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Effect of Crude Oil Pollution on Seed Germination and Shoot Emergence Toxicity of *Garcinia kola* Seedlings

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Abstract: ***Crude oil pollution is the release of petroleum hydrocarbon into the environment. The aim of the study is to unveil the danger of crude oil pollution on germination of seeds of indigenous tree species. In this research, seed germination and shoot emergence of Garcinia kola in crude oil contaminated soil was investigated. The impact of the pollutant on seed germination was compared between five polluted treatments coded as BLCO1, BLCO2, BLCO3, BLCO4 and BLCO5 and one non-polluted treatment (NBLCO) for thirty weeks after sowing (30WAS). Analysis of variance indicated significance difference between the varied treatments at p≤ 0.05. Percentage germination for NBLCO was quiet high (97%) compared to 36% from BLCO5. The difference between the highest and the lowest rate of germination was 60%. The result showed that the hydrocarbon compound influenced seed germination and shoot emergence of the tree species. The effect was delay germination and seed dormancy.***

Keywords: Pollution, germination, crude oil, Garcinia kola

1. Introduction

Seed is a fertilized ovary that can develop into new plant. It is said to be embryonic organ in plant that stores surplus food nutrients. Seed is of fundamental important in forest regeneration and a key element in plant production (Ekeke, 2014). If spread in a good environment it may developed into a new plant. However, germination can proceeds to growth development when the needed factors are activate from a good soil condition. The poisoning of soil by crude oil elements may deactivate metabolic processes that trigger germination and plant regeneration (Burns *et al.*, 2000; Duke *et al.*, 2000; Edema *et al*., 2009; Akpan *et al.*, 2018). Under polluted environment, the soil metabolic process is tempered and germination may not occur. The alteration in the normal functioning of soil and supply of necessary germination factors in seed are germination inhibitors that may result in seed dormancy or even mortality. The period by which seed await favourable environmental condition is called seed dormancy.

Crude oil spill is common in the Niger Delta region (Lubcon, 2012; Ekeke, 2017; Akpan *et al.*, 2018), the impact of this menace on the growth performance of indigenous tree species has not been properly studied. Vegetation may be seen as the first victims of oil spill on land ecosystem. Studies had observed that oil spills kill agricultural plants or inhibit the growth performance of the entire vegetation cover, (Njoku *et al.*, 2008; Mensah *et al.*, 2013).

Garcinia kola Heckel commonly known as bitter cola in Nigeria is an economic tree from the family Guttiferae. All parts of Bitter kola (leaves, bark, fruit and roots are locally used for as herb for treatment of different ailment. The tree is a major source of chewing stick, fruits are eaten, seeds for cultural purposes, etc. Each mature tree bears about 1,600 fruits. Each fruit bears 2-4 seeds (Keay 2010). And in rural and urban market each parcel of about 8 seeds is sold at #2oo.oo (two hundred Naira), this gives a rural farmer #25,000.00 (twenty five thousand Naira) per tree per year.

Its socio-economic importance notwithstanding, the cultivation of this plant is very much limited. Most farmers are discouraged from growing *Garcinia kola* due to the difficulties encountered in the germination, nursery growth and long yield term. Its regeneration is low and seedlings are uncommon and slow growing (Abbie, 1990). These limit the availability of seedlings for possible agroforestry/plantation establishment. Currently bitter cola is threatened in several West and Central African countries and in Nigeria. Considering its importance and the menace of crude oil pollution in the southern part of the country, incorporated with its socioeconomic benefits, appropriate strategies have be developed to promote the sustainability of this multipurpose tree.

2. Materials and Method

Study area

The study was carried out at the Forestry Research Institute of Nigeria, Swamp Forest Research Station nursery, Onne, Eleme local Government Area of Rivers State. It is geographically located at Latitude 4.7016998 North and Longitude 7.1748958 East. The site is about 4km from the Federal Ocean Terminal (Oil and Gas Free Zone) Onne, Eleme Local Government of Rivers State. The soil type is acidic in the deforested swamp forest agro-ecological environment. The mean annual rainfall is 2500mm - 2992mm. With mean relative humidity value of 75%.

Preparation for Experiment

Seeds were extracted from the harvested pods and washed in clean water. In order to carry out seed viability test to separate viable seeds from non viable seeds the seeds were put in a bucket of clean water (Oboho and Ogana, 2011; Yakubu *et al.*, 2014; Omokhua *et al.*, 2015). The seeds that

sank down the bucket of water were considered viable while those seeds that floated on the surface of water were considered non viable and were discarded. Viable seeds were first air dried for 4 days to ensure seed dryness before subjected to pre treatment test.

Pre-germination Treatment

Dried seeds were placed in germination tray that was filled with washed river sand to further ensure their viability. Seeds that developed node were termed viable with no germination problem and were pricked into the prepared growth media (the poly pots containing forest top soil).

