

Pollutant ranges from foreign substances, energies or naturally occurring contaminants such as gases., liquids, solids or high pitched sounds (Webster, 2010) when there is alteration in the environmental composition or condition either directly or indirectly it is said to be

polluted and this is as a result of man's daily activities (Ekweozor, 1987).

Amongst the pollutants that are easily encountered in the Niger Delta are the automobile spent oil and kerosene because they are found everywhere spilled into soils, drains and may even sip through the storage tanks. Causing serum pollution in the soil and as such requires remediation.

Automobile spent oil is defined as any synthetic oil which has been used and has resulted in its contamination by physical or chemical impurities (U. S. E. P. A, 2001). Automobile spent oils are greatly produced by mechanic workshops who fail to properly dispose spent lubricating oils thereby allowing a huge quantity to be disposed indiscriminately on plots and drainages thereby causing a major increase in pollution incidences in the environment more than pollution resulting from crude oil usage (Odjegba and Sadiqi, 2002). Greater soil amendment of polluted soil could be achieved by the use of fertilizers as they quicken the rate of degradation (Bollag *et al.*, 1994). The use of cereals and legumes as phytoremediators of polluted soils have been reported (Karth, Keyan *et al.*, 2000).

Maize (*Zea Mays L.*) is an important cereal crop that is widely cultivated all over the world. It is said to have originated from America. It is known by a multiplicity of names in various places and used as human food and animal feed (Purseglove, 1977). Its production is not limited to any ecological zone provided there are enough sunshine and rainfall. Maize produces a large number of seeds that are easily cultivable and has been recommended as one of the cereals that remediates the soil easily (Onuegbu, 2002).

This study therefore investigated the growth of maize in spent oil and kerosene polluted soil remediated with poultry droppings and urea.

Materials and Methods

Experimental site:

University of Port Harcourt is located on latitude 4^0 52'N and 4^0 55'N and longitudes 6^0 54'E and 6^0 56'E in Obio/Akpor Local Government Area (LGA), Rivers State. It is situated in the Niger Delta wetland of southern Nigeria. The study site is characterized by tropical monsoon climate with mean annual temperature of 25^0C to28^0 C and annual rainfall over 3000mm. the relative humidity is very high with an annual mean of 85% while, the soil is usually sandy or sandy loam underlain by a layer of impervious pan. The study site was situated at the University of Port Harcourt greenhouse which functions under the Plant Science and Biotechnology Department, in the Faculty of Science, University of Port Harcourt, Rivers State, Nigeria. An area of 10m x 15m was marked out with a measuring tape and then cleared to ground level. No covering was made so as to ensure sunlight had a direct focus on it, and rain to get to the plant. It represented a natural environment for proper and adequate plant growth.

Collection of maize grains

Treated grains of maize (*Zea Mays*)
(Swan 1 – yellow) were obtained from the Agricultural Development Program Office (ADP) at Rumuodomaya in Port Harcourt, Rivers State, Nigeria. The maize grains were treated with apron star to prevent rodent and fungal attacks. Apron star was applied to the grains as a post-harvest procedure and gives the maize grains a characteristic bluish colour after treatment.

Preparation of experimental bags for planting

A total of 48 experimental polythene bags were used for the first phase and second phase respectively. In all 96 polyethene bags were used for the study. The polyethene bags with the soil weighed 10kg each and were punctured all over to prevent water logging and create room for proper aeration.

Collection of spent oil and DPK

Dual purpose kerosene (DPK) was purchased from Nigerian National Petroleum Cooperation NNPC) filling station, Port Harcourt Township to avoid in order to avoid using adulterated product, while spent oil was collected from the mechanic village in mile III, Port Harcourt.

Collection of measuring cylinders

Measuring cylinders of different capacity were collected from the Plant Science and Biotechnology Laboratory and used to measure the required concentrations of the spent oil and kerosene.

Collection of fertilizers

Organic and inorganic fertilizers were used in this study. Poultry manure constituted the organic manure while urea was the inorganic fertilizer employed for the experiment.
Poultry manure was obtained from a poultry farm at Aluu in Ikwerre LGA. The inorganic fertilizer was purchased from ADP Rumuodomanya in Obio/Akpor LGA. The poultry manure was composted and crushed before its application on the maize plants.

Collection of soil sample

Soil sample was collected from the school fallowed garden with an auger from between 0 to 15cm soil depth and transported to the green house for further use.

Pre-planting preparation

Viability test

Seed viability was tested by soaking the maize grains in water and the removal of the grains that floated in water. After this, the maize grains were sown on damp blotter papers in petri-dishes and allowed to germinate. At the end of four days it is expended that the maize grains should start germination. The formula below was used to calculate the germination percentage.

$$\% \text{ Germination} = \frac{\text{Number of seedlings that germinated per pot}}{\text{Number of seeds planted per pot}} \times \frac{100}{1}$$

Soil samples and treatment

Composite samples of soils collected with metallic auger were made and the soil. Samples homogenized. 10kg of the soil sample was measured into the perforated poly bags (Onuh *et al.*, 2008a) both for the first and second block. Other soil

The soil samples in the perforated polyethene bags were polluted with different concentrations of kerosene and spent oil and labelled accordingly. The polluted soil was properly mixed with a hand trowel and labelled with each of the pollutant having their control experiments. The polluted and unpolluted soil samples were allowed to stand for 14 days, during the period the soil samples in polyethene bags were watered at two days interval.

