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TAXONOMIC IDENTIFICATION OF SPENT ENGINE OIL TOLERANT PLANT SPECIES AT SELECTED AUTO MECHANIC WORKSHOPS IN IMO STATE NIGERIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Authors JNA and ACU designed the study, performed the statistical analysis, wrote the protocols, managed the literature searches, interpretation and wrote the manuscript. Authors JNA, RIO and CMD managed the analysis of the study and supervised collection of data from the field. All authors read and approved the final manuscript.

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ABSTRACT

Indiscriminate disposal of spent engine oil is a serious ecological issue in most developing countries. Dearth of information in available literature on the type and characteristics of plants that can be applied in phytoremediation of spent engine oil polluted soils was the main reason forundertaking this study. The aim of this study was to identify indigenous plant species growing in the vicinity of auto mechanic workshops for inclusion as potential phytoremediators of hydrocarbon carbon contaminated soils in Imo State. For data collection, frequency of occurrence was used to evaluate prevalence of plant species in each sampling site. A total 137 plant species belonging to fifteen families were identified.The *Asteraceae* dominated with 22%, followed by *Poaceae* (17%), *Gramineae* (12%), *Leguminoseae* (9%), *Sterculiaceae* (8%), and *Araceae* (7%). Others were less dominant with *Cyperaceae, Malvaceae, Anacardiaceae, Euphorbiaceae, Vitaceae, Annonaceae, Ongraceae, Bignoniaceae,* and *Fabaceae* having 4%, 3%, 5%, 3%, 2%, 4%, 1%, 2%, and 1% respectively. Over all, the *Asteraceae* and *Poaceae* represented the dominant plant species across the sampled area which is an indication that they are spent engine oil tolerant and could be applied in phytoremediation technology.

Keywords: Plant species; tolerant; identification; used oil auto mechanic; phytoremediation; Imo state.

1. INTRODUCTION

With the increase in industrialization and subsequent imbalance in natural activities, global use and flagrant disposal of organic and inorganic pollutants in the environment is on the increase [1], reflecting an adverse effect on the terrestrial ecosystem and the biodiversity they support. Local and international costs, together with growing demand for cleaner and safe ecosystem bring these environmental problems to the front pages of newspapers and to research journals on a regular basis [2].

Alteration of ecological balance in the natural environment is caused by various anthropogenic activities going on unabated in most developing countries like Nigeria. The majority of these pollutants pave their way into soil resulting to the

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release of toxic elements to the environment due to unsustainable use, indiscriminate disposal methods and management that typify most developing countries [3]. Consequently, the soil ecosystem is continuously being degraded, causing deleterious impacts and loss of key resource that is fundamental to life on the planet. These chemosynthetic contaminants are known to be persistent and non-degradable in the soil [4]. Persistence and toxicity of these chemicals is a devastating environmental problem in most developing countries today. Typical example of such chemosynthetic toxicant currently bedeviling soil ecosystem as a result unregulated disposal is spent engine oil. Indiscriminate disposal of spent engine oil on bare land has caused considerable environmental problem [5].

In recent decades, environmental pollution by petroleum and petrochemical products has been a trending issue of global concern [6-9] In Nigeria, as in many developing countries, soil pollution occasioned by indiscriminate disposal of petroleum and its allied products is considered a serious ecological issue [10-11]. This ecological issue is rising as a result of the prevalent mode of disposal of these wastes in the environment. Hence, it is an issue of optimum importance to protect the ecosystem from industrial contamination or pollution which is continually threatening the terrestrial and aquatic ecosystem due to increasing anthropogenically released exposure of chemical agents that are capable of causing damage to the flora and fauna in the environment [12].

In Imo State, as in many other states in the Nigeria, there tends to be an upsurge in the number of vehicles been serviced on daily basis. These vehicles as well as generator set/other machine parts require servicing when they develop some kind of fault. The activities at this mechanic workshop generate wide varieties of wastes that are indiscriminately dumped on soils thereby contaminating the soil and underground water and its environs [13]. While these waste substances could contain hazardous chemicals such as TPH, PAHs and heavy metals which can be deleterious to humans even at low concentrations, potential ecological risks and the levels of these contaminants are not well known [14]. In 2005, PAHs ranked 7th in the biennial ranking of chemicals deemed harmful which may pose the greatest possible risk to human health. The ecological effects of spent engine deposition to the ecosystem and the escalating environmental contamination by these chemicals have been a major source of concern [15].

