PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 29 (4) 1049-1054 April 2025

Growth and Yield Performance of Azadirachta Indica A. Juss Seedlings in a Spent Engine Oil Contaminated Soil at Jericho, Ibadan, Oyo State, Nigeria

OJELABI, OK; IHEDIUCHE, CI; ABIODUN, FO

Department of Soil and Tree Nutrition, Forestry Research Institute of Nigeria, PMB 5054, Jericho, Ibadan Oyo State, Nigeria

**Corresponding Author Email: ty4ril2012@gmail.com*
**ORCID: https://orcid.org/0000-0003-2012-8776*
**Tel: +2348032183394*

Co-Authors Email: iheduchecally@yahoo.com; feminikan@gmail.com

ABSTRACT: Soil contamination is a growing concern in many African countries including Nigeria, leading to nutrient deficiencies and toxicities that impact crop growth and reduced yield. Hence, the objective of this paper was to evaluate the growth and yield performance of *Azadirachta indica A. Juss* seedlings in a spent engine oil contaminated soil at Jericho, Ibadan, Oyo State, Nigeria using appropriate standard methods. Results obtained for growth parameters indicate that collar diameters were significant at 3Weeks after Transplanting (WAT), number of leaves was significant at 2-6 WAT while plant height reveals that 3-6WAT were also significant when compared the control (No treatment). Total biomass results showed no significant difference between the root and the stem and the heavy metals in the spent engine oil are low ranging from slight to severe contamination (Fe < Pb < Cd < Cu < Zn). In conclusion, *Azadirachta indica A. Juss's* seedlings responses reveals that the plant can be used to monitor and manage contaminated locations while taking the toxicity stress of engine oil suspension concentration into consideration.

DOI: https://dx.doi.org/10.4314/jasem.v29i4.5

Cite this Article as: OJELABI, O. K; IHEDIUCHE, C. I; ABIODUN, F. O (2025) Growth and Yield Performance *of Azadirachta Indica A. Juss* Seedlings in a Spent Engine Oil Contaminated Soil at Jericho, Ibadan, Oyo State, Nigeria. *J. Appl. Sci. Environ. Manage.* 29 (4) 1049-1054

Dates: Received: 14 February 2025; Revised: 24 March 2025; Accepted: 10 March 2025; Published: 30 April 2025

Keywords: Soil contamination; plant growth; Azadirachta indica; Spent engine oil; Heavy metals

Petroleum resources have made a significant contribution more than four decades to both the global energy demand and the economic prosperity of oil producing countries e.g. Nigeria (Ite *et al*., 2016). One of the most significant and persistent environmental issues is pollution which is caused by petroleum products (Mbah *et al*., 2009). Due to the widespread use of oil and petroleum products worldwide, Petroleum Hydrocarbons (PHCs), which include motor fuels, industrial solvents, and many other items, are the most often used organic contaminants (Sharonova *et al*., 2012). The response of plants to PHCs differs and several studies have shown the environmental hazards of petroleum products on the soil (Njoku *et al*., 2009, Parveen *et al*., 2014, Singh *et al*., 2020). Ite *et al*., (2018) report the effects of petroleum on the environmental problem in Niger-delta Nigeria. All these depositions of metals on the road surface and runoff water have led to the contamination of the soil (Ogbonna *et al*., 2011). The neem tree (*Azadirachta indica A.Juss*.) is a tropical evergreen tree (deciduous in drier areas) which grows almost everywhere and a native to Indian sub-continent (Kumar *et al*., 2013). It has been known to be useful in soil enrichment and for insect, pest and disease control (Xuan *et al*., 2004). It can

**Corresponding Author Email: ty4ril2012@gmail.com*
ORCID: https://orcid.org/0000-0003-2012-8776
Tel: +2348032183394

adapt to a wide array of topographic, climatic, and edaphic variables and grows well in shallow, dry, rocky soils, even those with hard, calcareous or clay pan soils at a shallow depth. In contrast to other species, neem is very stress-tolerant and has also shown to improve the fertility and water-holding capacity of the soil (Kanse *et al*., 2015). Very little is known about how early seedling growth of neem tree species is impacted by contaminated soil from automotive activity in the Nigeria. Hence, the objective of this paper was to evaluate the growth and yield performance of *Azadirachta indica A. Juss* seedlings in a spent engine oil contaminated soil at Jericho, Ibadan, Oyo State, Nigeria.

