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Effect of Biostimulation with Organic Amendment on the Growth and Yield of Maize (*Zea Mays*) In Diesel Oil (Ago) Polluted Soil

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Abstract: *The effect of poultry manure and cow dung amendment of diesel oil polluted soil on the growth of Zea mays (Maize) was carried out in a green house at Lamingo area of Jos. The experiment was set up in a randomize block design (RBD) of five (5) replicates for each treatment. Loamy soil (500g) was polluted with 250ml of diesel oil in perforated polyethene bags size (64x21cm) and amended with poultry manure and cow dung at 0%.10%, 20% and 30% soil weight. Three (3) seeds of maize were planted in each pot. Two types of control were set up to validate this experiment: a positive control (500g of soil + 0ml of diesel + 0% manure) and a negative control (500g of soil + 250ml diesel + 0% manure). These were observed for germination and growth parameters for 13 weeks. The results showed that maize seeds in the positive control had the shortest day to germination (6day), an average of 12 and 13 days to germination was observed in plots treated at 30% poultry manure and cow dung respectively. No germination was observed in both the negative control and at 10% organic manure treatment. Maize plants in the positive control plots had highest mean leaf count (13) followed by those at 30% manure treatment (11) and (12) respectively, while those at 20% manure treatment had the least number of leaves. Results on stem girth followed a similar trend with the aforementioned parameters. Plant height at weeks 10 and 12 were significantly higher than those of all other weeks, but do not differ from each other at 0.05 level of probability. Plant in the control had the highest number of kernels per cob (187) followed by plot at 30% manure treatment 150 and 180 respectively for poultry manure and cow dung. The study has shown that diesel contamination affected growth and yield of maize plant adversely. However among the manure treated plots those exposed to higher fraction of poultry manure strived better than those treated with equal fraction of cow dung. Poultry manure can therefore be recommended as a biostimulant in diesel oil polluted soil.*

I. Introduction

The earth has faced many disasters that have been caused by humans throughout history. One of the most important hazard jeopardizing our environment today is petroleum pollution which occurs as a result spills during extraction, processing, transportation and pipeline rust or damage (Yakubu, 2007)

Crude oil and petroleum products such as gasoline, fuel oil and diesel fuel are complex mixture of organic compounds and have been shown to be toxic to plants, in addition to their adverse effects on soil ecosystem through adsorption to soil particles (Anonymous, 2003).

In Nigeria most of the terrestrial ecosystem and shore lines in oil producing community are important agricultural land under cultivation. Any contact with crude oil usually results in damage to the soil, microorganism and plants (Adedokun & Ataga, 2007). Agbogidi *et al*. (2005) reported that oil spillage constitute the most significant source of oil pollution in the Niger Deltal region of Nigeria. Oil spillage also destroys farmlands and has significant effect on plant growth.

Bioremediation's role is to optimize conditions for natural microbes to degrade environmental pollutant (Penny *et al*., 2003). There are two main approaches to oil spill bioremediation, which are; bioaugmentation and biostimulation (Yakubu, 2007).

Bioaugmentation deals with the use of beneficial microbes that have an affinity towards specific pollutants (Venosal *et a*l., 1996; Mekec & Mendelssilni, 1995). While biostimulation involves the aeration and addition of selected micronutrient and sometimes top soil to appropriate quantities (Shekwolo, 2005; Swannell *et al*., 1999) i.e the modification of the environment to stimulate exiting bacteria capable of bioremediation. The primary advantage of biostimulation to bioaugmentation is that bioremediation will be undertaken by already present native microorganism that are well suited to subsurface environment and are well distributed spartially within the subsurface (Mishra *et al*., 2001).

Maize (*zea mays* L, 2n= 20) is an important cereal crop of the world and household staple food in Nigeria, it has worldwide significance as human food, animal feed and as a raw material for the manufacture of hundreds of industrial product. These products include corn starch, matodexrins, corn flour, corn oil, corn syrup and products of fermenting and distilling industry, and is grown across the country (Nigeria) (Miracle, 1996).

There is a dire need to prevent, control and clean up hydrocarbon polluted soil. Although excavation and chemical treatment of the polluted soil seems the most definite measure, cost of such operations and damage to

building and infrastructure prevents such an approach. It is against this background that this present work was designed with the aim of determining the efficacy of cow dung and poultry manure as biostimulants in soil polluted with diesel and to evaluate the response of maize on the soil.

II. Materials And Methods

The research was conducted in a green house located at Lamingo Shere Hills area of Jos East LGA of Plateau state, Nigeria between February to April, 2011. Jos is located on latitutde 9^0 52'N and on longitude 8^0 53' E has an equable climate averaging 22°C (75°F) daily, with an verage humidity of 60% and average annual rainfall 1400 mm (56").

Maize seeds were purchased from Angwa Rukuba market, the organic manure (cow dung and poultry manure) were collected from Jos abattoir and a poultry farm in Lamingo area respectively. The diesel oil was obtained from U.U.Martins fuel station at Yantrailer area of Jos North LGA of Plateau state.