Phytoremediation is defined as the cleanup of contaminated sites using plants. This is a remediation technique that uses plants to detoxify contaminated soils. It presents an efficient, "green clean," environmental, low cost, and eco-friendly technology that uses plants to reduce or remove inorganic and organic pollutants from environment The main reason behind the implementation of phytoremediation is the possibility for low-cost remediation [16].

An exhaustive plant selection must be made prior to the application of a plant in phytoremediation program. Selection of plants from the populations of the metal-polluted sites for their recovery is now the focus, as they are adapted to soil and climatic conditions to the zone, which should made phytoremediation a much easier task [17]. One of the strategies that can be followed when working in phytoremediation is the use of native hyperaccumulator plants of high biomass, mainly those adapted to the climatic and soil conditions of the polluted site.

Interest in phytoremediation has grown significantly following the identification of metal hyperaccumulator plant species. Hyperaccumulators are conventionally defined as species capable of accumulating metals at levels 100-fold greater than those typically measured in common nonaccumulator plants. Thus, a hyperaccumulator will concentrate more than: 10 ppm Hg; 100 ppm Cd; 1,000 ppm Co, Cr, Cu, and Pb; 10,000 ppm Ni and Zn. To date, approximately 400 plant species from at least 45 plant families have been reported to hyperaccumulate metals. Most hyperaccumulatorsbioconcentrate Ni, about 30 absorb either Co, Cu, and/or Zn, even 11 fewer species accumulate Mn and Cd, and there are no known natural Pbhyperaccumulators [18].

Selection of plant species depends on several factors such as their ability to treat the concerned pollutants, to achieve their remedial properties and for their adaptability to other site-specific factors [16] The most preferred vegetation characteristics include adaptation to local climates, depth of the plant's root structure, ability of the species to flourish in the type of soil present, ability to extract or degrade the concerned contaminants to less toxic form, fast growth rate, ease of planting and maintenance and the uptake of large volumes of water by evapotranspiration [19]. It has been reported that care should be taken into consideration during the selection process to prevent the introduction of non-native species into the areas where those species are absent [20]. Therefore, identification of species growing in spent engine oil contaminated sites is an essential step in phytoremediation technology. Till date, information on literature regarding plant species that can be used in phytoremediation of spent engine contaminated soil is still lacking in Imo state.

Therefore, this study was carried out to profile the occurrence of plant species growing in the vicinity of selected auto mechanic workshops in Imo State with a view to applying them in phytoremediation of spent engine oil contaminated soils.

2. STUDY AREA

The study was conducted in Imo State southeast Nigeria. Imo State has a total of twenty seven (27) Local Government Areas (L.G.A). The state lies within latitudes 4°45'N and 7°15'N, and longitude 6°50'E and 7°25'E with an area of about 5,100 sq km3. However, its population is about 4,927, 5634 (NPC, 2006). The people of Imo State are basically of Igbo extraction having similar cultural activities like other Igbo communication and they speak Ibo language. The state is influenced by urban sprawl whereby smaller communities merge together. There are several activities that go on in the state, notable among them is automobile workshops scattered all over the nooks and crannies of the state from which used engine oil and other solvents containing pollutants are deliberately or accidentally spilled on any available space by the artisans in the business of auto repairs. There is no regulation on sitting of the auto workshops; as a result, they are located at random or directly in front of residential or commercial areas.

2.1 Identification of Plant Species

Identification of plant species growing on the sampling sites was carried out. The survey method was carried out with slight modifications from reported procedures according to previous studies in other parts of the countries [21-23]. At each mechanic site, individual plants growing in the vicinity of the mechanic workshop were identified around 5 metre radius, enumerated and subsequently sorted based on family and species [22]. A control sample plot with no history of auto mechanic activities was established 100m away for sample collection. Other plants which could not be readily identified *in situ* were collected and taken to the taxonomy unit of the Laboratory Department of Biology, Federal University of technology, Owerri for proper identification. Frequency of occurrence was estimated as the rate (%) at which a plant species appeared in the sampling sites [22]. The percentages of family of plants were estimated based on the number of plants in the same family compared with the total number of plants families in the sampling area [24].