Soil amendment materials and treatment
Poultry manure and urea were the two materials used for the amendment. The experiment was in two blocks; block 1 made up of 10kg of soils with 100ml and 200ml DPK and spent oil amended with 1kg of poultry droppings and 100g of urea.

Block 2 also had 10kg of soils mixed with 100ml and 200ml DPK and spent oil amended with 1kg of poultry droppings and 100g of urea. The treatments and amendments were done as illustrated below.

Maize experiment using organic manure as remediator
T_1: 100ml spent oil + poultry manure
T_2: 200ml spent oil + poultry manure
T_3: 100 DPK + poultry manure
T_4: 200 DPK + poultry manure
T_5: No pollution + poultry manure
T_6: No pollution, No amendment.

Amendments were properly mixed in each bucket containing soil and were left for a month before maize grains were planted. Each treatment was replicated four (4) times and the buckets placed at random using a complete randomized block design.

Planting of maize
Maize grains were planted one month after soil amendment. Four seeds/grains were planted per bucket and soil recovery potentials were monitored through the plant height, leaf area, number of leaves, and plant growth for each treatment for twelve weeks after planting. (12WAP).

Determination of fresh plant weight
This was done at twelve weeks of growth of maize in the field. The whole plant was weighted using an electric weighting scale and recorded for the various treatments.

Determination of dry weight; of maize
Determination of dry weight of maize was done by even drying for about three days which was weighed using the electric weighting scale (LP 620 Model) and result recorded.

Determination of plant height
Plant height was determined by measuring the height of plants with a meter rule at the early growth stage and a measuring tape at the advanced stage when the plants had outgrown the meter 3 weeks after planting (3WAP) and continued for twelve weeks (12 WAP).

Leaf number
Leaf number for maize was counted from the plots amended with poultry manure and urea and the mean values recorded. Counting of leaves was done at 3 weeks interval for 12

Stem girth
Stem girth was also measured using the vernier-calliper and recorded for maize plants from the various polluted and remediated plots

Leaf area
Leaf area of maize in the remediated plots was assessed using the special graph technique.

Statistical Analysis
Data collected were subjected to the appropriate analysis using SAS (2007).

Results
Results of maize growth on automobile spent oil and kerosene (DPK) polluted soil and remediated with poultry manure and urea fertilizer as shown in various maize plant parameters performance such as plant height(cm) leaf number, stem girth chlorophyll content and leaf area (cm^3) are shown below. Others include the fresh and dry weight of maize at twelve weeks after planting (12 WAP).

Plant Height (cm) of maize
Plant height steadily increased in all the treatments with organic and inorganic amendments with time as shown in fig. 1. It was observed from the results that maize plant recorded the highest mean height in treatment 1(T_1) on the 3rd and 6th weeks and treatment 4 (T_4) with the highest main plant height for the 9th and 12th weeks. However, treatment 6 (T_6) had the lowest mean heights throughout the 12 weeks monitored for organic manure.
On the contrary, treatment 6 (T_6) had the highest mean heights for inorganic amendment all through the observation periods, while the lowest plant height was recorded in treatment 2 (T_2).

