Occurrence and Distribution of Plants within Selected Mechanic Workshops with Potential for Phytoremediation

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ABSTRACT

The present study documents the frequency of occurrence of lawn plant species growing within some motor mechanic workshops in Benin City metropolis, using Quadrant method of sampling and identification of plants. The results shows that the Species compilation of plants found within the Auto Mechanic Workshops were; *Axonopus compresus*, *Eleusine indica*, *Eragrotis tenella*, *Ageratum conyziodes*, *Cyperus esculentum*, *Commelina erecta*, *Cyperus rotundus*, *Matracarpus villosus*, *Eragrotis tenella*, *Cynodon dactylon*, *Perotis indica*, *Mariscus alternifolius*, *Oldenlandia corymbosa*, *Emilia coccinea*, and *Phyllanthus amarus*.

In Bright Engineering Auto Mechanic Workshop 1, the Poaceae family had the highest number of species (17) and 55% occurrence, while the Cyperaceae family had lowest number of species (4) with and 13 % occurrence. The total number of species found in this Mechanic Workshop was 31 comprising 3 families. In Eric and Son Mechanic Workshop, Cyperaceae family had the highest number of species (16) and 64% occurrence, while the Commelinaceae family had lowest number of species (6) with and 20% occurrence. The total number of species found in this Mechanic Workshop was 30 comprising 3 families. In Ekogiawe and Sons Auto Mechanic Workshop, Poaceae family had the highest number of species (19) and 45% occurrence, while the Phllanthaceae family had lowest number of species (2) with and 3% occurrence. The total number of species found in this Mechanic Workshop was 65 comprising 5 families. In Agbons Auto Mechanic Workshop, Poaceae family had the highest number of species (40) and 59% occurrence, while the Rubiaceae family had lowest number of species (4) and 7% occurrence. The total number of species found in this Mechanic Workshop was 68 comprising 4 families. This finding therefore presents a list of plants that are likely candidates for remediation strategies and management for spent engine oil contaminated soils.

(Keywords: auto mechanic workshops, naturally occurring plants, lawn, plant distribution, phytoremediation potential, heavy metal contamination, oil contamination control, biodiversity)

INTRODUCTION

Plant distribution is governed by a combination of historical factors, ecophysiology and biotic interactions. The set of species that can be present at a given site is limited by historical contingency. In order to show up, a species must either have evolved in an area or dispersed there (either naturally or through human agency) and must not have gone locally extinct (Adeniyi, 1996). The set of species present locally is further limited to those that possess the physiological adaptations to survive the environmental conditions that exist. This group is further shaped through interactions with other species.

Plant communities are broadly distributed into biomes based on the form of the dominant plant species. For example, grasslands are dominated by grasses, while forests are dominated by trees (Adeniyi, 1996). Biomes are determined by regional climates, mostly temperature and precipitation, and follow general latitudinal trends. Within biomes, there may be many ecological communities, which are impacted not only by climate and a variety of smaller-scale features, including soils, hydrology, and disturbance regime. Biomes also change with elevation, high elevations often resembling those found at higher latitudes.

These types of plants have always been important to humans. They have been grown as food for domesticated animals for up to 6,000 years (Anoliefo *et al*., 2006). They have been used for paper-making since 2400 BC or before. The most important food crops are the grains of grasses such as wheat, rice and barley. They have many other uses, such as feeding animals, and for lawns. There are many minor uses, and grasses are familiar to most human cultures. In some places, particularly in suburban areas, the maintenance of a grass lawn is a sign of a homeowner's responsibility to the overall appearance of their neighbourhood. Many municipalities and homeowners' associations have rules which require lawns to be maintained to certain specifications, sanctioning those who allow the grass to grow too long (Adeniyi, 1996). In communities with drought problems, watering of lawns may be restricted to certain times of day or days of the week.

Crude oil readily adheres to and spreads as a thin film on most plant surfaces. Penetration of oil from the surface into plant tissues may take place only as long as there is free oil on the surface. The rate and extent of penetration is affected by quality and thickness of cuticle, number of stomata, and also depends on oil type, particularly surface tension and viscosity of the oil (Anoliefo and Umweni, 2004). Plants with heavy cuticles and few stomata are resistant. Oil, after penetrating through stomata or cuticle appears to move within plant tissues through intercellular spaces rather than along vascular tissues.

