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Evaluation of the Impact of oil tainting on physiognomic qualities of *Gmelina arborea* in the tropical rainforest zone of Nigeria

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Abstract

The research was conduced to study the effect of oil pollution on the physiognomic characteristics of *Gmelina arborea* and the pollutants used are diesel oil and spent engine oil respectively. The experiment lasted for 6 months before analysis was done. Five treatments were carried out separately for diesel oil and spent engine oil in which the application of pollutants was at the rate 0, 400, 800, 1200 and 1600 mls. Each pollutant and each treatment was replicated three times and subjected to analysis of variance (ANOVA). Internode differences, number of leaves, number of branches were measured as part of the physiognomic characteristics that are observable for the experiment. Results show that all treatments have significant effects after the analysis. Both pollutants have a significant role to play in the physiognomic properties and characteristics of the tested crop *G. arborea.* At one week after application and three weeks after application, spent engine oil only had a minimal effect on branching pattern of *G. arborea* wildling but as from six weeks after application, the effect was phenomenal on all vegetative parameters of the plant. At one week after application, diesel oil had no effect on *G. arborea* wildling but at three weeks after application, diesel oil had a significant effect on the vegetative parameters of *G. arborea* wildling. A further research is needed on the recovery possibility of *G. arborea* if reconditioned after the effect of pollutants. This will help in environmental stability of parts of the world where oil pollution is rife.

Keywords: Pollution, diesel oil, spent engine oil, wildling, physiognomy.

INTRODUCTION

Pollution is the act of disordering the atmospheric normal nature of the environment. Pollution can be in the form of air, water or land which is caused by man directly or indirectly. Ecosystem is affected negatively and may cause adverse effect in human health or lead to death in a large quantity dose. Pollution is the addition to the ecosystem of something which has a detrimental effect on it. When oil is released into the natural environment, the result is termed an oil spill (www.oilsinformation.com). One of the most important causes of pollution is the high rate of energy usage by modern, growing populations. Spent engine oil is the hydrocarbon product of crude oil with $C_{15} – C_{20}$ in molecular nature. It is dense in nature and black in colour; engine oil has purple.

Diesel oil is a petroleum refined product obtained from the middle distilled of crude oil. Its pollution makes it unsatisfactory for plant growth due to insufficient reaction of the soil and the microbes because of the displacement of air from spaces between the soil particles (www.oilsinformation.com). When diesel is added to water it is suspended and when added to soils it makes the soil acidic thereby affecting the plant which could result into stunted growth. Oil pollution is the contamination of any part of the environment with any liquid hydrocarbon and the most serious source is the water pollution. Oil pollution is due to oil exploration and extraction (www.climaterealityproject.org/truth, 2000). Oil pollution mainly occurs due to poor maintenance, engineering and management in oil producing areas of

the countries, recklessness driving of articulated vehicles and vandalization of pipelines

Study background origin

G. arborea is an economic tree which has strong timber values; it belongs to the family *Verbenaceace,* the kingdom Plantea, division *Magnoliphta*, class *Magnolipsida*, order *lamiales*, genius *Gmelina* and species *G. arborea.*

Geographical distribution

G. arborea is a fast growing tree which occurs almost all over the world; it occurs naturally throughout the part of India at altitude of up to 1500 m above the sea level. It occurs extensively from the Ravi Eastwards in the sub-Himalayan tracts, common throughout Assam and adjoining areas of Northern West Bengal. Sporadically found in Western and Southern India. It occurs naturally in Myanmar, Thailand, Laos, Cambodia, Vietnam and in Southern Provinces of China and has been planted extensively in Sierra Leone, Nigeria, Malaysia, and on experimental basis as well in other countries. It is also planted in gardens and avenues and planted elsewhere on a large scale.

Utilization of the species

G. arborea timber is reasonably strong for its weight; it is used in constructions, furniture, carriages, musical instruments and artificial limbs formation. Once seasoned, it is a very steady timber and moderately resistant to decay and it ranges from very resistant to moderately resistant to termites. Its timber is highly esteemed for door and window panels, joineries and furniture instruments because of its light weight, stability and durability. It is also used for bentwood article. In boat building, it is used for decking and for oars.

G. arborea is a popular timber for picture and slate frames, turnery articles and various types of brush backs (wooden brush), brush handles, toys, handles of chisels, files, saws, screw drivers, sickles. The wood is also used for manufacturing tea chests and general purpose plywood, black boards, frame core and cross brands of flush door shutters. In instrument industries *G. arborea* timber is widely employed for the manufacture of drawing boards, plane tables, instrument boxes, thermometer scales and cheaper garden metric scale. It is also used in carriage and bobbing. It is an approved timber for handles of tennis rackets, frames and reinforcements of carom board and packing cases and crates. It is used in paper making industries, tissue papers and matches wood industry. Its leaves are considered good for cattle with crude protein 11.9% and also as feed to eri-silk worm. The species is also planted in *taungya* systems with short-rotation crops and as a shade tree for coffee and cacao (Mohammed, 1999).