Fig 1: Maize plant height

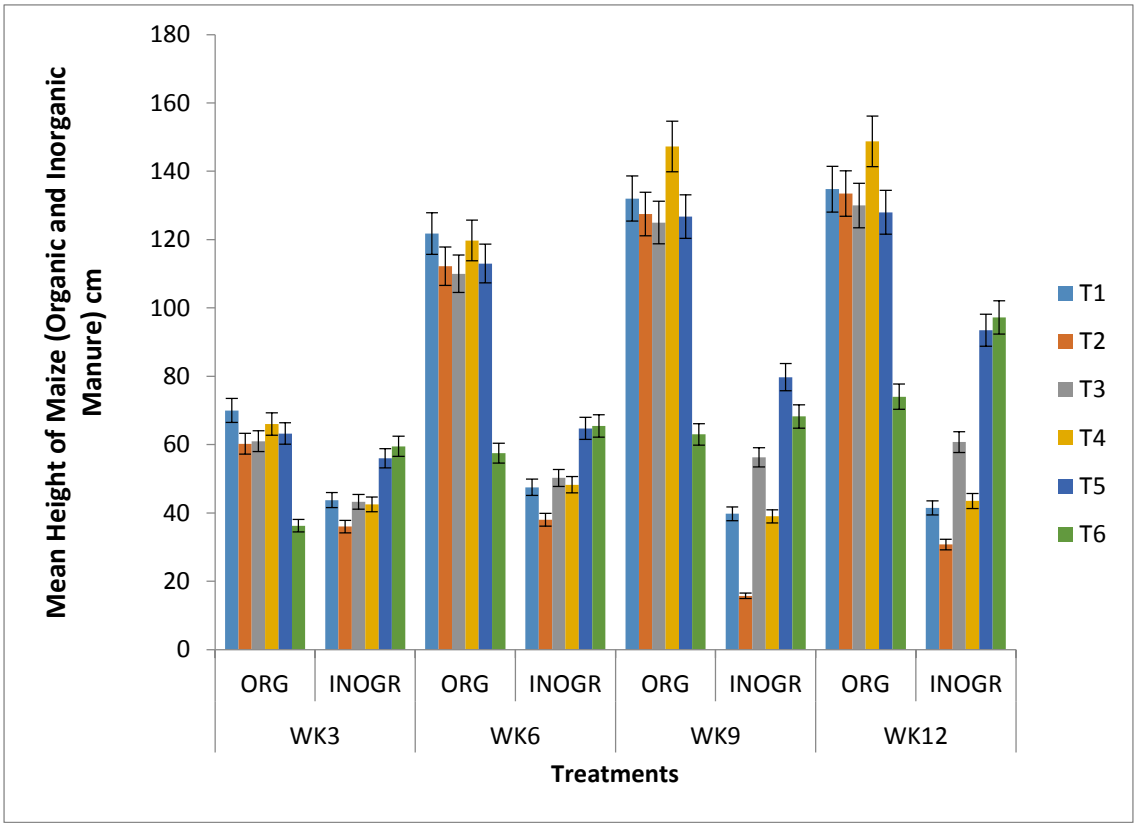

Fig 1 Effects of Organic and Inorganic Manure on the Height of Maize Grown in Spent Oil and DPK Polluted Soil.

T1 = 100ml Spent Oil + (Poultry Droppings (organic) and Urea (Inorganic) , T2 = 200ml spent oil + (Poultry Droppings(organic) and Urea (Inorganic)), T3 = 100ml DPK + (Poultry

Droppings(organic) and Urea (Inorganic)), T4 = 200ml DPK + (Poultry Droppings(organic) and Urea (Inorganic), T5 = Unpolluted soil + (Poultry Droppings(organic) and Urea (Inorganic)), T6 = Control (Unpolluted soil without any amendment.

Leaf number of maize as affected by pollution following amendment

The results of the mean number of leave of maize grown on spent oil and kerosene (DPK) polluted soil and remediate using poultry droppings and urea are presented in fig 2. The result portrayed a steady increase in leaf number of maize with some variability on different treatments. In general the number of leaves increased maize plants grown in organic manure amended soil, while maize plants grown in inorganic manure amended soil had reduced leaf number. Treatment 1 (T_1) and treatment 3 (T_3) mad the highest leaf number while treatment 2 (T_2) had the lowest leaf number for the organic amendment.

Fig 2: Effects of organic and inorganic manure on the leaf number of maize grown on spent oil and DPK polluted soil and amended with poultry manure and urea.

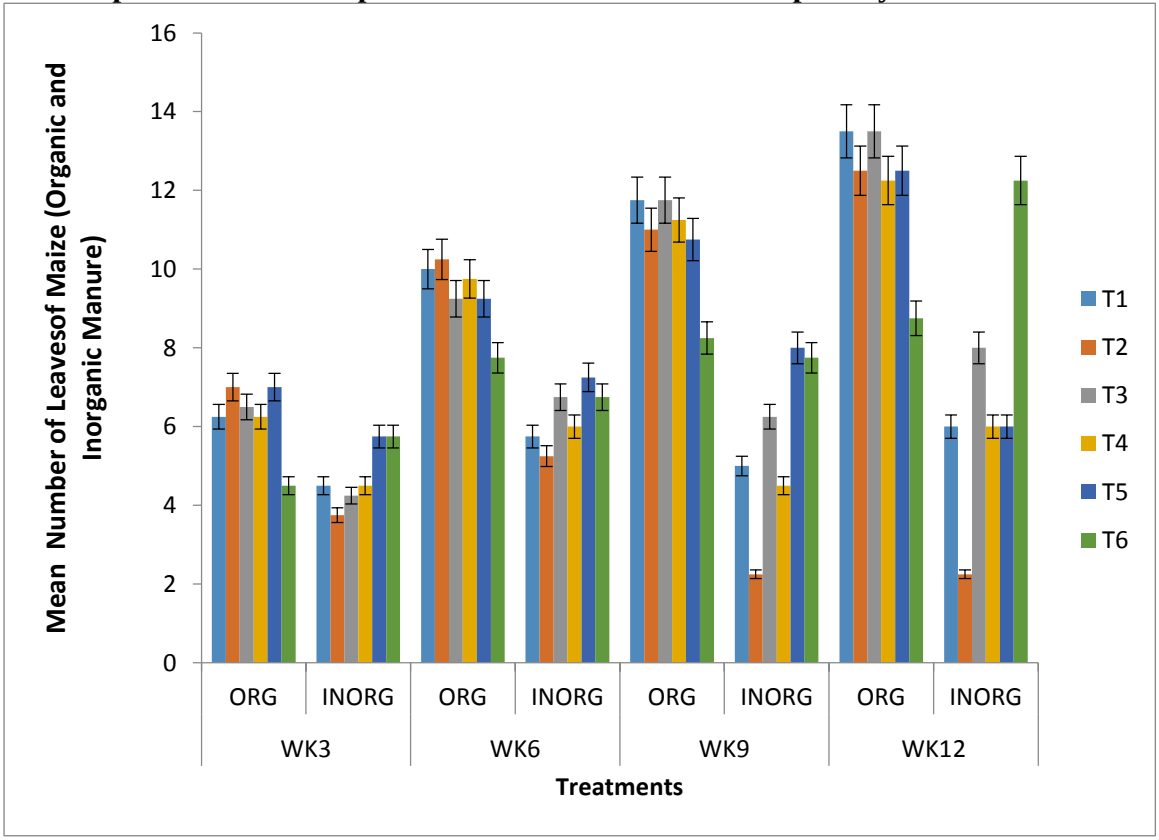

Fig. 2 Effects of Organic and Inorganic Manure on the Leaf Number of Maize Grown in Spent Oil and DPK Polluted Soil.