MATERIALS AND METHODS

Description of study area: This experiment was conducted in the screen house of soil and tree nutrition department of Forestry Research Institute of Nigeria Jericho, Ibadan, which lies between latitude 07^{o}23'N and longitude 03^{o}56'E. The study location has an annual rainfall pattern from 1400-1500 mm, the mean maximum temperature is 31.90 C, minimum 24.2C and relative humidity of 74.55% (FRIN annual Meteorological Report 2018).

Sample collection: Considering the base map of the study area, a free method of soil survey was used on the field for the identification of the soil units with observations based on vegetation. The topsoil (0-15cm) and sub soil (15-30cm) utilized was collected from the identified soil unit in the FRIN Arboretum, air-dried, then coarsely crushed and sieved using a 2 mm sieve.

The growth parameter readings for plant height were collected using the measuring tape from the base of the stem to the highest tip of the plant's apical bud, the collar diameter was measured from the base of the stem (circumference) using a digital Venier caliper while the number of leaves is visually counting the visible leaves.

The spent engine oil was collected from the mechanic village from the waste engine oil from cars and trucks.

Laboratory analysis: The sieve samples were subjected to Physicochemical analysis which include: The soil pH was determined in a 1:1 soil-to-water ratio using a glass electrode pH meter (Udo and Ogunwale, 1986) and particle size was analyzed using the Bouyoucos hydrometer technique (Bouyoucos, 1962). The Kjeldahl (1883) technique was used to determine the total nitrogen content and the Mehlich III extraction method (Mehlich, 1984) was used to determine the available phosphorus and analyzed using spectrophotometer. Ammonium acetate was used to extract the exchangeable cations (K, Ca, Na, and Mg). A flame photometer was used to analyzed potassium and sodium, while an atomic absorption spectrophotometer was used to evaluate calcium and magnesium. An Atomic Absorption Spectrophotometer was used to analyzed the number of extractable micronutrients (Fe, Mn, Cu, and Zn) that were extracted using 0.1N HCl solution (shown in Table 1). Seeds used for the experiment were sourced from Seed Section of the Sustainable Forest Management Department of Forestry Institute of Nigeria, Ibadan. The seeds were pre-germinated in river sand and the raised seedlings were then transplanted into a 3 kg polyethylene bag soil mixed with the contaminants (spent engine oil). The chemical composition of the spent engine oil was analyzed (shown in Table 1). The experiment was laid out in a Completely Randomized Design (CRD), having five treatments: 0ml, 20ml, 40ml, 60ml and 80ml respectively that were replicated ten times to make a total of 50 experimental units.

Data analysis: The following parameters were taken into consideration: collar diameter (mm), Plant height (cm), Number of Leaves and Plant Biomass at the end of the experiment. With the use of Genstat statistical software, all the data collected were examined using analysis of Variance (ANOVA) and the Duncan Multiple Range Test (DMRT) was used to separate the mean at the 5% Level of Significance

RESULT AND DISCUSSIONS

The experimental soil was sandy soil with a pH level (6.56) which was slightly acidic.

The overall physicochemical analysis (shown in Table 1) revealed that Total Nitrogen (T.N) was very high when compared with the critical level of 0.15% while the Available phosphorus (A.P) and exchangeable potassium (K) were very low when compared with the critical level of 0.85mg/kg and 0.16 cmol/kg respectively, obtained for soil in South Western Nigeria (FMANR 1990, Kayode and Agboola 1985).

