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Assessing the Impact of Spent Engine Oil Contamination Soil on the Growth of *Adansonia digitata* Linneous Seedlings Compared to Top Soil

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ABSTRACT
Some landscapes are known with soil pollutants and it is important to establish indigenous tree species to acclaim this substance. Therefore, this study was carried out to determine the comparative effect of top soil and spent engine contaminated soil on the growth pattern of *Adansonia digitata* seedlings in the nursery which was done in year 2023. Complete Randomized Design was used for the study with two treatments and fifteen replicates. Independent sample T- test and descriptive statistics were used for the analysis. Experiment was conducted for three months while shoot height, stem diameter and number of leaves were measured. Top soil produced better morphological characteristics of the species. *Adansonia digitata* can grow and survive in both top and contaminated soil but better with top soil. Therefore, this study recommended that *Adansonia digtata* should be planted in top soil. However, this species performed closely to the top soil. Therefore, further study should be conducted to determine on the ability of the species to absorbed ion and cation for remediation of the pollutants in the savannah landscape.

INTRODUCTION

Heavy metal contamination of soil constitutes a profound environmental and health hazard, posing significant risks to human populations and ecosystems. Direct ingestion or contact with contaminated soil serves as a primary pathway for exposure (McLaughlin *et al.,* 2000). A diverse array of heavy metals, encompassing lead (Pb), chromium (Cr), arsenic (As), zinc (Zn), cadmium (Cd), copper (Cu), mercury (Hg), and nickel (Ni), can infiltrate soil through various anthropogenic activities, including industrial processes and waste disposal (GWRTAC, 1997). Notably, these metals exhibit remarkable persistence in soil, resisting microbial and chemical degradation (Akintola and Bodede, 1999), and can remain present for extended periods following introduction (Adriano, 2003).

The presence of toxic metals in soil can significantly impede the biodegradation of organic contaminants, thereby exacerbating environmental pollution (Maslin and Maier, 2000). *Adansonia digitata* (Linn), commonly known as the African baobab, is a revered and ecologically significant tree species native to the African continent and the southern Arabian Peninsula (Yemen, Oman) (Salami *et al.,* 2020). This remarkable species is characterized by its exceptional longevity, with some individuals estimated to be over 2,000 years old, based on radiocarbon dating. Typically found in dry, hot savannas of sub-Saharan Africa,

the baobab dominates the landscape and serves as a vital source of food, water, and shelter for numerous animals.

The baobab's impressive characteristics include its deciduous nature, with a height of up to 20m, and a hugely swollen trunk diameter of 3-10 m (up to 28m in older individuals) (Bosch *et al*., 2004). The bark is smooth, folded, and reddish-brown or grayish-brown, while the leaves are compound with 3-9 leaflets, each 5-15 cm long. The flowers are long, white, and solitary in leaf axils.

The remediation of heavy metal-contaminated soil is crucial to mitigate associated risks, restore land productivity, enhance food security, and alleviate tenure problems arising from changes in land use patterns. Heavy metals occur naturally in the soil environment through pedogenetic processes, but anthropogenic activities have accelerated their accumulation, leading to levels that pose risks to human health, plants, animals, ecosystems, and other media (Pierzynski *et al.,* 2000; D'amore *et al.,* 2005; Kabata *et al.,* 2001; Zhoa and Kaluarachchi, 2002; Bolann *et al.,* 2008).

Soil attributes, including depth, moisture content, consistency, permeability, temperature, nutrient content, and porosity, significantly influence the type of plant growth (Salami and Akinyele, 2023; Boyle and Powers, 2013). Furthermore, studies have shown that dumpsite wastes release harmful leachates containing heavy metals into local water bodies, leading to environmental hazards. Consequently, the remediation of contaminated soils is essential for creating a safe and conducive environment. Therefore, the tree plantation can be used as a method of remediation of waste lands, to refurbish soil fertility and productivity. This study focused on the potential of *Adansonia digitata* to uptake and distribute heavy metal in their roots and shoot planted in dumpsite soil in view of prescribing better tree seedlings for polluted environment.