Oil may further penetrate into individual cells after passing through cell walls and plasma membranes. According to Baker (1981), the outer walls of mesophyll cells are lipophyllic, which should facilitate oil penetration, but cell walls are normally considered saturated with water which should inhibit passage of oil. Chen *et al*. (1996) suggest that hydrocarbons dissolve in the plasma membrane and make it more permeable to a variety of substances by displacing membrane lipid constituents.

Oil pollution on land can result in direct adverse effects to contacted vegetation. It has been known for some time that oils have herbicidal properties. Any direct toxic effects on plants, notably herbaceous vascular plants, usually are quite distinct. Leaves may display partial injury such as chlorotic or necrotic lesions or become entirely necrotic and prematurely abscise (Anoliefo and Umweni, 2004). Some indirect effects on foliage also have been noted. Hutchinson and Hellebust (1974) observed that five weeks after a crude oil spill regrowth leaves (from previously dormant lateral buds that were stimulated to break dormancy by the oil- induced death of the apical bud) of several species native to Alaska, had very large surface areas (gigantism) relative to control leaves of the same species. They further reported that the leaves of *Ledium palustre* had thin cuticles and the tomentose red hairs on the leaf underside which are usually characteristic of this species were absent.

Plant roots also can be directly or indirectly affected by the presence of oil in soil. McCown and Deneke (1973) observed that roots of spruce seedlings growing in pots after the surface soil was treated with crude oil were brown and injured. They also reported that roots of dandelion seedlings were severely injured and death resulted after crude oil was applied to the pots in which they were growing. Root injury also can be related to intermediate compounds alkanoic acids, phenols and aromatic acids which can potentially form when oil is biodegraded by microorganisms in soil (Anoliefo and Vwioko, 1995).

Soil microorganisms also can deplete important soil nutrients such as nitrogen and thus inhibit root/plant growth. In addition, oil contaminated soil may become anearobic and reducing conditions can result in increased solubilities of iron (Fe) and manganese (Mn) to the extent that these potentially phytotoxic elements are absorbed by roots/plants (Anoliefo and Vwioko, 1995). High oil concentrations in soil not only reduce the amount of water and oxygen available for plant growth (Anoliefo *et al*., 2008) but also can interfere with soil-plant-water relations through direct physical contact (coating of root tissues) thereby adversely affecting plant growth.

Oil pollution on terrestrial environments can drastically affect a plant community. Sensitive species may become extinct and tolerant species dominate (Chen *et al*., 1996). Overall plant cover can be reduced and some areas may remain barren. In severe spills, a plant community can be drastically altered or eliminated and the affected area(s) may remain unproductive for several years if no attempt is made to reclaim the site (Gibson and Polard, 1988) studied the short term effects of a relatively low level of crude oil (11 l/m) on species numbers and productivity of a simple grass-herb community in Nigeria. He reported that the pollution had a drastic effect on the simple ecosystem and especially on the component herbaceous species.

In contrast rhizomatous perennial species were less severely affected (Hall, 2002). At least 50% of the species in the affected habitats became extinct following the oil application and the total loss in forage production for a period of six months at the polluted sites was as high as 74%. Other researchers also have observed drastic effects on plant communities following oil pollution (Gleba *et al*., 1999). Oil pollution also can contribute indirectly to other aspects of habitat deterioration such as sheet erosion. It is generally accepted that lack of vegetation cover, and disrupted soil structure and reduced moisture holding capacity of oil polluted soil all can contribute to erosion.

Imevbore and Adeyemi (1981), estimated the critical level at which oil begins to damage plants at about 1 kg per square meter. However, he felt that this was a conservative estimate and underscored the fact that the 'critical' level had not been well established. In this regard he conducted germination tests with oat seeds in loamy-sand contaminated with various amounts of a paraffin-rich crude oil. Based on this and other exploratory crop work, he concluded that about 3% by weight was the 'critical' oil content of the soil under which plants will continue to grow without showing severe symptoms of damage. This value was in good agreement with his earlier estimate.

The more recent work by McGrath *et al*. (1995) who examined germination of oat seeds in sandy Alberta soil to which a paraffinic crude oil had been applied at rates up to 8% (w/w) also supports this estimate. He observed that seed germination was unaffected by oil contents in soil up to and including 4% and that there was no germination at the higher rate (8%). In addition, Merkl *et al*. (2005), in greenhouse studies with oiled, fertilized, silt-loam, mineral soil removed from a field in Alaska four years after crude oil was applied at 10 and 20 l/m found that residual oil levels under 7.5% allowed germination of barley and brome seeds but reduced shoot heights, whereas residual oil contents of 13.5% in the soil completely inhibited seed germination.

