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*Full Length Research Paper*

# Eco-taxonomic distribution of plant species around motor mechanic workshops in Asaba and Benin City, Nigeria: Identification of oil tolerant plant species

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**A survey of plant species and their families present in auto mechanic workshops in Benin City and Asaba was carried out. The frequency of occurrence of plants in the sites visited was used to determine prevalence. *Peperomia pellucida* occurred most in all the sites visited with a 55% frequency. The high rate of occurrence of a particular plant species in the frequency table, suggests that such plants are tolerant and may be introduced as a possible phytoremediating agent.**

**Key words:** Tolerant plants, mechanic workshops, *Peperomia pellucida*, waste engine oil.

## INTRODUCTION

The world wide demand for lubricating oils for industrial processes, passenger and heavy goods vehicles stands at about 38.5 million tons (Szramka, 1995). This gives an indication of high level production of spent oil from these sectors. Due to the epileptic nature of public power supply in Nigeria, the use of private electricity generating sets, in recent times, have increased the need for engine lubricants (Anoliefo et al., 2001). The disposal of this waste oil into gutters, open vacant plots and farms is a common practice mostly done by auto mechanics and allied artisans. Waste engine oil pollution is responsible for several environmental problems, risks to human health and plants, including decreased soil microbial activity and fertility (Mc Grath et al., 1995).

There are relatively large amounts of hydrocarbons in the spent engine oil including the highly toxic polycyclic aromatic hydrocarbon (PAH) (Wang et al., 2000). Spent engine oil in soil creates unsatisfactory conditions for plant growth ranging from heavy metal toxicity to insufficiency in aeration of the soil (Anoliefo and Vwioko, 1995). Edeberi and Nwanokwale (1981) observed that most heavy metals such as V, Pb, Al, Ni and Fe which were low in the unused engine oil gave higher concentrations in the spent engine oil. Heavy metals such as Cu and Zn are essential for normal plant growth, although elevated concentration of both essential and non-essential metals can result in growth inhibition and toxicity symptoms (Hall, 2002). However, Cunningham and Lee (1995) reported that plants and their roots can create a soil environment rich in microbial activity that can change the availability of organic contaminants or enhance the degradation of contaminants such as petroleum hydrocarbons. These plants include those that are found around mechanic workshops where the major soil pollutant is spent engine oil.

Identification of plants that is prevalent in such polluted sites needs to be done so that their capacity for tolerance and potential for phytoremediation of such polluted sites could be assessed. This study aims to documents the frequency of occurrence of plant species growing within some motor mechanic workshops at Asaba and Benin metropolis.

## MATERIALS AND METHODS

### Study areas

Twenty (20) different motor mechanic workshops were randomly selected for the present study, 10 at Asaba and 10 in Benin City, Nigeria. Those at Asaba were located at Okpanam Road, Gbenu Street, Anwai Road, West End Junction, Coker Junction, Onitsha-Benin Express Roads 1 and 2, Okpanam Road, Old Secretariat Road, Fumnanya Street, and Nnebisi Road. Sites selected in Benin

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City were located at Technical road junction, Upper Forestry road, Ikpoba slope, Lower Uwasota road (Uwelu), Oteghekpen street (Siluko road), Uwasota road, Benin–Lagos road (Ugbowo), Benin – Lagos (Adolor junction), Federal Government Girls College road and Ogba road. These selections reflect representative spread of the mechanic workshops in Asaba and Benin City.

**Collection and identification of plant samples**

Higher plant species were collected around 5 metre radius of each motor mechanic workshop. The different plant species at the various workshops were separately kept in labeled polythene bags and then taken to the laboratory where they were pressed and identified. Frequency of occurrence was determined as the rate (%) at which a plant species appeared in the experimental sites sampled.