MATERIALS AND METHODS

Description of the study area

The study was conducted over a two-year period in a location situated at 11°70' N latitude and 9°34' E longitude, with an altitude of 460 meters above sea level. The area, characterized by a tropical climate, receives a mean annual rainfall of 750mm, which provides a favorable condition for agricultural activities (Gidado *et al.,* 2023; Jibo *et al*., 2023; Ilu *et al*., 2023) The mean annual temperature in the area supports the growth of a variety of crops, including okra. The geographical location and climatic conditions of the study area make it a representative site for investigating the effects of NPK 15:15:15 fertilizer and spacing on okra growth. The area's relatively uniform climate and soil conditions ensured that the results obtained from the study were reliable and applicable to similar agro-ecological zones. The topography of the area is generally flat, with a high land area of approximately 750 meters. The soil type in this region is predominantly sandy-loam, as reported in previous studies (Garba *et al*., 2021; Ilu *et al*., 2020; Salami *et al*., 2020; Jibo *et al.,* 2018). This soil type is characterized by a mix of sand, silt, and clay, providing a suitable medium for plant growth.

Data collection

The spelt engine contaminated soil was collected from a mechanical village located in Dutse, Jigawa State. Top soil was also be collected at Forestry Nursery, Federal University Dutse Jigawa State. Seeds of Adansonia digitata were obtained from the mother tree at Kila, Gwaram Local Government Jigawa state. Soil sample was air-dried and sieved so as to remove stones, roots and other materials that may be detrimental to the emergence of the young plants from the seed.

Procedure

Seeds of Adansonia digitata were sown in germination boxes which were moist daily and monitored. A sample of 1kg of soil for two treatments (Soil: T1 and T2) were filled into a plastic pot perforated with 3-4 holes at the base.

Sampling design

The experiment was arranged in Completely Randomized Design (CRD) with two treatments and fifteen replicates respectively.

Data analysis

The collected data was subjected to independent sample T test with aid of statistical package for social sciences (SPSS) version 19 and also descriptive statistics.

RESULTS AND DISCUSSION

Findings from table 1 showed the close performance of morphological attributes in terms of shoot height, leaf number and stem diameter between the two treatments. However, top soil performed better for shoot height and impacted fairly for both stem diameter and leaf number.

Table 1: Mean observed from the parameters of seedlings

SN	Parameters	Top Soil effect	Spelt engine Contaminated Soil
1	Plant length (cm)	29.3	20.3
2	Leaf number	17.2	16.1
3	Collar diameter (mm)	1.51	1.3

Source: Field survey, 2023

Table 2: Analysis of Independent sample T test

SN	Parameters	T calculated	T Tabulated
1	Plant length (cm)	2.14	3.09^{ns}
2	Leaf number	2.17	3.70^{ns}
3	Collar diameter (mm)	2.14	2.84^{ns}

Note: ns there is no significant differences at 0.05% probability level

Discussion

Soil nutrient is a substance taken by a cell from its environment and used in catabolic or anabolic reaction with soil to the plant (Salami *et al*, 2020; Patel, 2008). Important physical properties of forest soils include texture, structure, porosity, density, aeration, temperature, water retention and movement. The physical properties of forest soils affect every aspect of soil fertility and productivity (Osman, 2013). Plant nutrients (cations and anion) are absorbed from the soil solution by plant roots which also release small quantities of ions (H+, OH- and HCO_3). Soils also contain minerals that can dissolve to resupply the soil solution. Addition of nutrients or ions through fertilization or other inputs increases ion concentration in the soil solution. However, if there is an imbalance in cation and anion uptake in plant root cells, these cells release cations or anions depending on the imbalance. This process can influence soil solution pH (John *et al.,* 2013; Salami *et al*., 2020). The result from the table 1 showed that the mean number of leaves of Baoba (*Adansonia digtata*) observed from the experiment with top soil is 17.4 and contaminated soil is 16.2. This implied that top soil is favorable in germination of Baoba (*Adansonia digtata)* than contaminated soil. There were no significant differences between the treatments at 0.05% probability level (Table 2). Salami *et al*. (2020), agreed that seed of *Spondia mumbin* with and epicarp and without which sown in the top soil had the highest germination percentage and growth performance compare to river sand. Agbogidi and Eruoto (2002), reported that contaminated soil (sewage sludge soil, spent engine oil on the soil) significantly affect the number of leaves, collar diameter and leaf area of seedlings with reductions in these parameters being concentration dependent. The concentration dependent reduction in leaf area and number of leaves agrees with the report of Agbogidi *et al*. (2005); Vwioko and Fashemi (2005); Sharifi et al., (2007). Shoot height is the vertical distance between the base of the tree and the tip of the highest branch on the tree. The result from the table 1 above showed that the mean height of all tree *(Adansonia digtata)* sampled from the experiment top soil is 29.4cm with that of contaminated soil being 20.4cm. This implied that the top soil contains nutrient that support the growth of Adansonia digtata than the contaminated soil. Nwoko *et al*. (2007), reported that the presence of spent engine oil in the soil-plant micro environment appeared to have an effect on the normal soil chemistry such that the nutrient release and uptake as well as the amount of water could be reduced. Vwioko and Fashemi. (2005), among many other authors had reported that reduction in plant height is a visible effect of substance that are toxic, and inhibit plant growth. The table 1 above showed that the mean stem diameter of plant sampled from top soil 1.52 is more than that of contaminated soil. There is no significant differences between the treatments at 0.05% probability level (Table 2) for both stem diameter and leaf number. Agbogidi and Eruoto (2002) reported that contaminated soil (sewage sludge soil, spent engine oil on the soil) significantly affect the number of leaves, collar diameter and leaf area of seedlings with reductions in these parameters being concentration dependent. i.e contaminated soil prevent affect the number of leaves i.e this leave is reduced in number which reduce the photosynthetic activities of the plant, in other words shortage in food supplies and this tends to affect the stem growth of the plant. From the results above it show that top soil is good in stem growth than contaminated soil.