The micro nutrient (Cu, Mn, Fe and Zn) ranges from medium to high which can be attributed to long period of fallow, degree of weathering and leaching associated with soil formation processes (Kang *et al*., 1991). The heavy metals (shown in Table 2); Cadium (Cd), Lead (Pb) and Zinc (Zn) ranges from slight to severe contamination which is similar to some research findings for soil of some contaminated sites in Nigeria (Adedosu *et al*., 2013, Oluwatuyi *et al*., 2020, Eludoyin *et al*., 2021 and Mafiana *et al*., 2021).

Table 1: Physicochemical characteristics of uncontaminated soil samples from the study area

Parameters	Uncontaminated soil
pH in H_20	6.56
Total Nitrogen (g/kg)	1.12
Available Phosphorus (mg/kg)	1.20
Exchangeable cations (cmol/kg)	
Ca	2.00
Mg	0.30
K	0.05
Na	0.20
Extractable Micronutrients (mg/kg)	
Mn	45.60
Fe	103.60
Cu	2.10
Zn	24.0
Particle size distribution (g/kg)	
Silt	2.50
Clay	7.00
Sand	90.50
Textural class	Sandy soil

Table 2: Mean Heavy metals Levels in Spent Engine Oil

Parameters	Results (mg/kg)
Pb	0.004
Fe	0.160
Cu	0.003
Cd	0.002
Cr	0.004
Zn	0.680
Mn	0.016

Impacts of engine oil contamination on the growth parameters (Plant height, Collar diameters and Numbers of leaves): Table 3 results revealed that at 3, 4, 5 and 6 Weeks after Transplanting (WAT) there was significant difference in the plant height of the neem seedlings, while at 1 and 2 WAT there were no significant differences. Treatment AI5 (*Azadirachta Indica* 5 (control) at 6 WAT shows the highest number of plant heights at 31.6cm while the lowest number of plant heights at treatment AI1 at 15.55cm respectively.

When comparing the effect of used engine oil contaminated soil on plant height to the Control experiment, a notable reaction was seen. According to Agbogidi *et al.,* (2012), concentration-dependent effects of used spent oil were observed on plant height, leaf area, number of leaves, and biomass of *Jatropha curcas* seedlings.

Table 4 results revealed that at 2,3,4,5 and 6 WAT there was significant difference in the numbers of leaves while at 1 WAT there was no significant difference. Treatment AI1 at 6 WAT shows the highest number of leaves of 61.0 when compared with the control (AI5) with the lowest treatment at 6 WAT is 12.78.

The spent engine oil contaminated soil samples had a negative impact on the number of leaves on the seedlings which is the decrease in the number of leaves and this is similar to the results of Osuagwu *et al.,* (2017) and also Babalola *et al.,* (2015) has similar decrease in the number of leaves due to high concentration of motor oil on the amendments of soils.

Table 5 results revealed that the collar diameter at 3WAT only was significantly different while at 1,2,4,5 and 6 WAT shows no significant differences. Treatment AI5 (control) shows the highest collar diameter at 6.00mm while the lowest treatment AI3 at 2 WAT of 2.61 mm.

The plants that were grown in the soil without any spent engine (control) oil performed better than the ones planted in the polluted soil. This is similar to the findings of Akinpelu *et al.,* (2015), Tanee *et al.,* (2011) and Ikhajiagbe *et al.,* (2010).