3. RESULTS AND DISCUSSION

Taxonomic identification of plant species at 27 randomly selected auto mechanic workshops resulted to a total number of one hundred and thirty seven (137) species belonging to fifteen (15) different families. Fifty five (55) of these plant species were identified in Orlu zone, thirty eight (38) was identified in Okigwe zone while forty four (44) were identified from Owerri zone with the non-operational areas having 25, 29 and 41 plant species respectively (Fig. 1).In terms of species percentage dominance, the *Asteraceae* dominated with 22%, followed by *Poaceae* (17%), *Gramineae* (12%), *Leguminoseae* (9%), *Sterculiaceae* (8%), and *Araceae* (7%). Others were less dominant with *Cyperaceae*, *Malvaceae*, *Anacardiaceae*, *Euphorbiaceae*, *Vitaceae*, *Annonaceae*, *Ongraceae*, *Bignoniaceae*, *and Fabaceae* having 4%, 3%, 5%, 3%, 2%, 4%, 1%, 2%, and 1% respectively. In all the sites visited, plant species of the *Asteraceae* family were the most dominant (Fig. 2).

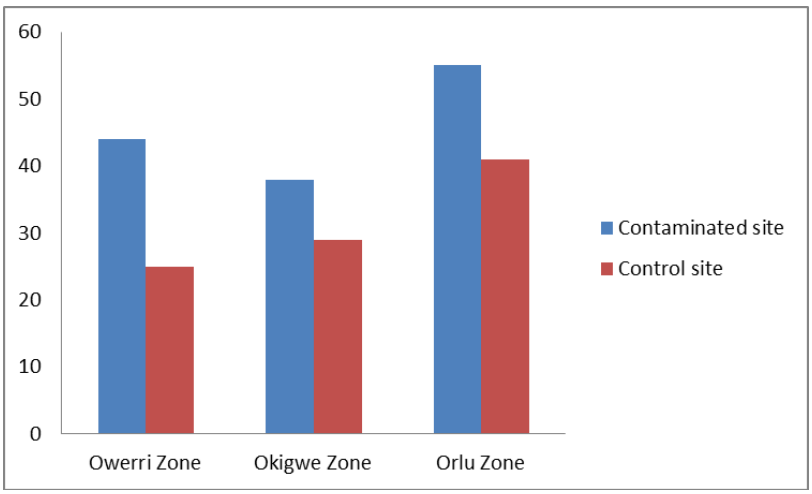

Fig. 1. Distribution of plant species based on zone. Each bar represents numerical values of species identified from nine (9) sampling sites per zone