CONCLUSION

This study showed that *Adansonia digtata* can grow and survive in both top soil and contaminated soil but with top soil doing better. Finding revealed that the species responded well for all morphological features and performed better in top soil than the contaminated soil. Recommendations Study should be conducted on the ability of the species to absorbed ion and cation for remediation of the pollutants in the savannah landscape. Additionally, study recommends that *Adansonia digtata* should be planted in top soil than contaminated soil as it supports the growth of morphological features in the plants.

REFERENCES

Adriano, D. C. (2003) Trace Elements in Terrestrial Environments: Biogeochemistry, Bioavailability and Risks of metals, Springer, New York, NY, USA 2nd edition

Agbo, I. R. (2017). Impacts des usages traditionnels sur la vulnérabilité de Detarium microcarpum Guill. and Perr. (Caesalpiniaceae) dans le district phytogéographique Zou au Bénin (en Afrique de l'Ouest). Int. *J. Biol. Chem. Sci.,* 11(2), 730, https://doi.org/10.4314/ijbcs.v11i2.16

Akah, P. (2012). Genus Detarium: ethnomedicinal, phytochemical and pharmacological profile. Phytopharmacology, 2(3): 367-375, http://inforesights.com/phytopharmacology/archive.html (10/03/2021).

Akintola, O. O. and Bodede, I. A. (1999). Heavy metal Remediation Potential of Adansonia digitata Linn seedlings in Dumpsite contaminated soil. A proceeding of 41st Annual conference of Forestry Association of Nigeria Pp 215-222

Akpata, M. I. and Miachi, O.E., 2001. Proximate composition and selected functional properties of Detarium microcarpum. Plant Foods Hum. Nutrition 56(4), 297-302, https://doi.org/10.1023/A:1011836332105

Alais, C. and Linden, G. (1991). Food biochemistry. 1st ed. Springer.

Alakali J. S., Okonkwo T. M. and Uwu L.U., 2009. Effect of food binders on the textual and sensory characteristics of ice cream. *Afr. J. Biotechnol.*, 8(12), 2853-2856.

Amandikwa C., Bede, E. N. and Eluchie, C. N. (2017) Effects of processing methods on proximate composition, mineral content and functional properties of "Ofor" (Detarium microcarpum) seed flour. *Int. J. Sci. Res*., 6(5), 966-970, https://doi.org/10.21275/ART20172977.0

Anhwange B.A., Ajibola V.O. and Oniye S.J., (2004). Chemical studies of the seeds of Moringa oleifera (Lam) and Detarium microcarpum (Guill and Sperr). *J. Biol. Sci*., 4(6), 711-715, https://doi.org/10.3923/jbs.2004.711.715

Arbonnier, M. A. (2002). Arbres, arbustes et lianes des zones sèches d'Afrique de l'Ouest. Montpellier, France :CIRAD.Diop N. et al., 2010. Le ditax (Detarium senegalense J.F. Gmel.): principales caractéristiques et utilisations au Sénégal. Fruits, 65(5), 293-306, https://doi.org/10.1051/fruits/2010025

Boyle, J .R. and Powers, R.F (2013). Forest Soil. In: Reference Module in Earth Systems and Environmental Sciences.