## RESULTS AND DISCUSSION

A combination of all the plant species resulted to a total number of seventy (70) different plant species that were identified in the 20 randomly sampled mechanic workshops at Asaba and Benin City (Table 1). Thirty five (35) of these plant species were identified in Benin City while 55 were identified at Asaba. *Peperomia pellucida* occurred most in all the sites visited with a 55% frequency. The plant occurred in all the sites in Benin City, but were found in only one site at Asaba. *Fluerya aestuans* and *Eleusine indica* were moderately distributed in all the sites. The distribution of *Ageratum conyzoides* and *Tridax procubens* could also be described as moderate. Similarly, *Acanthospermum hispidum* was well distributed in sites at Asaba but was not found in Benin City (Table 1). Plant species that were least distributed in all the sites sampled include *Aneilemia aequinoctiale, Aspillia africana, Ananas comosus, Euphorbia hyssopifolia, Setaria pallide-fusca, Setaria longiseta, Spigelia anthelmia* and *Euphorbia heterophyllia* (Table 1). In all the sites visited, plant species of the family Poaceae were most prevalent (Figure 1). This was followed by the families Asteraceae > Euphobiaceae > Amaranthaceae = Caesalpiniaceae > Cyparaceae in that order. Plants of the family Bromeliaceae, Lamiaceae, Asystasiae, Ficeae and Musaceae were among the least prevalent plant.

The prevalence of some plant species such as *Peperomia pellucida* and *Acanthospermum hispidum* in one metropolis but not in the other (Table 1) can be attributed to environmental factors. The topography of the land, soil type, drainage characteristics, climatic factors and the level of oil present in the environment include the environmental factors that affect growth of plants (Imevbore and Adeyemi, 1981).

Spent engine oil in soil contains relatively large amounts of hydrocarbons, including the highly toxic polycyclic aromatic hydrocarbon (PAH) (Wang et al., 2000) and toxic heavy metals (Edeberi and Nwanokwale, 1981). Plants growing in metal-contaminated soil must have developed some degree of tolerance to metal toxicity in order to survive. Metal tolerance may result from two basic strategies: metal exclusion and metal detoxification (Baker, 1981). The excluders prevent metal uptake into roots avoiding translocation and accumulation in shoots (De Voss et al., 1991). These plants have a low potential for metal extraction, but they can be used to stabilize the soil, and avoid further contamination spread due to erosion (Dahmani-Muller et al., 2000). In contrast, hyperaccumulators absorb high levels of metals in cells.

*Peperomia pellucida* could be termed the most spent engine oil-tolerant plant species in Benin City because it was found in all the sites visited in this city. Similarly, *Acanthospermum hispidum* could be described as the most tolerant species in Asaba where it occurred in most of the sites. Among the moderately distributed plant species found in the experimental sites are those that have been shown in previous studies to survive in crude oil (Merkl et al., 2005) and heavy metal contaminated soils (Wong and Lau, 1985; Chukwuma, 1995,). Accordingly, *Eleusine indica* has been shown to survive in crude oil and Pb contaminated soils, and *Panicum* maximum in Ni, Zn, and Mn contaminated soil. These plants have developed heavy metal tolerant strategies (Dahmani-Muller et al., 2000) as well as a range of potential cellular mechanisms (Hall, 2002) which enable them detoxify heavy metals as well as PAH so as to survive and reproduce in highly contaminated soils.

The present study suggests that plants found on spent engine oil polluted sites are tolerant to heavy metal constituents of spent engine oil. This is because spent engine oil contains heavy metals such as V, Pb, Al, Ni, and Fe (Edeberi and Nwanokwale, 1981). Earlier studies (Adeniyi, 1996; Yusuf et al., 2003) reported that *Talinum triangulare, Vernonia amagdylina* and *Telferia occidenttalis* were tolerant to Cd, Cu and Ni in the soils on which they were grown. *Commelina communis* survived in Cd polluted soils by metal exclusion (Wei et al., 2005). *Euphorbia hirta* has also been considered a phytoremediant as it is able to take up considerable amount of Cu and Ni in its tissues (NedelKoska and Doran, 2000).