METHODOLOGY

Soil and wildling plant preparation

The soil for the experiment was collected from under a locust bean tree. The loamy soil was collected and sieved, 50 bays of pots were worked on. Each pot was filled with 6.5 kg of top soil. Fifty wildlings of *G. arborea* was nursed in the nursery for conditioning before they were transferred to the permanent pots where the experiment was finally carried out. Pruning was conducted twice on the tested crop; firstly 5 weeks after planting and lastly 2 weeks before application of the pollutants. After the pruning the tested crop was left for rainfall to aid the moisture content of the plant against drought before application of pollutants.

Treatments

The research design was a complete randomized block design (CRBD) consisting of (1) one soil type (2) one plant type and 3 replicates with three control (3) 2 pollutants with 4 levels of diesel oil and spent engine oil application making 30 experimental units. Diesel oil applied at 400, 800, 1200 and 1600 mls respectively to each bag except the control that had no application and denoted by 0 mls. Spent engine oil was also applied according to the diesel application above. The whole experimental bags were then subjected to watering and exposure to daily environmental condition throughout the experiment

Parameters measured

a) Internodes length
b) Number of leaves
c) Number of branches

The internodes length were measured with transparent graduated meter rule at two (2) weeks intervals after pollution and subsequently one week intervals after week 5 because of the rapid changes in the physical appearance of the tested crop.

Statistical analysis

Data collected were subjected to analysis of variance ANOVA and the least significant different was calculated along the treatments. This shows the rate of tolerable level of oil pollution to Agricultural crops.

RESULTS AND DISCUSSIONS

Effect of diesel oil on growth parameter (length of internodes)

The effect of diesel on *G. arborea* did not have any effect on the internodes length at 1, 3 and 5 weeks after application of pollutant (diesel) which were also not significantly different from each other (Table 1). At

Table 1. Effect of diesel oil pollution on length of internodes.

Treatment	Parameter: Weeks after application of pollutant (WAAP)					
	1	3	5	6	7	8
D0 mls	1.3^{A}	2.2^{A}	2.3^{A}	2.0^{A}	2.0^{A}	2.0^{A}
D400 mls	0.9^{A}	1.3^{A}	1.3^{A}	1.0^{BA}	1.0^{B}	1.0^{B}
D800 mls	1.0^{A}	1.0^{A}	1.0^{A}	1.0^{BA}	1.0^{B}	1.0^{B}
D1200 mls	2.0^{A}	2.0^{A}	2.0^{A}	1.3^{B}	1.0^{B}	1.0^{B}
D1600 mls	1.3^{A}	1.3^{A}	1.3^{A}	1.3^{B}	1.0^{B}	1.0^{B}
LSD (0.05)	NS	NS	NS	0.7	0.0	0.0

D = Diesel oil; WAAP = Weeks after application of pollutant; NS = Non – significant.

Table 2. Effect of diesel oil pollution on the number of branches.

Treatment	Parameter: Weeks after application of pollutant (WAAP)					
	1	3	5	6	7	8
D0 mls	5.0^{A}	6.3^{A}	10.7^{A}	11.3^{A}	12.7^{A}	15.3^{A}
D400 mls	5.0^{A}	5.0^{B}	7.3^{A}	5.3^{B}	2.3^{B}	1.3^{B}
D800 mls	5.0^{A}	5.0^{B}	8.0^{BA}	4.7^{B}	1.7^{B}	0.3^{B}
D1200 mls	5.0^{A}	5.0^{B}	10.7^{BA}	4.3^{B}	2.0^{B}	0.0^{B}
D1600 mls	5.0^{A}	5.0^{B}	8.7^{B}	4.7^{B}	0.0^{B}	0.0^{B}
LSD (0.05)	NS	0.5	2.8	1.8	0.9	1.5

D = Diesel oil; WAAP = Weeks after application of pollutant; NS = Non – significant.

6WAAP, plants with zero application (control) had longer internodes length which was significantly different from other plants obtained from the applications D400, D800, D1200 and D1600 mls of diesel whose plants from D1200 and D1600 mls had less significant effect than those applied with D400 and D800 mls which are not significantly different from each other. However, at 7 and 8 WAAP, plants from zero application had longer internodes length than plants from D400, D800, D1200 and D1600 mls and it was significantly different from them (Table 1). Therefore the level of pollutant had significant effect on the internodes length at all rate and it had highest significant at 5, 6 and 7WAAP.