The work by Nedelkoska *et al*. (2000) indicates that seeds can tolerate fairly high levels of oil pollution in soil. However, McGrath *et al*. (1995) only examined the effects of oil on germination and seedling development. Hence the oil concentrations they suggested as being uninhibitory to seed growth cannot be considered as safe levels for plant growth since adverse effects may have developed had the test plants been grown to maturity.

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 document the frequency of occurrence of lawn plant species growing within some motor mechanic workshops in Benin City metropolis.

MATERIALS AND METHODS

Study Areas

Four (4) different motor mechanic workshops were randomly selected, each in four different Local Government Areas (LGA) located within Benin City, Nigeria. From earlier reconnaissance, these workshops were reportedly the busiest within the LGA's. The first workshop was located at Ugbowo-Lagos Road, Isihor (Ovia North-East

LGA). The second was located along Murtala Mohammed Way (Ikpoba-Okha LGA). The third and fourth are both located at Agho Street, Off Ekehuan Road (Oredo LGA) and Mela Motel Road (Egor LGA), respectively.

Quadrant Sampling and Identification of Plants

Regions of significant oil pollution within each auto-workshop were identified. Within region, a midpoint was determined as the spot where spent engine oil was dumped; it was from this midpoint that radial dimensions were obtained. Using a 1 m^2 quadrant, plant species were sampled from within a 3 meter radius about the midpoint. The total number of plant species within the quadrant was counted. Lawn species and non-lawn species were identified and counted.

Computation of Weed Biodiversity Studies

Biodiversity of weeds was computed using the formulas below. Only weeds that were >3 cm high were counted.

Given that:

S= total number of species
N= total number of individuals
ni= number of individuals in the ith species

Species Richness Indices

Margalef'f index, $d = \frac{S-1}{Ln(N)}$

Menhinick's index, $D = \frac{S}{\sqrt{N}}$

Diversity Indices

Shannon's index, HI=-∑si=1pilnpi

Where $pi = \frac{ni}{N}$

This index gives the level for which a plant population consists of several species in cohabitation.

Evenness Indices

Evenness, $E = \frac{H}{Hmax} = \frac{H}{\log S}$

$EI = \frac{HI}{Ln\ S}$

The index varies between 0 and 1, where E=1 gives the situation when all species are equally abundant.

Simpson's Dominance Indices

Simpson's indiex, C= ∑si=1pi2

$D = \frac{\sum si=1 \quad ni(ni-1)}{N(N-1)}$

The index varies between 0 and 1, and gives the probability that two individuals drawn at random from a population belong to the same species.

For each species, % frequency of occurrence was calculated using;

% frequency of occurrence = (number of fields species was detected/total fields sampled) × 100.

Determination of Total Aliphatic Hydrocarbons (TAH)

Determination of TAH and PAH contents of soil were according to methods described by Dean and Xiong (2000).

Apparatus and Conditions for TAH

A GC-2010 (Shimadzu) gas chromatograph (GC) equipped with a split/splitless injector and a flame ionization detector (FID) from Agilent Technologies Inc. was used in this study. The separation was carried out on a OV-17 capillary column (30 m × 0.25 mm i.d., 0.25μm film thickness) from Agilent Technology. A volume of 3 μL sample was injected, in the injector at 300 ^oC, in the mode at a split ratio of 10. GC oven temperature was initially maintained at 500^oC for 3minutes, then programmed to 2000^oC at a rate 200^oC/min and maintained for 2 minutes, before it was finally raised with a rate of 50^oC/min to a final temperature of 2700^oC for 3 minutes.

Nitrogen (ultrapure) was obtained from PCI nitrogen generator (Model no.NAG-02) and used as carrier gas at a constant flow rate of 9.0 mL/min. The detector temperature was set at 3000ºC. Control valve from Prama Engineering Company (Mumbai) was used as switch and adjustment of air to FID. 5μL gas-tight syringe from SGE Analytical science, Australia were also used. Under these conditions, samples were eluted at 17.633 minutes with a run time of 30 minutes.

Extraction of HC from Sample

The mass of soil sample equivalent to 100 mg of sample were taken in a separating funnel and extracted with 2×25 ml of chloroform. The residue was dissolved in HPLC grade acetone and the solution was filtered through Whatmann filter paper No.1. Before injection both standard and sample solution was filtered through 0.45μm syringe filter. Then 3 μl of standard and sample solutions were injected into injector and chromatogram was recorded.