T1 = 100ml Spent Oil + (Poultry Droppings (organic) and Urea (Inorganic) , T2 = 200ml spent oil + (Poultry Droppings(organic) and Urea (Inorganic)), T3 = 100ml DPK + (Poultry Droppings(organic) and Urea (Inorganic)), T4 = 200ml DPK + (Poultry Droppings(organic) and Urea (Inorganic), T5 = Unpolluted soil + (Poultry Droppings(organic) and Urea (Inorganic)), T6 = Control (Unpolluted soil without any amendment.

Maize stem girth:

Maize stem Girth (mm) Results of maize stem growth grown in spent oil and DPK polluted soil

and remediated with organic and inorganic manure is shown in fig 3.
Stem girth for maize planted in soil polluted and remediately using inorganic and organic manure shows significant increase with time.

Maize recorded the highest mean stem growth in organic manure remediated soil in treatments 2 and 5 [T_2, T_5] at the 9th week and 12th week after planting, with the lowest stem growth recorded at 3rd – 12th weeks after planting in treatment 6 [T_6]. The highest stem growth for the inorganic treatment was observed in treatment 5 [T_5] at 3-12 weeks after planting while treatment 2[T_2] yielded the lowest plant growth within the sample period.

Fig 3: Effects of organic and inorganic manure on maize stem girth on soil polluted with spent oil and DPK and amended with organic and inorganic manure.

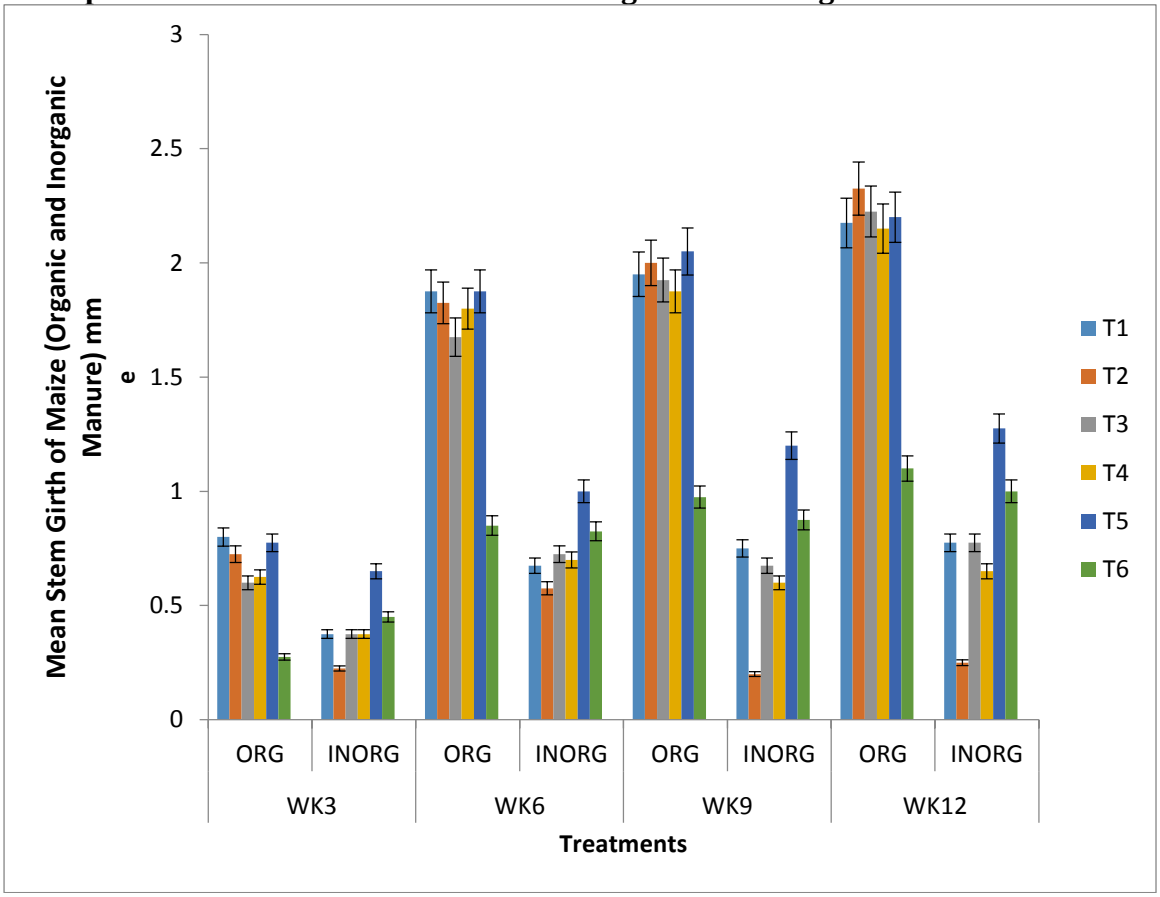

Fig 3 Effects of Organic and Inorganic Manure on the Stem Girth of Maize Grown in Spent Oil and DPK Polluted Soil.