Elsevier FAO/WHO, (2004). Vitamin and mineral requirements in human nutrition. 2nd ed. Roma: FAO; Geneva, Switzerland: World Health Organization.

Garba, A., Salami K. D. and Akanbi W. B. (2021). Assessment of Endangered economic tree species and conservation Techniques in Jigawa state FUDMA Journal of Agriculture and Agricultural Technology V 7(2)116-123

Gidado, H. A. Salami, K. D. Kareem, A. A., Jibo, A. U., Adam Fatima, Oginni, D. O. (2023) Effect of frequencies of watering and water volumes on the growth performance of Adansonia digitata (Linn) Seedlings. Australian Journal of Science and Technology ISSN Number (2208-6404) Volume 7; Issue 1; March 2023 Australian

GWRTAC, (1997) Remediation of metals – contaminated soils and ground water, Tech Rep. TE-97 -01 GWRTAC, Pittsburgh, Pa, USA , GWRTAC-E Series

Igbabul, B. D. and Idikwu, H .O. (2012). Effect of fermentation on some functional properties of Mucuna sloanei and Detarium microcarpum. J. Food Technol., 10(3), 83-86, https://doi.org/10.3923/jftech.2012.83.86

Ilu, K. J., Salami, K. D., Jibo, A. U. and Muhammad, Y. K. (2023) Influence of the Levels of Soil Contamination on the Early Growth Performance of Adansonia digitata Linn. Seedlings Proceedings of the First Faculty of Agriculture International Conference, Nnamdi Azikiwe University, Awka, Nigeria

Ilu, K. J., Salami, K.D. Muhammad. Y. K (2020) Influence of Tapping Dates on The Yield Of Acacia Senegal (L) Wild at Two Different Locations in Jigawa State, Nigeria. FUDMA Journal of Sciences (FJS) Vol. 4 No. 1, March, 2020, pp 246-249

Issaoui-Mansouri, K. (2010). Souveraineté alimentaire: un concept en émergence, http://redtac.org/possibles/files/2010/10/S1-C1-IssaouiB.pdf (24/08/2022)

Jibo, A. U. Salami K. D. and Lawal. A. A. (2023) Morphological Response and early growth characteristic of Senegalia senegal (Linn) wild and Balanites aegyptiaca (Linn) as influenced by Mychorrhiza and salt concentrate

Jibo, A.U., Salami, K.D and Inuha, I.M (2018). Effects of Organic manure on growth Performance of *Azadirachta indica* (A.Juss) seedlings during early growth in the Nursery. *FUDMA Journal of Sciences (FJS)*. Vol 2 (4):99-104

John, L. H., Samuel LT, Weiner LN and James DB (2013). Soil fertility and fertilizers: Introduction of Nutrient Management 8th edition, pp. 185-221Melin, E, 1962

Kini F., Ouédraogo S. and Guissou P.I., (2010). Propriétés nutritionnelles et thérapeutiques du fruit de Detarium microcarpum Guill. & Perr. Fruit Veg. Cereal Sci. Biotechnol, 4(special issue), 26-30.

Kouyate, A. M. (2005). Aspects ethnobotaniques et étude de la variabilité morphologique, biochimique et phénologique de Detarium microcarpum Guill. & Perr. au Mali. Thèse de doctorat : Ghent University (Belgique).

Kouyate, A. M. and Lamien N. (2011). Conservationand sustainable use of genetic resource of priority food tree species in subsaharan Africa Detarium microcarpum, https://citarea.citaaragon.es/citarea/bitstream/10532/1687/1/2011_343EN.pdf (10/3/2021).

Kouyate, A. M., Nacoulma B.M.I., Lykke A.M. & Thiombiano A., (2016). Estimation de la production fruitière des espèces ligneuses alimentaires en Afrique sub-saharienne. Ann. Sci. Agron., 20, 69-78.