Some of the plants that were observed to be less prevalent in occurrence in the present study have been found in previous studies to exhibit tolerance to petroleum hydrocarbons and heavy metals. For example, *Amaranthus spinosus* was earlier reported by Chen et al. (1996) to accumulate Cu in its root tissues. Similarly, Odjegba and Sadiq (2002) also showed that *Amaranthus hybridus* is tolerant to soil pollution by spent engine oil. Salvador et al. (2004) reported that some elements like Fe, Cu, Zn, Sr, Pb, Cr, Co, Ni, Cd, and Ba were detected in some species of Amaranthaceae. Merkl et al. (2005) also reported that roots of *Cyperus aggregatus* were unaffected by petroleum hydrocarbons.

Almost all the plant families that are most prevalent in this present study have been reported to accumulate heavy metals. Prasad and Feitas (2003) stated that about

**Table 1.** Distribution of Plant Species in Mechanic Workshops Located in Asaba and Benin City. Values show the frequency of occurrence (%) of plant species in respective locations.

| s/n | Plant species | Family | Asaba (%) | Benin City (%) | Ave. (%) | s/n | Plant species | Family | Asaba (%) | Benin City (%) | Ave. (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *Amaranthus spinosus* | Amaranthaceae | 0 | 40 | 20 | 36 | *Euphorbia hyssopifolia* | Euphorbiacea | 20 | 10 | 15 |
| 2 | *Gomphrena celosiodes* | Amaranthaceae | 40 | 10 | 25 | 37 | *Euphorbia heterophyllia* | Euphorbiacea | 10 | 0 | 5 |
| 3 | *Aneilemia beniniens* | Amarantheceae | 0 | 10 | 5 | 38 | *Euphorbia hirta* | Euphorbiacea | 40 | 0 | 20 |
| 4 | *Aneilemia aequinoctiale* | Amarantheceae | 30 | 0 | 15 | 39 | *Mallotus oppositifolius* | Euphorbiacea | 0 | 10 | 5 |
| 5 | *Colocasia esculentum* | Araceae | 10 | 10 | 10 | 40 | *Mimosa pudica* | Fabaceae | 0 | 10 | 5 |
| 6 | *Acanthospermum hispidum* | Asteraceae | 70 | 0 | 35 | 41 | *Ficus exasperate* | Ficeae(Moraceae) | 0 | 10 | 5 |
| 7 | *Ageratum conyzoides* | Asteraceae | 20 | 60 | 40 | 42 | *Hyptis suaveolens* | Lamiaceae | 20 | 0 | 10 |
| 8 | *Aspillia africana* | Asteraceae | 30 | 0 | 15 | 43 | *Spigelia anthelmia* | Loganiceae | 10 | 0 | 5 |
| 9 | *Chromolaena odorata* | Asteraceae | 10 | 0 | 5 | 44 | *Malvastrum coromandelianum* | Malvaceae | 0 | 30 | 15 |
| 10 | *Melanthera scandens* | Asteraceae | 0 | 20 | 10 | 45 | *Sida rhombifolia* | Malvaceae | 20 | 0 | 10 |
| 11 | *Synedrella nodiflora* | Asteraceae | 20 | 0 | 10 | 46 | *Musa paradisiaca* | Musaceae | 10 | 10 | 10 |
| 12 | *Tridax procumbens* | Asteraceae | 60 | 20 | 40 | 47 | *Boerhavia coccinea* | Nyctaginacea | 10 | 0 | 5 |
| 13 | *Vernonia cinerea* | Asteraceae | 30 | 20 | 25 | 48 | *Peperomia pellucida* | Piperaceae | 10 | 100 | 55 |
| 14 | *Asystasia gomstretis* | Asystasieae | 20 | 0 | 10 | 49 | *Plastostoma africanum* | Piperaceae | 20 | 0 | 10 |
| 15 | *Newbouldia laevis* | Bignoniaceae | 10 | 0 | 5 | 50 | *Cenchrus biflorus* | Poaceae | 10 | 0 | 5 |
| 16 | *Ananas comosus* | Bromeliaceae | 20 | 10 | 15 | 51 | *Echinochloa colona* | Poaceae | 0 | 10 | 5 |
| 17 | *Cassia hirsuta* | Caesalpiniacea | 30 | 0 | 15 | 52 | *Eleusine indica* | Poaceae | 40 | 50 | 45 |
| 18 | *Cassia mimosoides* | Caesalpiniacea | 0 | 10 | 5 | 53 | *Eragrostis tenelia* | Poaceae | 40 | 20 | 30 |
| 19 | *Cassia obtusifolia* | Caesalpiniacea | 10 | 10 | 10 | 54 | *Panicum maximum* | Poaceae | 30 | 40 | 35 |
| 20 | *Cassia occidentalis* | Caesalpiniacea | 0 | 10 | 5 | 55 | *Panicum rapens* | Poaceae | 10 | 0 | 5 |