Effect of diesel oil pollution on the number of branches

At 1WAAP, application of diesel oil does not have any significant effect on the treatments and the zero applied plants. The application does not have any significant difference (Table 3). At 3, 6, 7 and 8WAAP zero application had more branches than plants produced from the treatments which were not significantly different from each other (Table 2). Also, at 5WAAP both the D0 and D1200 mls had more branches than other treatments which was significantly different from other treatment while D400 mls had the lesser branches which was also significantly different from other plants obtained (Table 2).

Effect of diesel oil pollution on number of leaves

At 1WAAP, there were no significant effect on the rates of diesel application on the treatments and the control (D0) in the numbers of leaves because no physical changes occurred in the experiment (Table 3). However, at 3, 5, 6, 7 and 8 WAAP, the control (D0) had more leaves than the treatments which were not significantly different from each other.

Effect of spent engine oil pollution on length of internodes

At 1 and 3WAAP, plants obtained from zero application of spent engine oil had longer length of internodes which is significantly different from other plants applied with spent engine oil that are not significantly different from each other (Table 4). At 5 and 6WAAP, SE400 mls had plants with longer internodes length than other plants produced with soil treated with spent engine oil and the control which are not significantly different from each other except control that is longer than SE800, SE1200 mls and SE1600. However, at 7 and 8WAAP there is no significant effect on both the control and the treatments

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Table 3. Effect of diesel oil pollution on number of leaves.

Treatment	Parameter: Weeks after application of pollutant (WAAP)					
	1	3	5	6	7	8
D0 mls	4.7^{A}	6.7^{A}	23.3^{A}	2.7^{A}	32.0^{A}	35.7^{A}
D400 mls	5.0^{A}	5.0^{B}	5.0^{B}	2.3^{B}	0.7^{B}	0.0^{B}
D800 mls	5.0^{A}	5.0^{B}	3.7^{B}	2.3^{B}	1.3^{B}	0.0^{B}
D1200 mls	5.0^{A}	5.0^{B}	3.0^{B}	2.7^{B}	0.0^{B}	0.0^{B}
D1600 mls	5.0^{A}	5.0^{B}	4.3^{B}	2.0^{B}	0.0^{B}	0.0^{B}
LSD (0.05)	NS	0.5	5.3	3.7	2.6	2.7

D = Diesel oil; WAAP = Weeks after application of pollutant; NS = Non – significant.

Table 4. Effect of spent engine oil pollution on length of internode.

Treatment	Parameter: Weeks after application of pollutant (WAAP)					
	1	3	5	6	7	8
SE0 mls	1.7^{B}	2.0^{B}	2.3^{BA}	2.7^{BA}	2.3^{A}	2.3^{A}
SE400 mls	4.^{0A}	4.0^{A}	5.0^{A}	3.3^{A}	1.3^{A}	0.7^{A}
SE800 mls	1.3^{B}	1.3^{B}	1.3^{B}	1.0^{B}	1.0^{A}	1.0^{A}
SE1200 mls	1.0^{B}	1.0^{B}	1.0^{B}	1.0^{B}	2.3^{A}	2.3^{A}
SE1600 mls	1.0^{B}	1.0^{B}	1.0^{B}	1.0^{B}	1.0^{A}	1.0^{A}
LSD (0.05)	1.9	1.8	2.7	1.7	NS	NS

SE = Spent engine oil; WAAP = Weeks after application of pollutant; NS = Non – significant.

Table 5. Effect of spent engine oil pollution on number of branches.

Treatment	Parameter: Weeks after application of pollutant (WAAP)					
	1	3	5	6	7	8
SE0 mls	5.0^{A}	5.7^{A}	12.0^{A}	11.7^{A}	13.0^{A}	13.0^{A}
SE400 mls	4.0^{A}	4.0^{A}	5.0B^{A}	3.7^{B}	0.7C^{B}	0.3^{B}
SE800 mls	5.0^{A}	5.0^{A}	10.0^{C}	4.3^{B}	1.7^{B}	0.3^{B}
SE1200 mls	3.3^{A}	3.3^{A}	6.7C^{B}	4.0^{B}	0.3^{C}	0.3^{B}
SE1600 mls	5.0^{A}	5.0^{A}	7.0C^{B}	3.3^{B}	0.0^{C}	0.0^{B}
LSD (0.05)	NS	NS	4.0	2.8	1.2	1.6

SE = Spent engine oil; WAAP = Weeks after application of pollutant; NS = Non – significant.

because the plants were observed dead (Table 4).