Table 3: Influence of spent engine oil on the Plant height (cm) of *Azadiratchta indica*

Treatment	Weeks After Transplanting (WAT)					
	1	2	3	4	5	6
AI 1	19.10	21.60	24.90	27.70	28.90	30.00
AI 2	15.55	16.35	19.35	20.20	21.30	22.10
AI 3	15.65	16.40	18.18	19.60	19.80	20.50
AI 4	15.80	17.00	18.12	19.30	21.80	22.50
AI 5	16.55	21.60	25.85	28.40	30.80	31.60
LSD	2.91	5.26	6.14	6.54	6.92	6.91
Mean	16.53	18.59	21.30	23.10	24.50	25.40

Table 4: Influence of spent engine oil on the Number of leaves of *Azadiratchta indica*

Treatment	Weeks After Transplanting (WAT)					
	1	2	3	4	5	6
AI 1	25.30	38.30	48.80	54.60	57.70	61.00
AI 2	22.00	27.50	33.30	37.40	40.50	45.30
AI 3	20.20	24.30	30.20	34.30	37.80	40.80
AI 4	19.70	23.20	25.80	29.90	32.60	35.60
AI 5	28.00	31.70	44.30	47.70	50.70	53.60
LSD	8.27	9.78	13.35	13.50	13.09	12.78
Mean	23.00	29.00	36.50	40.80	43.90	47.30

Table 5: Influence of spent engine oil on the collar diameter of *Azadiratchta indica*

Treatment	Weeks After Transplanting (WAT)					
	1	2	3	4	5	6
AI 1	3.15	3.87	4.43	4.95	5.51	5.84
AI 2	3.05	3.83	4.80	4.79	5.18	5.59
AI 3	2.61	3.13	3.92	4.30	4.69	5.26
AI 4	3.13	3.50	3.80	4.23	4.66	5.12
AI 5	3.13	3.91	4.50	4.98	5.46	6.00
LSD	0.55	0.64	0.66	0.73	0.82	0.91
Mean	3.01	3.65	4.31	4.71	5.11	5.57

Impacts of engine oil contamination on the Total Biomass (Wet and Dry Weight): Fig. 1 reveals significant differences among the leaves, root and stem. The root recorded the highest total biomass (Wet weight) at treatment AI1 of 5.39g while number of leaves recorded the lowest total biomass at treatment AI3 of 0.83g.

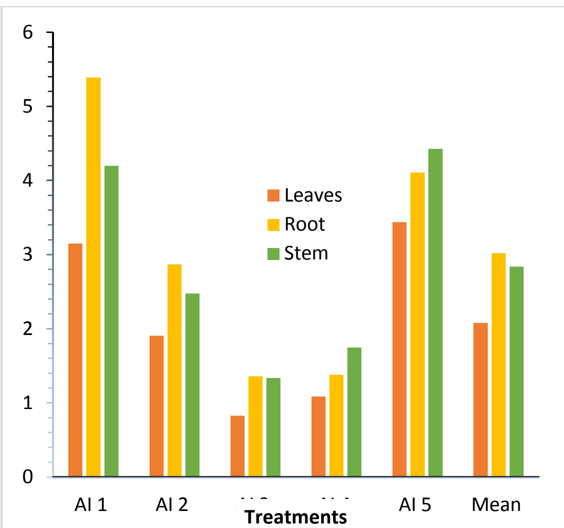

Fig. 1: Influence of oil- spent engine on the Total Biomass (Wet Weight) of *Azadiratchta indica*

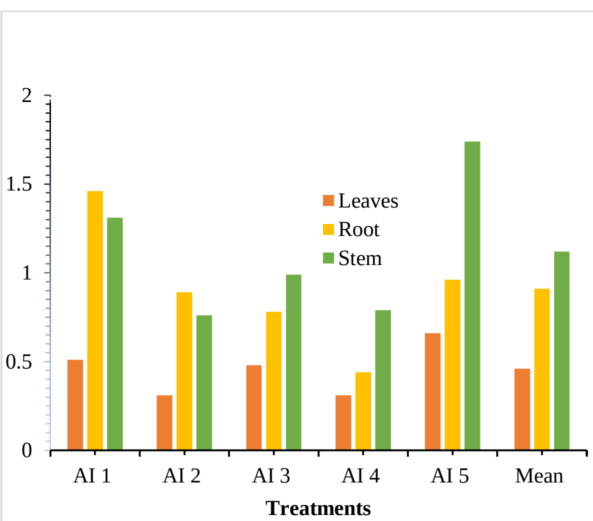

Fig. 2: Influence of oil- spent engine on the Total Biomass (Dry Weight) of *Azadiratchta indica*

Fig. 2 reveals significant difference between root and stem while leaves show no significant difference. Stem recorded the highest value of 1.74g at treatment AI5 while leaves recorded the lowest value of 0.31g at treatment AI5 (control).