Statistical Analyses

Data obtained were analyzed in triplicates using SPSS-20 version at a confidence limit of 95%.

RESULTS AND DISCUSSION

The Table 1 provides a description of the auto mechanic workshops visited for the study. These workshops, as earlier mentioned, were selected based on the fact that as the time of this study, vehicular presence was most prevalent per LGA coupled with the fact that they seemed the mechanic workshops with more hard pans and oil-polluted soils; perhaps because of increased activity. These workshops were not established at the same time. Moreover, there were different periods by which the workshops were constantly weeded.

Total aliphatic hydrocarbon contents of soils obtained from the mechanic workshops was highest around Ikpoba-Okha LGA (6618.02 mg/kg) compared to Ovia (3917.22 mg/kg) (Table 2).

Significant differences in concentrations of the aliphatic fractions occurred with dodecane ($p = 0.024$), docasane ($p = 0.046$), hexacosane ($p = 0.033$) and tricosane ($p = 0.041$) respectively. Concentrations of dodecane were highest at Ikpoba-okha, but lowest in Ovia. However, tricosane, there was significantly higher concentration at Ovia North-East (255.13 mg/kg) than elsewhere.

Table 1: Names and Location of Mechanic Workshops Visited in the Study.

S/N	LGA cited	Name	Address	Age of workshop (years)	Periodicity of clearing weeds	Nature of auto repairs
1	Ovia North-East (MOV)	Bright Engineering Workshop	36, Benin/Lagos express way by total filling station, Oluku, Benin City	4	Monthly	PD
2	Oredo (MOR)	Eric and Sony Workshop	36 Aurosa Street off Igbesamwan road	15	once in 3 months	PE
3	Egor (MEG)	Ekogiawe and Sons Workshop	Agbontaen Street off Evbareke off textile mill road	10	Monthly	PE
4	Ikpoba-Okha (MIO)	Agbons Workshop	195 upper sakponba road after Jesus Christ junction	4	2 times a month	PD

PE repairs only petrol-engine vehicles, PD repairs only petrol-engine as well as diesel-engine vehicles, DE repairs only diesel-engine vehicles

Table 2: Total Petroleum Hydrocarbons of Pooled Soil Samples within the 3m Radius of the Midpoint in Each Mechanic Workshop Located within Selected Local Government Areas in Benin City.

	Selected Local Govt. Areas				p-value
	Ikpoba-Okha	**Oredo**	**Egor**	**Ovia NE**	
Nonane (C 9)	653.625	602.585	527.955	570.9075	0.153
Decane(C 10)	1099.5	829.255	726.55	1085.6638	0.056
Dodecane(C 12)	1948.94	1059.22	728.035	1803.539	0.024
Tetradecane(C 14)	681.205	628.01	550.23	594.9975	0.181
Hexadecane(C 16)	113.22	92.97	4.69	13.335	0.268
Octadecane(C 18)	528.835	487.535	327.155	461.9088	0.157
Nonadecane(C 19)	173.78	160.21	140.37	51.7888	0.206
Eicosane(C 20)	724.465	391.32	542.85	370.7475	0.094
Docasane(C 22)	218.975	201.875	76.875	191.2638	0.046
Tetracosane(C 24)	162.895	150.175	101.575	342.2813	0.058
hexacosane(C 26)	249.45	45.59	39.94	43.1925	0.033
Tricosane(C 30)	63.125	58.195	150.99	255.13625	0.041
TAH (mg/kg) (Summed)	6618.015	4706.94	3917.215	5784.762	NA
PAVH (mg/kg)	14.955	3.485	4.715	73.965	0.024

The biodiversity of weeds was identified. Each table presents the species of plants and their numbers within the quadrant, families of the plant species ranging from the Poaceae, Asteraceae, Cyperaceae, Rubiaceae, Commilnaceae, Phyllanthaceae

Table 3: Plants Found within Workshop Located at Ikpoba Okha Local Government Area, Benin City.

Plant species within quadrant	Family	Status	Number of species	Occurrence (%)
Axonopus compresus	Poaceae	LP	4	13
Eleusine indica	Poaceae	LP	5	16
Eragrotis tenella	Poaceae	LP	8	26
Ageratum conyziodes	Asteraceae	NLP	10	32
Cyperus esculentum	Cyperaceae	NLP	4	13
Total			31	100

LP = Lawn plant, NLP = Non lawn plant.