T1 = 100ml Spent Oil + (Poultry Droppings (organic) and Urea (Inorganic) , T2 = 200ml spent oil + (Poultry Droppings(organic) and Urea (Inorganic)), T3 = 100ml DPK + (Poultry Droppings(organic) and Urea (Inorganic)), T4 = 200ml DPK + (Poultry Droppings(organic) and Urea (Inorganic), T5 = Unpolluted soil + (Poultry Droppings(organic) and Urea (Inorganic)), T6 = Control (Unpolluted soil without any amendment.

Maize leaf area [cm^2]
Results on maize leaf area growth in different concentrations of spent oil and DPK remediated with poultry manure and urea are presented in Fig 4. It was observed that there was unsteady increase and decrease in leaf area of the various treatments in both amendments

[poultry manure and urea]. Highest leaf area was recorded in treatment 5 [T_5] on the 9th week and 12th week after planting for the organic treatments. This was also followed by treatment 1[T_1] and treatment 2[T_2] at 6 weeks and 2 weeks after planting. The lowest leaf area was recorded in treatment 6[T_6] all through the periods of observations. Treatment 3 [T_3] had the highest leaf area for the inorganic remediation at 12 weeks after planting [12 WAP], followed by treatment 5 at 9th and 6th week after planting [9th & 6th WAP], and finally treatment 6 at 3rd week after planting [3 WAP]. Treatment 2 [T_2] had the least leaf area the weeks of observation.

Fig 4: Effects of organic and inorganic manure on the leaf area of maize grown in spent oil and DPK polluted soil and remediated with poultry dropping and urea.

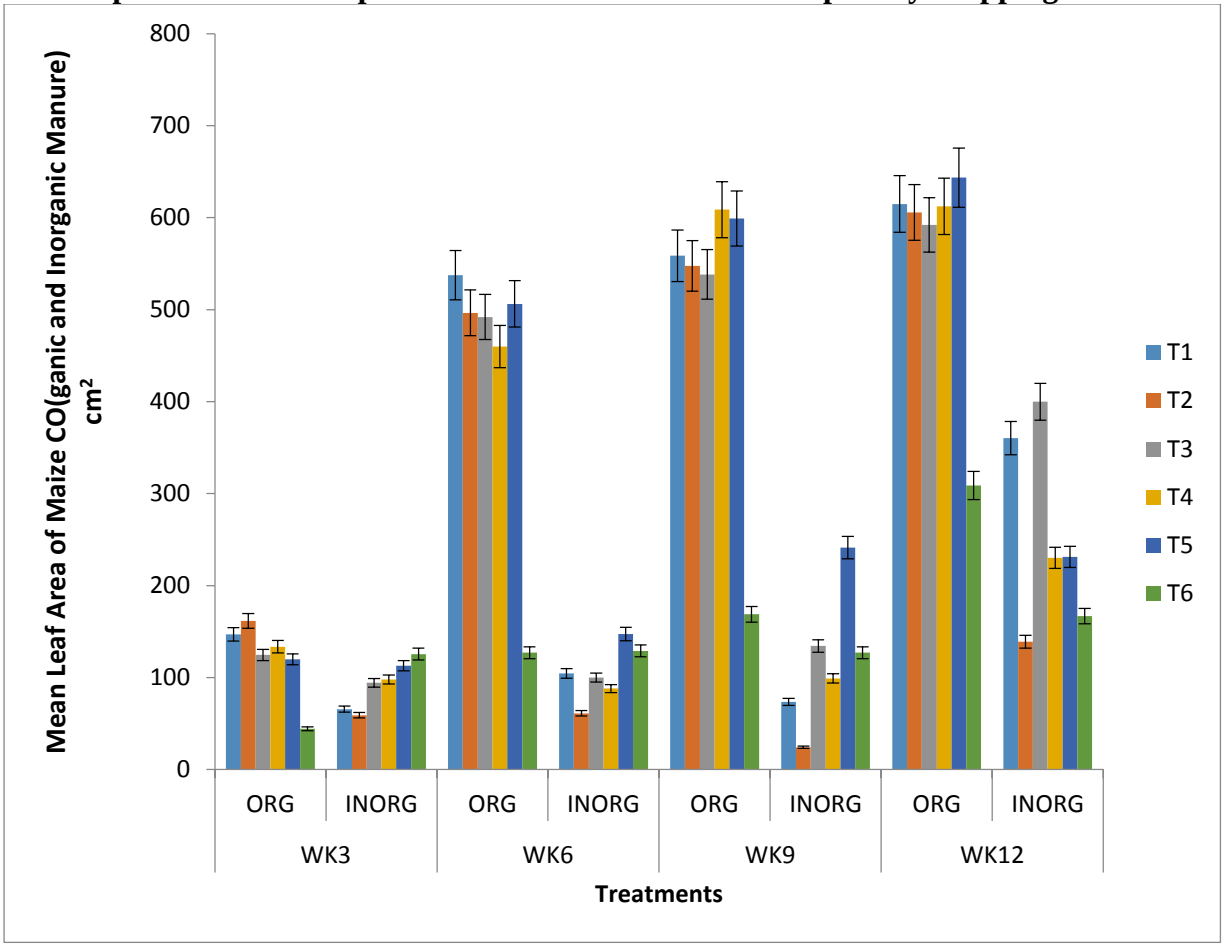

Fig 4: Effects of Organic and Inorganic Manure on the Leaf area of Maize Grown in Spent Oil and DPK Polluted Soil.