Conclusion: In conclusion, the accumulation of engine oil in the soil can therefore, permanently damaged its properties, rendering it unsuitable for plant growth and survival, and also leads to low fertility. The response of *Azadiratchta indica* indicates that the plant can be used to monitor and regulate polluted sites taking into accounts the toxicity stress to engine oil suspension concentration.

REFERENCES

Adedosu, TA; Adedosu, HO; Sojinu, OS; Olajire, AA (2013). N-Alkanes and polycyclic aromatic hydrocarbons (PAHs) profile of soil from some polluted sites in Niger Delta, Nigeria. *Enviro. earth Sci*. *68*, 2139-2144.

Agbogidi, OM; Eruotor, PG (2012). Morphological changes due to spent engine oil contamination and its heavy metal components of *Jatropha curcas Linn* seedlings. *Proceedings of Internation. Conf. on Biosci, Biotechno. and Healthcare Sci.* (ICBBHS2012) Dec14-15, 2012 Singapore.

Akinpelumi, BE; Olatunji, OA (2015). Effects of sawdust soil amendment on the soil, growth and yield of *Solanum esculentum Linn.* in waste engine oil-polluted soil. *J. Sci. in Cold and Arid Reg*, *7*(2), 128-136.

Babalola, EA; Olusanya, AO (2015). Effect of sawdust soil amendments on the soil, growth and yield of Solanum esculentum Linn. In: waste engine oil polluted soil. *J. Sci. in Cold and Arid Reg.* 7(2):128-136.

Bouyoucos, GJ (1965). Hydrometer method improved for making particle size analysis of soils. *Soil Sci. Soc. of America Pro.* 26: 917- 925.

Eludoyin, OS; Afolabi, OO (2021). Evaluation of heavy metals and contamination status of soil around abandoned and active Nigerian dumpsites. *J. Geo. Environ. and Earth Sci. Internat*. *25*(10), 1-11.

FMANR, (1990). Literature review on soil fertility investigations in Nigeria (in Five Volumes). *Fed. Min. of Agric. Nat. Res*, Lagos, pp: 32-45.Forestry Research Institute of Nigeria Meteorological Report, 2018.

Ikhajiagbe, B; Anoliefo, GO (2010). Impact of soil amendment on the phytotoxicity of a 5-month-old waste engine oil polluted soil. *Afri. J. Environ. Sci. Techn.* 4(4): 215–225.

Ite, AE; Harry, TA; Obadimu, CO; Asuaiko, ER; Inim, IJ (2018). Petroleum hydrocarbons contamination of surface water and groundwater in the Niger Delta region of Nigeria. *J. Environ. Poll. Human Heal*, *6*(2), 51-61.

Ite, AE; Ufot, UF; Ite, MU; Isaac, IO; Ibok, UJ (2016). Petroleum industry in Nigeria: Environmental issues, national environmental legislation and implementation of international environmental law. *Ame. J. Environ. Prot*, *4*(1), 21-37.

Kang, BT; Gichuru, MP; Hulugalle, NR; Swift, MJ (1991). Soil constraints, for sustainable upland crop production in humid and sub-humid West Africa. *Proceedings of the 24th Internat. Symp. Trop. Agric. Res.*, 1991 Kyoto, Japan. Pp 101-112.

Kanse, OS; Whitelaw-Weckert, M; Kadam, TA; Bhosale, HJ (2015). Phosphate solubilization by stress-tolerant soil fungus *Talaromyces funiculosus* SLS8 isolated from the Neem rhizosphere. *Annals of Microbio*. *65*, 85-93.