Table 3 shows the species compilation of plants found within Auto Mechanic Workshop at Ikpoba-Okha Local Government Area, Benin City, Poaceae plants were most prevalent with a total of 17 of the 31 plants within quadrant. The most prevalent grass species was *Eragrostis tenella* with a total of 8 followed by *Eleusine indica* (16.13%). *Axonopus compresus* was the least grass species (12.90%). The most prevalent plant species was *Ageratum conyzoides* (32.26%), followed by *Cyperus esculentum* (12.90%).

Table 4 shows the computation of plant species found within mechanic workshop at Oredo LGA. *Cyperus rotundus* was most prevalent in workshop two making a total of 12 of the total 30 plants within quadrant (Table 2), the second most prevalent is *Matracarpus villosus* (26.67%). The least prevalent plant species was *Cyperus esculentum* (13.33%), no grass plant species was found.

Table 4: Plant Species Found within Mechanic Workshop at Oredo Local Government Area.

Plant species within quadrant	Family	Status	Number of species	Occurrence (%)
Cyperus esculentum	Cyperaceae	NLP	4	14
Commelina erecta	Commelinaceae	NLP	6	20
Cyperus rotundus	Cyperaceae	NLP	12	40
Matracarpus villosus	Rubiaceae	NLP	8	26
Total			30	100

LP = Lawn plant, NLP = Non lawn plant.

Table 5: Plants Species found within Workshop Located at Ovia North East Local Government Area Benin City.

Plant species within quadrant	Family	Status	Number of species	Occurrence (%)
Eragrotis tenella	Poaceae	LP	8	12
Eleusine indica	Poaceae	LP	3	5
Cynodon dactylon	Poaceae	LP	6	9
Perotis indica	Poaceae	LP	12	19
Mariscus alternifolius	Cypereceae	NLP	12	19
Ageratum conyziodes	Asteraceae	NLP	10	15
Oldenlandia corymbosa	Rubiaceae	NLP	4	6
Emilia coccinea	Asteraceae	NLP	2	3
Phyllanthus amarus	Phllanthaceae	NLP	2	3
Cyperus esculentum	Cyperaceae	NLP	6	9
Total			65	100

LP = Lawn plant, NLP = Non lawn plant.

In Table 5 above, the most prevalent plants in workshop 3 were Poaceae plants making a total of 29 out of the total 65 plants within the quadrant. The most prevalent grass species was *Perotis indica* (18.46%) (Table 3), the second most prevalent grass species was *Eragrotis tenella* (12.31%). *Agerantum conyziodes* was the second most prevalent plant (15.38%). The least prevalent plant species are *Emilia coccinea*, *Phyllanthus amarus* both having an equal number of distribution (3.10%).

Table 6 shows species of plants found within auto mechanic workshop at Ovia NE LGA. It shows that poaceae plants were most prevalent with a total of 40 of 68 total plants within quadrant. The most prevalent grass species was *Eleusine indica* (52.94%), *Eragrotis tenella* was least prevalent grass species (4/68) which shares equal distribution with *Mitrcarpus villosus* (5.88%) making it the least prevalent plant species in Ekogiawe and Sons auto mechanic workshop.

The Table 7 shows species diversity of lawn plants sampled within the selected mechanic workshops. Species richness of lawn plant in workshop 3 was highest compared to those in the other workshops (0.74). The lowest species richness was obtained in workshop 1 (0.35), whereas no of lawn plants grew in workshop 2. Diversity (Shanon's index) was also highest in workshop 3 (9.69) and lowest in workshop 4 (0.51).

DISCUSSION

The research was carried out to know the floristic distribution of lawn plants within mechanic work in Benin City, due to Habitat alteration (including habitat loss, degradation and fragmentation) is now among the major risks of ecosystem degradation by human activities (Imevbore and Adeyemi, 1981).

Table 6: Plants Species Found within Mechanic Workshop at Egor Local Government Area Benin City.

Plant species within quadrant	Family	Status	Number of species	Frequency of occurrence (%)
Eleusine indica	Poaceae	LP	36	53
Eragrostis tenella	Poaceae	LP	4	6
Cyperus esculentum	Cyperaceae	NLP	16	24
Commenlina erecta	Commelliaceae	NLP	8	12
Mitrcarpus villosus	Rubiaceae	NLP	4	7
Total			68	100

LP = Lawn plant, NLP = Non lawn plant.