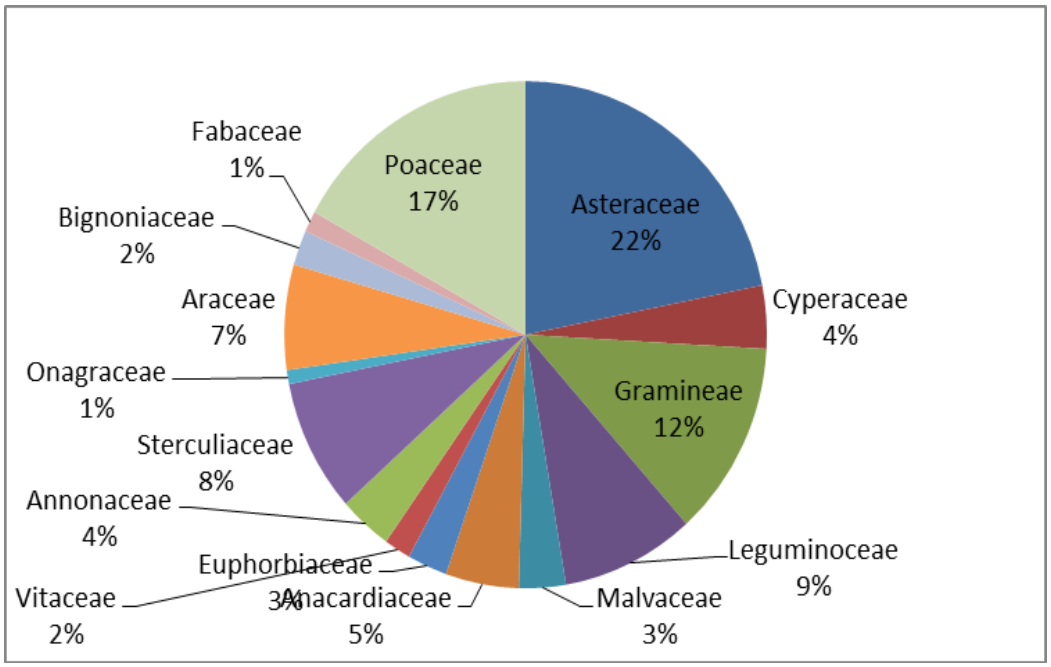

Fig. 2. Percentage dominance of the plant species across the sampled areas

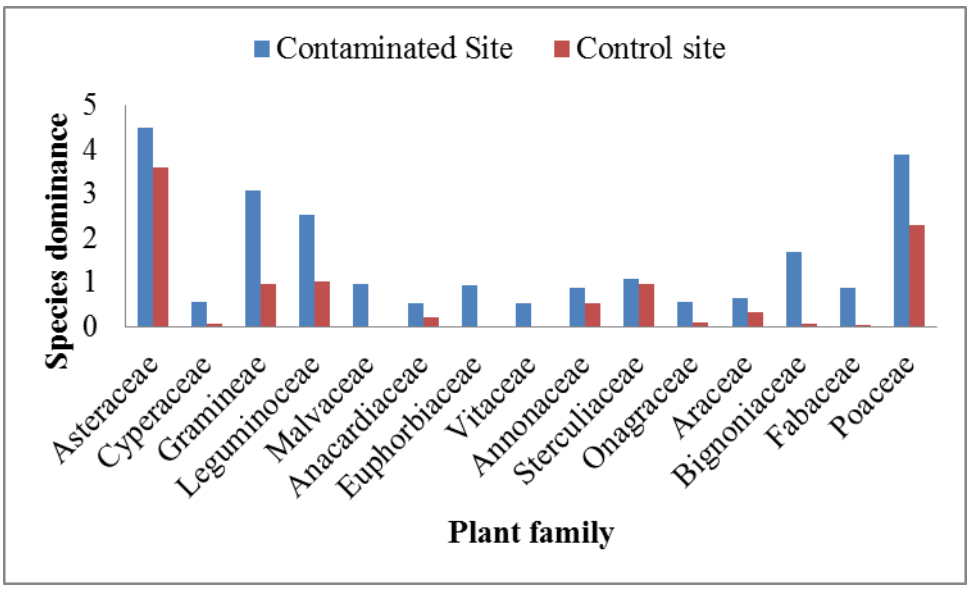

Fig. 3. Extent of plant dominance between plant families in both contaminated and control site. Each bar represents numerical values of species identified from nine (9) sampling sites per zone

The *Asteraceae* followed by the *Poaceae* represented the dominant plant families across the sampled sites (Fig. 3). The dominance of some plant species such as *Chromolaena odorata, Aspillia africana, Eleusin indica* etc observed in the sampled areas could be attributed to prevailing environmental factors in such areas. [22]had reported similar trend in auto mechanic workshops in Asaba and Benin. It is possible that the plants must have developed some degree of tolerance to metal toxicity in order to thrive in such environments [25]. Spent engine oil is known to contain organic and inorganic compounds including the highly toxic poly aromatic hydrocarbons (PAH) [26]. As such, plants growing on such contaminated soils are tolerant to the toxic nature of the polluted soils. Earlier studies carried out by [27] at petroleum contaminated sites suggested that *Chromolaena odorata, Aspillia africana* are high accumulators with biological accumulation concentration of 2.8+0.03 and 1.3+0.28 respectively. Meanwhile plants in the

vicinity of spent engine oil contaminated soils have been reported to bioaccumulate trace metal pollutants which consequently degrade the rate of phytodiversities [28-33]. It was noticed that the vegetation condition of both sampled and non-operational areas (control) rather than diverse composition, were clustered. Negri et al. [33-38] observed that most of the plant families identified in this study have been reported to accumulate heavy metals.

4. CONCLUSION

The present study sought to document plant species growing around selected auto mechanic workshops in Imo State for inclusion as potential phytoremediators. Several plant species belonging to different families were identified. The species from the *Asteraceae* followed by the *Poaceae* were the dominant species identified. Dominance of this plant species is indication that they are tolerant to spent engine oil contaminated soil. We recommend these dominant species be used in phytoremediation of spent engine oil contaminated soil.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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