T1 = 100ml Spent Oil + (Poultry Droppings (organic) and Urea (Inorganic) , T2 = 200ml spent oil + (Poultry Droppings(organic) and Urea (Inorganic)), T3 = 100ml DPK + (Poultry Droppings(organic) and Urea (Inorganic)), T4 = 200ml DPK + (Poultry Droppings(organic) and Urea (Inorganic), T5 = Unpolluted soil + (Poultry Droppings(organic) and Urea (Inorganic)), T6 = Control (Unpolluted soil without any amendment.

Fresh and dry weight of maize

Results of the fresh and dry weight of maize grown in different concentrations of spent oil and DPK and remediated with poultry droppings and urea are presented in fig 5.

Maize had a higher fresh weight when grown on poultry manure amended soil when grown on urea amended soils. Maize dry weight and fresh weight were highest in treatment 2 [T_2] followed by treatment 4 [T_4] on soil amended with poultry manure. The lowest fresh and dry weight was recorded in treatment 6 [T_6].
It was also noted that maize highest fresh and dry weight were recorded in treatments 5[T_5] followed by treatment 3 [T_3] and least in treatment 2[T_2] on urea amended soils.

Fig 5: Effects of organic and inorganic manure on the fresh and dry weight of maize polluted with spent oil and DPK.

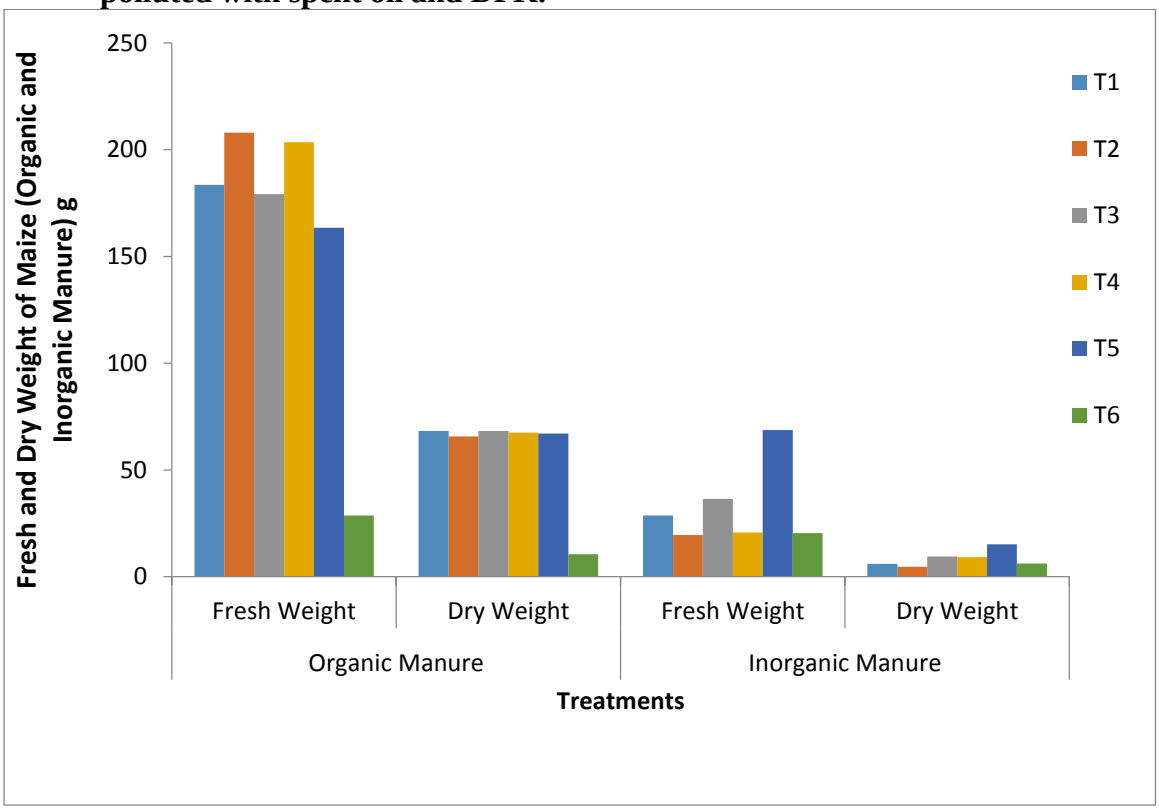

Fig 5 Effects of Organic and Inorganic Manure on the Fresh and Dry weights of Maize that is grown in Spent Oil and DPK Polluted Soil.

T1 = 100ml Spent Oil + (Poultry Droppings (organic) and Urea (Inorganic) , T2 = 200ml spent oil + (Poultry Droppings(organic) and Urea (Inorganic)), T3 = 100ml DPK + (Poultry Droppings(organic) and Urea (Inorganic)), T4 = 200ml DPK + (Poultry Droppings(organic) and Urea (Inorganic), T5 = Unpolluted soil + (Poultry Droppings(organic) and Urea (Inorganic)), T6 = Control (Unpolluted soil without any amendment.