**Table 1.** Contd.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | *Carica papaya* | Caricaceae | 10 | 20 | 15 | 56 | *Phyllantus amarus* | Poaceae | 50 | 0 | 25 |
| 22 | *Cleomae rutidosperma* | Capparaceae | 0 | 10 | 5 | 57 | *Rottboellia cochinchinensis* | Poaceae | 10 | 0 | 5 |
| 23 | *Chloris pilosa* | Chlorideae | 30 | 0 | 15 | 58 | *Setaria barbata* | Poaceae | 10 | 40 | 25 |
| 24 | *Solenospermum monostrachyrus* | Celastrineae | 30 | 0 | 15 | 59 | *Setaria longiseta* | Poaceae | 10 | 0 | 5 |
| 25 | *Commelina diffusa* | Commelinacea | 10 | 0 | 5 | 60 | *Setaria pallide-fusca* | Poaceae | 10 | 0 | 5 |
| 26 | *C. benghalensis* | Commelinaceae | 30 | 30 | 30 | 61 | *Portulaca oleracea* | Portulaceae | 20 | 10 | 15 |
| 27 | *Commelina erecta* | Commelinaceae | 0 | 10 | 5 | 62 | *Talinum triangulare* | Portulaceae | 30 | 10 | 20 |
| 28 | *Ipomoea mauritiana* | Convulvulacea | 10 | 0 | 5 | 63 | *Mitracarpas villosus* | Rubiaceae | 10 | 0 | 5 |
| 29 | *Ipomoea tribola* | Convulvulacea | 30 | 20 | 25 | 64 | *Oldenlandia corymbosa* | Rubiaceae | 10 | 0 | 5 |
| 30 | *Bryophyllum pinatum* | Crassulaceae | 0 | 10 | 5 | 65 | *Physalis angulata* | Solanaceae | 10 | 10 | 10 |
| 31 | *Cyperus rotundus* | Cyperaceae | 10 | 0 | 5 | 66 | *Solanum nigrum* | Solanaceae | 0 | 10 | 5 |
| 32 | *Cyperus tuberosus* | Cyperaceae | 40 | 0 | 20 | 67 | *Spermacoce verticillata* | Spermacoceae | 30 | 0 | 15 |
| 33 | *Mariscus alternifolius* | Cyperaceae | 20 | 0 | 10 | 68 | *Fluerya aestuans* | Urtinaceae | 30 | 70 | 50 |
| 34 | *Mariscus flabelliformis* | Cyperaceae | 0 | 20 | 10 | 69 | *Fluerya ovalifolium* | Urtinaceae | 30 | 0 | 15 |
| 35 | *Alchornea laxiflora* | Euphorbiacea | 10 | 0 | 5 | 70 | *Vernonia ambigua* | Vernonieae | 10 | 0 | 5 |