Forty bottom perforated polyethene bags with a diameter of 64cm and a depth of 21cm were each filled with five hundred grams (500g) of soil collected from a farm site at Lamingo area of Jos east LGA, 30 pots were used as the experimental pots in which the soil was mixed with 250ml of diesel oil (AGO) and were then treated with 10%, 20%, 30% soil weight of each manure respectively. i.e (Manure + diesel + soil). Two sets of control were used (i) A positive control (0% manure + 0% diesel + soil), (ii) a negative control (0% manure + 250ml diesel + soil 500g).

This was left to stand for two weeks before seeding. The pots were then set up in a randomized complete block design with (8) treatment combinations i.e 2manure types, 3 fractions of each manure and two controls. Each treatment was replicated five (5) times. Three seeds of the corn (*Zea mays*) were sown in each polyethene bags at depths of 30cm, the pots were watered daily. Data on germination was recorded after 7 days; seed which failed to germinate after 14 days were regarded as having not germinated. Seedlings were thinned to one per poly pot at two weeks after sowing. The results were monitored for 104 days (14 weeks). The following growth parameters were observed; number of days to germination, germination percentage (%), number of leaves, stem girth, plant height and number of cobs per plants were taken. After harvesting the number of kernels per cobs was taken. The data was subjected to analysis of varience (ANOVA) at 0.05 level of probability. Germination period was determined by observing the number of days to germination.

$$\text{Percentage germination} = \frac{\text{No of germinated seed} \times 100}{\text{Total no of seed sown series}}$$

Number of leaves was by visual counting of the number of leaves per plant, the stem girth was measured with a measuring tape, measurement was taking at the second node from the base. Plant height was measure using a tape rule at a distance from soil level to the flag leaf. While number of cobs per plant was taking by counting the number of cop per plant and lastly the number of kernel per cob was determine by counting the number of cobs per kernel from each plant.

III. Results

Mean Days To Germination

The result revealed that maize sowed in the positive control plots germinated within six (6) days. While no germination was recorded in the "negative control' plots and plots treated with soil weight 10% manure respectively. Plots treated with 20% soil weight manure had an average of thirteen (10) days to germination for poultry manure and 13 days to germination for cow manure at 30% soil weight manure treatment, cow dung fertilized plant recorded an average of 11 days to germination, while poultry manure treated plants recorded 8 days to germination (Fig 1).

Germination count

The result showed that the positive control (pots without diesel pollution) had the highest germination count with a percentage of 99.6%, followed by seeds sown in 30% manure amended well as those of the negative control (polluted with diesel but not amended with manure) had no growth (Table1) among amended pots, seeds sown in poultry manure treated soil generally had higher germination rate than those of cow manure treated soil (Fig 1**).**

Leaf Count

The number of leaves per plant increased with weeks. The control plots had the highest number of leaves after fourteen (14) weeks, followed by those of 30% manure treated plots while those of 20% treated plots had the least (Table 2). Among manure amend soil, generally poultry manure treated plants had higher number of leaves compared to those of cow manure treated. Positive control plots had the highest mean leaf count (Table 2).

Statistical analysis showed that mean leaf count differed significantly (<0.05) with weeks. For instance, mean count of leaves for week 12 were significantly higher than those of preceding weeks for both cow dung and poultry dung treated plots at 30% manure treatment.

However, mean count of leaves for the different manure did not differ from each other at 0.05 level of probability (Table2).

Stem Girth

The result of the mean stem girth followed a similar trend with those of the aforementioned parameters. The control plots had the highest stem girt followed by 30% and 20% manure respectively. Generally plants treated with poultry manure had higher stem girth than those of cow manure (Table 3).

Statistical analysis showed that the stem girth of plants grown in the control plants were significantly higher than those of all other treatments (table3).

Plant Height

Plant height increased with weeks, they were highest among the control plants followed by 30% and 20% manure treatment respectively. Plants amended with poultry manure had higher stem height than those grown on cow manure treated soil (Table 4).

Plant height recorded in weeks 12 and 16 were significantly higher than those of all other weeks but do not differ from each other at 0.05 level of probability.

Also, the plant height for the positive control plots were significantly higher than those of the other treatments at 0.05 level of probability (Table4)

IV. Number Of Cobs Per Plant

Number of Grains per Cob

Generally plants grown on the control plots had the highest number of kernels, followed by those treated with 30% manure then 20% manure respectively.

Among manure treated plants, those fertilized with poultry manure had higher number of kernels than those treated with cow dung (Table 6).

V. Discussion

There was no germination in the negative control" i.e (soil+Disel+0% treatment). This may be due to the effect of hydrocarbon on the seed. Amakiri and Onofeghara(1983), repoted that oil act as potent contact herbicides on *Zea mays*, *Abelmosehus esculantus and Cassicum frutescens*, *and that crude oil* also affect the germination of seeds of certain plants Like, quackgrass, alafafa and clover. The same was observed at 10% treatment of both poultry and cow manure. This may be attributed to concentration effect of the diesel oil pollutant and insufficient amount of the organic amendment. At treatment 20 and 30% cow and poultry manure, there was germination but the duration was longer than that of the positive control i.e. (no diesel +0% manure+ soil). It can be suggested that the presence of diesel oil (250 ml) in the soil extends the germination duration of maize seeds even with the addition of organic manure Table 1.