Design

Completely Randomized Design (CRD) was adopted according to (Wahua, 1999). The germination of *Garcinia kola* was dependent variable (Ede, 2009). The independent variables were the 6 dosages of crude oil which were coded as: NBLCO, $BLCO_1$, $BLCO_2$, $BLCO_3$, $BLCO_4$, and $BLCO_5$ respectively and representing bonny light crude oil at level 0ml (control), 10ml, 20ml, 30ml, 40ml and 50ml respectively making a total of 180 experimental samples units. The study recorded the duration of shoot emergence by taking data on the number of germinated seedlings weeks after sow (WAS). The data obtained were used to compute mean germination rate, percentage mean germination rate, and subjected to ANOVA analysis.

3. Result and Discussions

Table 1: ANOVA Table for Germination

	Sum of Squares	Df	Mean Square	F.cal	F.tab
Between Groups	8306.317	5	1661.263	55.233	.000
Within Groups	5233.433	174	30.077		
Total	13539.750	179			

Statistical analysis showed that shoot emergence indicated significance ($P \leq 0.05$) between the treatments. The variation between the treatments proved that germination varied for each group. This indicated that each treatment responded differently to crude oil treatment.

Table 2: Germination rate of the G. Kola seedlings

Treatments	Number of Germinated seeds	Germination mean	Percentage Mean Germination (%)
NBLCO	29.0	26.6	96.6
BLCO1	18.0	8.6	60.0
BLCO2	17.0	9.7	56.7
BLCO3	18.0	10.7	60.0
BLCO4	15.0	8.5	50.0
BLCO5	11.0	6.2	36.7

Table 2 shows that at the end of the experiment NBLCO showed the highest PMG value of 96%, while BLCO5 recorded least percentage mean germination (PMG) value of 36%. Germination is said to be drastically reduced with increased in quantity of crude oil. Considering the difference in PMG between NBLCO treatment and BLCO 5, the two treatments recorded a decrease of 60% in the shoot emergence of G. Kola. Projecting that between the none-polluted soil and the polluted soil treatment there was a loss of 63% seed mortality. The extrapolation exposed how much possible loss may be recorded in a minimal spilled incident. This means the pollutant has impact on the germination of seeds, confirming a study from Cleusa *et al*, 2011 which disclosed that diesel oil significantly affected germination and growth of seedling of *S.terebinthifolius* (Brazillian pepper).

From the weekly germination data in figure 1, treatment without pollutant (NBLCO) recorded early germination at first week after sowing (1WAS). Sprouting or germination process was delayed on others treatments that received the pollutant until treatment BLCO1 developed its first shoot at 3^{th} WAS.