Makalao M.M., Savadogo A., Zongo C. & Traore A.S., 2016. Composition nutritionnelle de 10 fruits sauvages consommés dans trois départements du Tchad. Int. J. Biol. Chem. Sci., 9(5), 2385-2400, https://doi.org/10.4314/ijbcs.v9i5.11

Mariod A.A., Mirghani M.E.S., Abdul A.B. and Abdelwahab S.I., (2009). Detarium microcarpum Guill and Perr fruit proximate chemical analysis and sensory characteristics of concentrated juice and jam. Afr. J. Biotechnol., 8(17), 4217-4221.

Maslin, P and Maier R. M. (2000) Rhamnolipid – enhanced mineralization of phenanthrenein organic metal co-contaminated soils. Bioremediation Journal 4(4):618-623

McLaughlin, M. J. Zarcinas B. A., Steven, D. P. and Cook, N. (2000) Soil testing for heavy metals. Communications in soil science and plant Analysis 31(11-14):1661-1700

Michael K., Sogbesan O.A., Onyia L.U. & Kefas M., 2019. Effect of processing methods on the nutritional and anti-nutritional value of Detarium microcarpum (Guill and Sperr) seed meals. Int. J. Appl. Res., 5(5), 68-72, https://allresearchjournal.com/archives/2019/vol5issue5/PartB/5-4-3-364.pdf

Obun, C. O., Yahaya S. and Lekene B., (2009). Evaluation of nutritive value of processed and unprocessed Detarium microcarpum (Guill and Sperr) seed meal fed to broiler chicks. J. Agric. For. Social Sci. (JOAFSS), 7(1), 214- 222.

Oibiokpa F.I., Adoga, G. I., Saidu A.N. and Shittu K.O., 2014. Nutritional composition of Detarium microcarpumfruit. Afr. J. Food Sci., 8(6), 342-350, https://doi.org/10.5897/AJFS2014.1161

Omokhua, G. E., Abbey W.M. and Olaleye S.M., (2013). Use of indigenous technology in processing and utilization of non-timber forest product in southeastern Nigeria. J. Agric. Soc. Res., 13(2), 68-75

Onweluzo, J. C., Leelavathi K. and Haridas, R. P. (1999b). Effect of Detarium microcarpum (Dm) and Mucuna flagellipes (Mf) gums on the quality of white bread. Plant Foods Hum. Nutr., 54(2), 173- 182, https://doi.org/10.1023/a:1008111610481

Onweluzo, J. C., Vijayalakshmi, M. R., Vijayanand P. and Eipeson, W. E., (1999a). Detarium microcarpum polysaccharide as a stabilizer in processed fruits.products. LWT Food Sci. Technol., 32(8), 521-526, https://doi.org/10.1006/fstl.1999.0592

Orwa, C ., Mutua, A., Kindt , R. Jamnadass, R. and Anthon, S. (2009) Agroforestry tree Database : a tree reference and selection guide version 4.0 world Agroforestry center , Kenya
http://www.worldagroforestry.org/resources/database/agroforestry

Osman, K. T (2013). Forest Soils, DOI 10.1007/978-3-31902541-4_2, © Springer International Publishing Switzerland. Patel SV, Golakiy A, Savalia SG and Gajera HP 2008. A Glossary of Soil Sciences. International Book Distributing Co., p. 330

Salami, K. D. and Akinyele, A. O. (2023) Evaluation of some Heavy metals and Physico – chemical properties of soil under two sampling depth in Gambari Forest Reserve (GFR), Ibadan, Oyo State, Nigeria Oyo State, Nigeria. Sustainability, Agriculture, Food, and Environmental Research 11(X), 2023

Salami, K. D., Lawal A. A., Oyebamiji, N And Yisau, J. A. (2020) Effect Of Nitrogen, Phosphorus Fertilizers And Mycorrhizal Nodulation On The Growth And Yield Of Tree Seedlings, FUW Trends In Science & Technology Journal, Www.Ftstjournal.Com E-ISSN: 24085162; P-ISSN: 20485170; April, 2020: Vol. 5 No. 1 Pp Katsina

Salami, K.D; Akinyele, A. O. and Folorunso, W.O. (2020). Effect of Pre-Treatments, Inorganic Fertilizer and Varying Soil Volumes on the Early Growth Performance of *Adansonia digitata* (Linn) Baobab. Nigeria *Journal of Horticultural Science, Horticultural Society of Nigeria*. Vol 25 (1):1-10