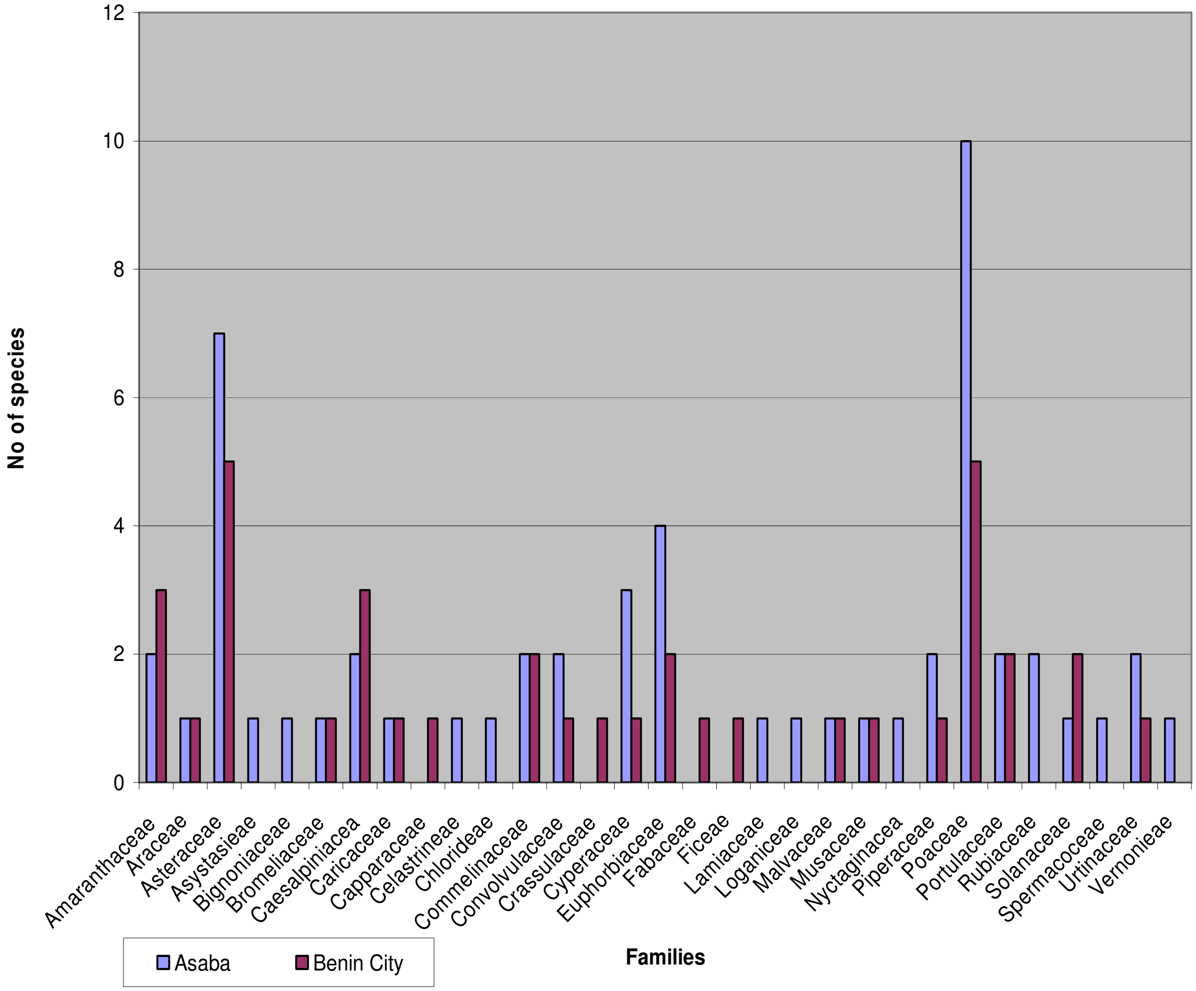


**Figure 1.** Number of plant species present by families in locations sampled.

400 plants that hyperaccumulate metals have been reported. They listed the families dominating these members to include Asteraceae, Brassicaceae, Caryophyllaceae, Cyperaceae, Cunouniaceae, Fabaceae, Flacourtiaceae, Lamiaceae, Poaceae, Violaceae, and Euphobiaceae. Plant families differed in their tolerance to spent engine oil based on the number of plant species present on the sites (Figure 1). The predominance of Poaceae over other families (Figure 1) in all the sites visited indicates that they are the most tolerant to spent engine oil and its heavy metal contents. Accordingly, Gibson and Pollard (1988) reported earlier that heavy metal tolerance was common in the family Poaceae. This phenomenon demonstrates that the family has the highest genetic potential to clean up spent engine oil-contaminated soil.

The present study thus identifies plant species and their families that were tolerant to spent engine oil polluted soils. This observation therefore presents a list of plants that are likely candidates for remediation strategies and management for spent engine oil contaminated soils.

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