Chlorophyll content of maize
Results of the chlorophyll contents of maize on different concentrations of spent oil and DPK polluted soil amended with poultry droppings and urea are shown in table 6.

Maize chlorophyll content results showed that maize plants grown in a soil polluted and amended with inorganic manure had much chlorophyll than the one amended with organic manure. Treatment 6[T_6] of the inorganic manure amended soil recorded the highest chlorophyll value. Thus was followed by treatments 2, 1, and 4 [T_2, T_1, T_4] of respectively. On the other hand, treatment 1 [T_1] of maize grown in spent oil and DPK polluted soils and remediated with

organic manure had the least chlorophyll value.

Fig 6: Effects of organic and inorganic manure remediated soils polluted with spent oil and DPK on chlorophyll contents of maize.

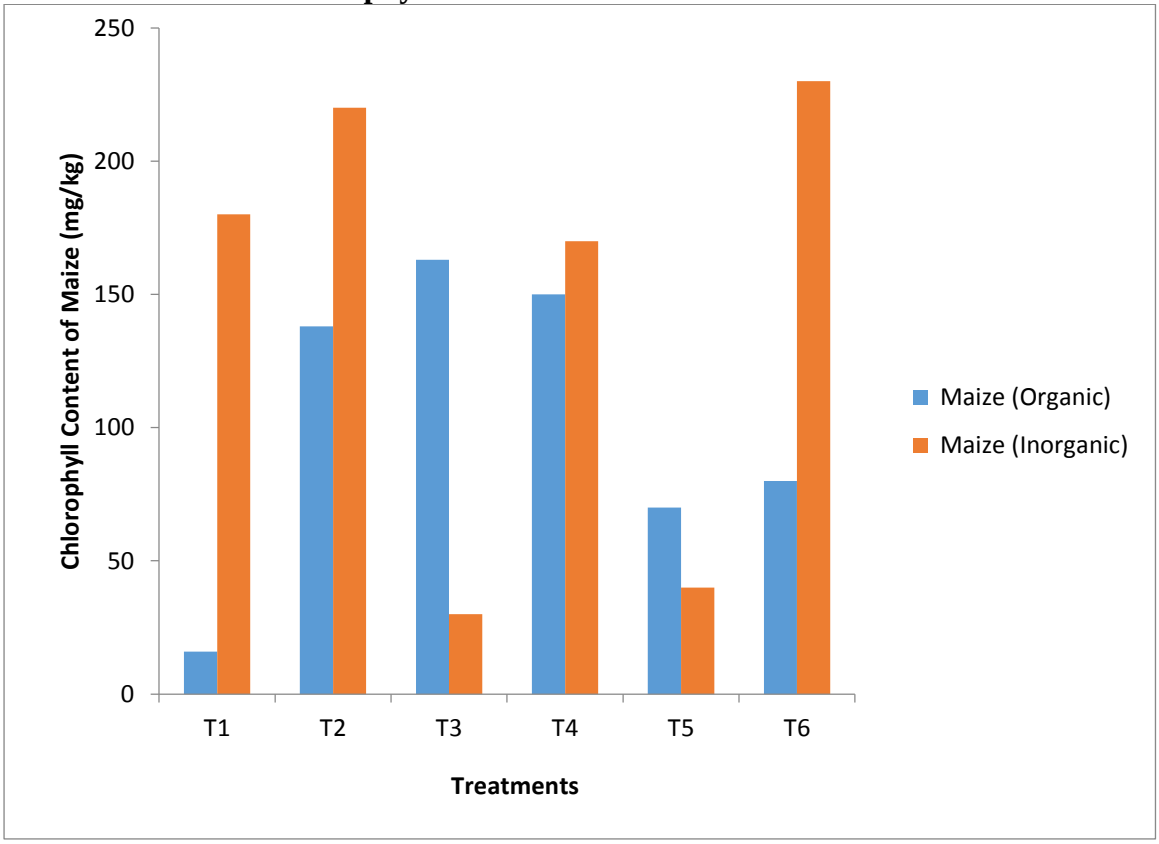

Fig 6 Effects of Organic and Inorganic Manure Chlorophyll content of Maize grown in Spent Oil and DPK Polluted Soil.

T1 = 100ml Spent Oil + (Poultry Droppings (organic) and Urea (Inorganic) , T2 = 200ml spent oil + (Poultry Droppings(organic) and Urea (Inorganic)), T3 = 100ml DPK + (Poultry Droppings(organic) and Urea (Inorganic)), T4 = 200ml DPK + (Poultry Droppings(organic) and Urea (Inorganic), T5 = Unpolluted soil + (Poultry Droppings(organic) and Urea (Inorganic)), T6 = Control (Unpolluted soil without any amendment

Discussion

Pollution of the soil by any agent affects the soil, its components and plants grown on such soils.

Pollution of soil with spent oil and DPK affected the germination of maize as it caused a delay in seeds emergence. Maize seeds germinated 3 days after planting in the control while no germination was recorded on the polluted soils after 3 days of planting [3DAP] maize seeds gradually germinated from the 4^{th} day [4DAP] on the soils treated minimally with 100mls of pollutants and from the 7^{th} day on the soil treated with 200ml of the pollutants. There was a constant decrease in germination on soils treated with spent oil. This must have been due to poor soil-wetability, and even where the seeds germinated, they lot vigour because of the longer period it took them to emerge from the soil. Most seeds were inhibited from germination as the seeds lost their viability. Certain chemical compounds inhibit the growth of plants are the cycle aromatic hydrocarbons [PAHS] which affects indirectly plant –

water-relationship. It was also reported that oil deposited in the soil by PAHs coat the seeds leading to poor germination (Volk, 1988). Generally, crude oil polluted soils are usually dark in colour and as such absorb heat thereby impeding germination (Ekundayo *et al.,* 2001).