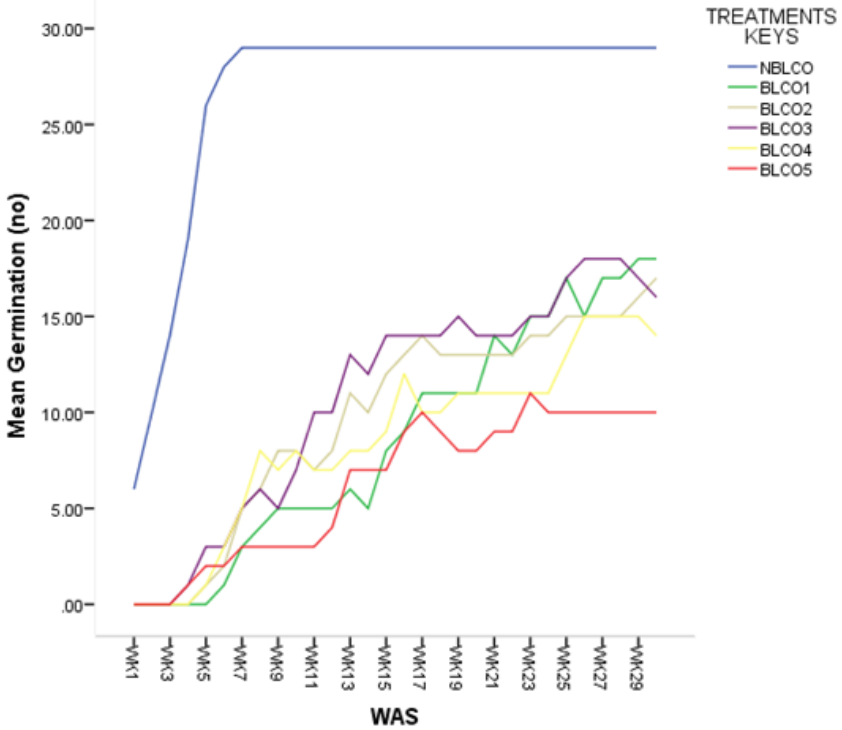

Figure 1: Germination at 30WAS of the Experiment

This development was later seen in others treatment from 5th WAS. Research done by Ogbohodo *et al*, 2004 and Cleusa *et al.*, 2011, reported that crude oil inhibited germination of *zea mays* and *Schinus terebinthifolius* respectively especially at higher pollution levels. The delay in germination of the seeds may be attributed to the some alteration in the soil environment such as: suffocation of the seeds due to exclusion of air and imbibitions of seed attributable to reduction in soil water by the pollutant. Again, from Cleusa *et al*, (2011), statement, toxic effect decreased over time. This was confirmed in the germination of G.kola seeds from polluted treatments at 3rd - 5th WAS compared with the none-polluted counterparts that took place at the very 1st WAS.

Also in figure 1, was irregular shape of the line graph for the polluted treatments compared with the unpolluted treatment NBLCO which had regular shape of a type germination curve. This pointed out that there were some losses recorded from $BLCO_1$ to $BLCO_5$ during the study period. An indication that the pollutant did not only affected the shoot emergence but also its survival. The rate of mortality in the polluted treatment was more obvious than the unpolluted treatments. Some shoot in polluted treatments after emergence could not survive, as indicated by the irregularity of the line graph for $BLCO_1$ – $BLCO_5$. The period of time that passed after the contamination is reflected in the weekly rate of germination of the seeds Duncan (2002) also observed similar alteration in seed germination of some gramineous, herbaceous and leguminous plants based on the contaminated period.

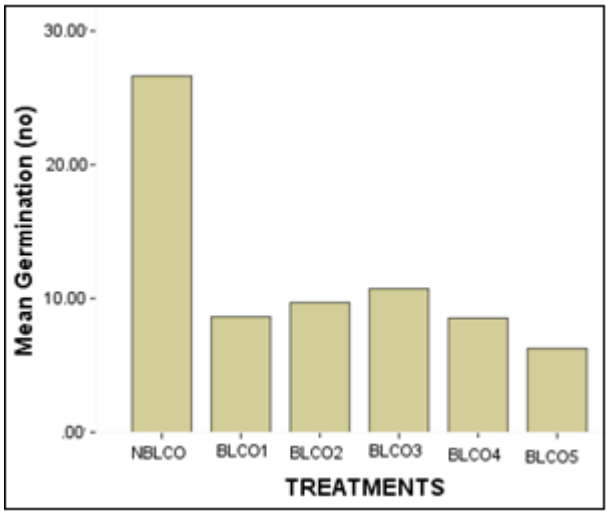

Figure 2: Comparison of Germination Rate between Different Treatments

In comparing germination rate between the six treatment groups, figure 2, showed that NBLCO presented the highest value of 27seedlings at the end of the experiment. Others like BLCO3 recorded 11 seedlings, followed by BLCO2 with 10seedlings, BLCO1 and BLCO4 with 9 seedlings each and lastly BLCO5 with 6seedlings.

4. Conclusion

The study proved the impact that crude oil may have on germination of *Garcinia kola* seed in South-South political zone of Nigeria with frequent oil spill incidents. With this result, the agitation over the clean-up of Niger Delta, Ogoni precisely cannot be over-emphasized. In the same way, the loss of biodiversity such as indigenous trees in the wild is possibly affirmed. Taking into consideration oil spilled records in our environment, and the volume discharged in a single episode, one cannot imagine the damage this may cause to forest resources and the local forest dependants whose lives depends on forest product like bitter kola for sustenance.

Talking about some developmental philosophies like Millennium Developmental Goals (MDG) and economy diversification, one may wonder the authenticity of the ideal judged by our attitude towards crude oil management in our environment. However, the study is an eye opener to readdress our mental reasoning towards the management of our environment. Knowing that all resources are important, and none is superior to the other, as all serves in the betterment of lives and development of our economy in their own way. Bitter kola tree for instance, prevents genetic erosion, generates income for a dependable family, mitigates climate change, beat air pollution, enhance soil fertility and conservation among others. On this note, the eradication of this indigenous species in the forest constitute to poverty, environmental degradation, terminal diseases, loss of economy, loss of fertile soil, low crop yield, etc.

The study revealed economic benefits of *Garcinia kola* beyond doubt and the quantum of a loss crude oil spills has done to others natural resources such as this forest tree. Moreover, the economic tree is threatened as crude oil is being released into our environment unanimously and little effort in made towards maintaining the population in the wild, nor establishing reserved plantations.

Finally, establishment of plantations and reafforestation is recommended. Again, more research work should be carried out on impact of crude oil on others indigenous tree species to expose the danger of crude oil on our local resources.

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