Effect of spent engine oil pollution on number of branches

At 1 and 3WAAP, spent engine oil did not have any significant effect on the number of branches of *Gmelina arborea* (Table 5). At 5WAAP plant produced from no application of spent engine oil had more branches followed by plants from SE80 0mls which are significantly different from other treatments. However, plants from SE1200 mls and SE1600 had more branches than SE400 mls which are significantly different from each other (Table 5). Also, at 6 and 8WAAP plants produced from zero spent engine oil application had more branches while the treatment had reduced numbers of breaches compared to the control.

At 7WAAP, plants with zero application of spent engine oil followed by SE800 mls had more numbers of branches which is significantly different from other treatments while SE400 had more branches than SE1200 and the least number was obtained in the rate SE1600 which were significantly different (Table 5).

Effect of spent engine oil pollution on the number of leaves

At 1WAAP application of spent engine oil had no

Table 6. Effect of spent engine oil pollution on the number of leaves.

Treatment	Parameter: Weeks after application of pollutant (WAAP)					
	1	3	5	6	7	8
SE0 mls	4.3^{A}	6.0^{A}	22.7^{A}	29.7^{A}	35.0^{A}	38.3^{A}
SE400 mls	3.7^{A}	3.3^{B}	3.3^{B}	2.7^{B}	1.7^{B}	1.0^{B}
SE800 mls	5.0^{A}	5.0^{BA}	4.3^{B}	2.0^{CB}	0.0^{C}	0.0^{B}
SE1200 mls	5.0^{A}	5.0^{BA}	3.0^{B}	0.7^{C}	0.0^{C}	0.0^{B}
SE1600 mls	5.0^{A}	5.0^{BA}	4.7^{B}	2.0^{CB}	0.0^{C}	0.0^{B}
LSD (0.05)	NS	2.1	4.9	1.7	0.9	1.3

SE = Spent engine oil; WAAP = Weeks after application of pollutant NS = Non – significant.

significant effect on the number of leaves and production of leaves (Table 6). At 3WAP, plants produced from zero application had more leaf numbers than the others which were significantly different from each other but differ significantly from SE400 which has lesser number of leaves (Table 6).

At 5 and 8WAAP, plants produced from zero application had more leaves than other treatment which indicate no significant effect on it but the rate of pollution had significant effect on other treatments. However, at 6WAAP, plants produced from SE0 and SE400 had more leaf number which was significantly different from each other, SE800 and SE1600 also had more leaves than SE1200 which were not significantly different from each other (Table 6).

SUMMARY

The research was carried out to assess the effect of oil pollution on the physiognomic characteristics of economic trees in which *G. arborea* was chosen as a test crop. Also the pollutants applied are diesel oil and spent engine oil. Diesel oil was applied to each bags of 6.5 kg loamy soil at the rate 0, 400, 500, and 1600 mls respectively and was replicated three times with 0mls as a control treat-ment. Spent engine oil was also applied to each bags of 6.5 kg loamy soil at the rate 0, 400mls, 800, 1200, and 1600 mls, respectively and was also replicated three times with 0mls as a control treatment. The tested tree crop shows negative effect of oil pollution in the physical development stages at different interval of weeks.

Conclusion

The rates of oil pollution or spillage cannot be eradicated totally but can be checked and reduced to a minimal level if proper check and control are put in place and when there is a binding law backing the mishandling of oils and waste products disposal. Diesel pollutant has a highly damaging effect on the microbes in the soil which reduce the germination process and the enzymatic process in the soil for the enhancement of crop growth and development. High volume of diesel spillage into agricultural land will lead to total loss of agricultural cultivation because it increases the acidity of the soil which will result to stunted growth of the crop.

Kayode et al. (1975) opined that “adverse effects noticed on the plants growing on polluted medium was due to unfavourable condition created in the soil, which results in drought and none availability of nutrient rather than the toxicity of the diesel and heavy element. Spent engine oil also possesses a relatively active damage on the agricultural crops because it blocks the pores of the soil. Oil spills make it unfavourable for the growth of plant due to insufficient aeration of the soil. This is as a result of the fact that the soil air has been displaced and filled with the oil and heavy metals processed by the oil. All necessary nutrients in the soil have also been displaced to the level of adsorption and are made unavailable for absorption to the plant root for good utility (Ekundayo, 1997). Oil spillage has proven to have adverse effect on the growth physiognomic characteristics of *G. arborea.* A further research is necessary on the recovery possibility of the plant if reconditioned after the effect of pollutants.

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