Growth and yield parameters such as Germination count, Mean number of leaves, Plant height and number of grains per plant were higher in poultry manure treated plants than those of cow manure and control plots (without manure).

This observation agrees with the report of Christo *et al*., (2008). Who suggested that the improved yield of plants treated with poultry manure may be due to suitability of the manure as biostimulant which helps in degrading diesel as well as providing nutrient for the plant.

Yield performance was higher with higher fraction of the manure. This agrees with the report of Onuh *et al.,* (2008). They attributed this observation to increased organic matter content which makes more nutrients available for both plant and microorganisms involved in bioremediation.

VI. Conclution

The study has shown that diesel contamination affected growth and yield of maize plant adversely.

However, among manure treated plants, those expose to higher fractions of poultry manure were found to perform better than those with equal fractions of cow dung.

Poultry manure can therefore be utilized in diesel polluted soil to grow plants such as maize.

Table 1; Mean Days to Germination of Maize Plant.

Treatment	Days		
		Poultry (g)	Cow Dung (g)
-Ve controll	**-**	**-**	**-**
+ Ve Controll	**6**		
10%		**0.0**	**0.0**
20%		**10**	**13**
30%		**8**	**11**

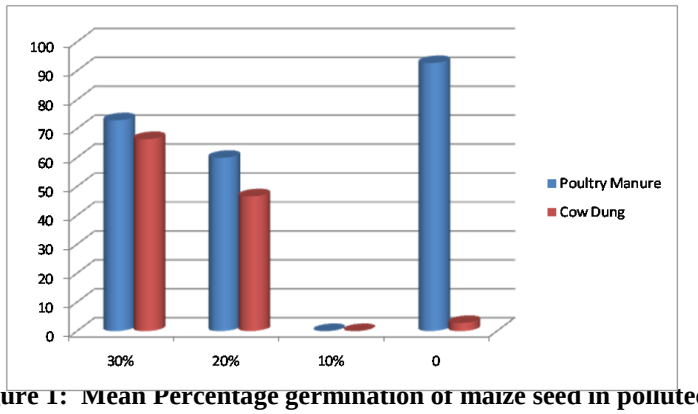

figure 1: Mean Percentage germination of maize seed in polluted soil.

Table 2: Effect of Maize Treatment on Mean Number of Leaves of Maize Plant Grown in Polluted Soil.

Manure treatment	Weeks					
	3	**6**	**9**	**12**	**16**	**LSD**
Cow manure						
0%	3	5	7	11	13	
10%	-	-	-	-	-	
20%	2	4	7	10	10	
30%	3	4	7	10	11	**2.81**
Poultry manure						
0%	3	5	7	11	13	
10%	-	-	-	-	-	
20%	2	5	7	10	10	
30%	3	4	8	11	12	
LSD	2.22					

Table 3: Effect of Biostimulation with Manure on Mean Stem Girth of Maize Plant Grown in Diesel Polluted Soil.

Manure Treatment	Weeks						
	3	**6**	**9**	**12**	**16**	**0%**	LSD
Cow manure							
0%	2.3	4.6	6	6.7	7.7	26.5	1.88
10%	-	-	-	-	-	-	
20%	1.4	2.6	4.0	5.4	6.4	19.2	
30%	1.7	3.0	4.7	6.0	6.8	21.5	
Poultry manure							
0%	2.3	4.6	6	6.7	7.7	26.5	
10%	-	-	-	-	-	-	
20%	1.8	2.9	4.0	5.5	6.6	20.2	
30%	2.0	3.3	5.0	6.4	7.0	23.0	
LSD	1.48						

Table 4: Effect of Maize Treatment on Height of Maize Plant Grown in Polluted Soil.

Manure treatment	Weeks					
	3	**6**	**9**	**12**	**16**	LSD
Cow manure						
0%	20	58	111	150	155	8.33
10%	-	-	-	-	-	
20%	8	18	44	96	112	
30%	10	22	48	110	118	
Poultry manure						
0%	20	58	111	150	155	
10%	-	-	-	-	-	
20%	10	21	58	110	120	
30%	10	26	67	124	131	
LSD	6.58					

Table 6 Number of Grain per Cob

Plots	Manure Treatment			
	10%	20%	30%	0%
Cow				
1	-	**150**	**175**	**101**
2	-	**130**	**189**	**120**
3	-	**170**	**199**	**140**
4	-	**135**	**175**	**145**
5	-	**140**	**160**	**124**
Poultry				
1	-	**170**	**210**	**101**
2	-	**183**	**201**	**120**
3	-	**185**	**255**	**140**
4	-	**192**	**202**	**145**
5	-	**172**	**214**	**124**

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