Maize plant height

Maize plant height increased overtime following the amendment of the spent oil and DPK polluted soil with organic manure. However, the highest values for plant height were recorded in the control treatment [T_6]. Organic manure aids crop growth as it improves soil physiochemical and biological properties. It also improves the soil moisture bolding capacity and favours microbial activities in the soil [Maheswarappa *et al.,* 1999). It was also recorded that despite all the enhancement done on the polluted soils ranging from T_1 to T_5, that T_6 which was not polluted recording the highest value for plant height and indication that unpolluted soil remains the best for increased plant height [Agbogidi *et al.,* 2007].

Leaf number of maize

Leaf number for maize grown in soil remediated with organic and inorganic manure were unsteady in their pattern of increase it was observed that at 3WAP, treatments 2 and 5 had the highest value, followed by treatments 3-4 and 5; with treatment 6 having the lowest number of leaves although the number of leaves recorded didn't differ significantly except between treatments 2 and 6 [P=0.05]. However, it was observed that treatments 1 to 5 had increased leaf number due probably to the addition of organic manure which increased the soil fertility hence more leaves grew.

For the inorganic, the mean leaf number was highest in treatments 6 while treatments 2 recorded the lowest value which decreased with time. This agrees with the report of Amakiri and Onofeghara, (1984) which stated that oil physical characteristics inflicted some stressful conditions, which may have hindered water up take and exchange of gases. Physiological drought may also occur as a result of the stressful condition (Anoliefo and Edegbai, 2000).

Stem girth

The stem girth of maize grown in both organic and inorganic amendment increased with increase in time. The highest stem girth in organic manure amended soil occurred in treatment. 2 and was followed by treatments 3 and 5, with treatment 6 having the lowest girth. The interpretation given here is that organic manure addition improved the girth of maize for all the treatments from 1 to 5 except treatment 6 that was not treated with organic manure stem girth did not differ between the weeks in all the treatments except in treatment 6 which differed significantly from all others. The highest stem girth for inorganic was observed in treatment 5 while the least stem girth was recorded in treatment 2. The stem girth for treatment 5 was highest because of non-pollution while that of treatment was greatly affected because of pollution (Agbogidi *et al.,* 2007).

Leaf Area of maize

Maize leaf area from soil polluted with spent oil and DPK and remediated with organic manure showed significant difference between treatments 1, 3 and 5, while between treatments 2, 4 and 6 there were significant difference. It was also observed that there was no significant difference between treatments 1 and 5 except for treatment 6 which differed from all. In general, it was noted that the addition of poultry manure to treatments 1 to 5 increased plant biomass that led to increased leaf area. For maize amended with urea, there was no significant difference in the treatments at 3 and 12 WAP while treatments 4, 5 and 6 had a slight significant difference in terms of weeks. Treatment 3 recorded the highest value

followed by treatments 1 with the least value recorded in treatment 2.
The addition of inorganic manure can lead to improvement in plant parameters as it enhances the soil fertility. However the leaf area of maize plants in treatments 2 and 4 reduced due to high concentrations of spent oil and DPK (Dejong E. 1980).

Fresh and dry weight of maize

Results for maize fresh weight from organic manure amended soil showed no significant difference between treatments 1-5, but there was a significant difference in fresh weight between treatment 6 and other treatments. It was also observed that maize planted in inorganic amended soil recorded no significant difference amongst treatments 1, 2, 4 and 6. Treatments 3 and 5 did not also differ significantly. The obvious observation was that maize plants from soils remediated with organic manure recorded higher values for both fresh and dry weights. It would be accredited to the fact that organic manure enriches the soil nutrients thereby promoting plants growth much more than inorganic manure.

Chlorophyll content of maize

It was seen from the result that the chlorophyll content of maize grown in organic and inorganic amended soil was high as seen in the performance of maize, there was increased in leaf area and as such more chlorophyll in maize plant especially in the poultry remediated soil in treatment 3, while treatment I had the least chlorophyll content. For inorganic treatment, treatment 2 had the highest chlorophyll with treatment 3 recorded the least.

Conclusion

The results obtained from this research work have shown how pollution of soil with automobile/spent oil and DPK remediated with poultry manure and urea fertilizer (DPK) affected the germination of maize, plants at different concentrations. The plant height, plant girth, number of leaves, leaf area, chlorophyll content, maize fresh weight and dry weight.

In general, it is obvious that when soils are polluted with any farm of petroleum hydrocarbon products, the soil and plants are negatively affected and the only solution is the remediation of such soils with appropriate remediators which will in turn help the soil to quickly return to its natural status for plant growth. This is important because it will take a longer period for the soil to naturally regain its status. However, the use of poultry droppings and urea fertilizers enhanced the productivity of the polluted soil and are therefore recommended for the amendment of crude oil polluted soil prior to planting of any crop.

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