Kayode, G; Agboola, AA (1983). Investigation on the use of macro and micro nutrients to improve maize yield in south western Nigeria. *Fert. Res*. 4(3), 211-221. Doi:10.1007/bf01049477.

Kjeldahl, J (1883). A new method for the estimation of nitrogen in organic compounds. Z. *Analy. Chem.* 22 (1), 366.

Kumar, VS; Navaratnam, V (2013). Neem (Azadirachta indica): Prehistory to contemporary medicinal uses to humankind. *Asian Paci. J. trop. Biomed.*, *3*(7), 505-514.

Mafiana, MO; Bashiru, MD; Erhunmwunsee, F; Dirisu, CG; Li, SW. (2021). An insight into the current oil spills and on-site bioremediation approaches to contaminated sites in Nigeria. *Environ. Sci. Pollu. Res 28*, 4073-4094.

Mbah, CN; Nwite, JN; Nweke, IA (2009). Amelioration of spent oil contaminated Ultisol with organic wastes and its effect on soil properties and maize (*Zea mays* L.) yield. *Wor. J. Agri*c. *Sci.* 5(2), 163-168.

Mehlich, A (1984). Mehlich 3 soil test extractant: A modification of Mehlich 2 extractant. Commun. *Soi. Sci. Plant Analy.* 15 (No. 12), 1409–1416.

Njoku, KL; Akinola, MO; Taiwo, BG (2009). Effect of gasoline diesel fuel mixture on the germination and the growth of *Vigna unguiculata* (Cowpea), *Afri. J. Environ. Sci. Techn.* 3(12), 466-471.

Ogbonna, PC; Okezie, N (2011), Heavy metal level and macronutrient contents of roadside soil and vegetation in Umuahia, Nigeria. *Terres. Aqua. Environ. Toxico.* 5(1), 35-39.

Oluwatuyi, OE; Ajibade, F.O; Ajibade, TF; Adelodun, B; Olowoselu, AS; Adewumi, JR; Akinbile, C.O (2020). Total concentration, contamination status and distribution of elements in a Nigerian State dumpsites soil. *Environ. Sust. Indic. 5*, 100021.

Osuagwu, AN; Ndubuisi, P; Okoro, CK (2017). Effect of spent engine oil contaminated soil on *Arachis hypog*ea (L.), *Zea mays* (L.) and *Vigna unguiculata* (L.) Walp. *Internat. J. Adv. Agric. Res.*, *5*, 76-81.

Parveen, S; Iqbal, MZ; Shafiq, M; Athar, M (2014). Effect of automobile polluted soil on early seedling growth performance of Neem (*Azadirachta indica A. Juss.). Adv. Environ. Res. 3*(1), 1-9.

Sharonova, N; Breus, I (2012). Tolerance of cultivated and wild plants of different taxonomy to soil contamination by kerosene. *Sci. Total Environ.* 424, 121-129.

Singh, Y; Singla, A; Sharma, A; Singh, NK (2020). Performance and emission characteristics of the diesel engine running on neem (*Azadirachta indica*) biodiesel with effect of exhaust gas recirculation at optimum injection strategies. *Pollu. 6*(4), 725-735.

Tanee, FBG; Albert E, (2011). Bio stimulation potential of sawdust on soil parameters and cassava (*Manihot esculenta; Crantz*) yields in crude oil polluted soil. *Adv. Environ. Bio.*12: 938–945.

Udo, EJ; Ogunwale, JA (1986). Laboratory Manual for the Analysis of Soil, Plant and Water Samples (2nd Edition). Department of Agronomy, University of Ibadan.

Xuan, TD; Tsuzuki, E; Hiroyuki, T; Mitsuhiro, M; Khanh, TD; Chung, IM (2004). Evaluation on phytotoxicity of neem (*Azadirachta indica. A. Juss*) to crops and weeds. *Crop Prot.*, *23*(4), 335-345.