Table 7: Diversity and Dominance Indices for Lawn and Non-lawn Plants within the Four Mechanic Workshops.

Location		SR1	SR2	SHi	EVi	DMi	RECi
Ikpoba-Okha	LP	0.60	0.35	-0.91	0.27	0.12	17.79
	AP	1.66	0.90	-1.16	0.47	0.24	28.61
Oredo	LP	---	---	---	---	---	---
	AP	0.88	0.72	-0.97	0.70	0.29	19.04
Ovia NE	LP	0.01	0.74	-9.69	0.69	0.06	46.14
	AP	2.16	1.24	-13.16	0.66	0.13	152.56
Egor	LP	0.27	0.54	-0.51	0.73	0.28	18.84
	AP	0.35	0.61	-1.26	0.79	0.36	33.46

SR1, SR2 Species richness; SHi Shannon's index; EVi Evenness index; DMi Dominance index; RECi Reciprocal index. LP lawn plants; AP non-lawn plants

The heterogeneity of the study area vegetation is being attributed to a number of retrogressive processes such as the influence of the post-oil pollution incident, human activities (farming), post-remediation process, the regeneration and floristic succession of study site. This has resulted to changes in vegetation structure in terms of abundance and species diversity. This corroborates the assertion by (Piperno and Sues, 2005), who observed human activity as an important agent influencing plant species biodiversity.

Table 1, the Species compilation of plants found within Bight Engineering Auto Mechanic Workshop, were *Axonopus compresus*, *Eleusine indica*, *Eragrotis tenella*, *Ageratum conyziodes* and *Cyperus esculentum*. The Poaceae family had 17 different species with 55% occurrence and they were all lawn plants, the Asteraceae family had 10 different species with 32% occurrence and they were all non-lawn plants, while the Cyperaceae family had 4 different species with 13% occurrence and they were all non-lawn plants. From the observation it was noticed that Poaceae family had the highest number of species and percentage occurrence, while the Cyperaceae family had lowest number of species with and percentage occurrence. The total number of species found in this Mechanic Workshop was 31 comprising of 3 families.

Table 2, the Species compilation of plants found within Eric and Sony mechanic workshop, were *Cyperus esculentum*, *Commelina erecta*, *Cyperus rotundus* and *Matracarpus villosus*. The Cyperaceae family had 16 different species with 54% occurrence and they were all non-lawn plants, the Commelinaceae family had 6 different species with 20% occurrence and they were all non-lawn plants, while the Rubiaceae family had 8 different species with 26% occurrence and they were all non-lawn plants. From the observation it was noticed that Cyperaceae family had the highest number of species and percentage occurrence, while the Commelinaceae family had lowest number of species with and percentage occurrence.

The total number of species found in this Mechanic Workshop was 30 comprising of 3 families. The result was in agreement with the work of Anoliefo *et al*. (2006), who reported that a survey of plant species and their families present in auto mechanic workshops in Benin City and Asaba was carried out and 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.

Environmental pollution (particularly of hydrocarbon nature) however, do have direct losses to the plant themselves by way of displacement and indirectly by way of serious threat to the biodiversity despite some form of resistance and resilience by some flora. The existence of species in the community largely depends also on its regeneration under varied local environmental conditions (Prasad and Freitas, 2003). Upon such condition open canopy might favour the vegetation establishment through increased solar radiation incident on the grass floor. Consequently, this could also influence the growth stages in seedling, sapling and young shrubs, herbs and trees of plant communities that maintain the population structure of any grass land. This corroborates the assertion that open canopy may favour germination and seedling establishment through increased solar radiation on forest floor.

Table 3, the Species compilation of plants found within Ekogiawe and Sons auto mechanic workshop, were *Eragrotis tenella*, *Eleusine indica*, *Cynodon dactylon*, *Perotis indica*, *Mariscus alternifolius*, *Ageratum conyziodes*, *Oldenlandia corymbosa*, *Emilia coccinea*, *Phyllanthus amarus* and *Cyperus esculentum*. The Poaceae family had 19 different species with 45% occurrence and they were all lawn plants, the Cypereceae family had 18 different species with 28% occurrence and they were all non-lawn plants, the Asteraceae family had 12 different species with 18% occurrence and they were all non-lawn plants, the Rubiaceae family had 4 different species with 6% occurrence and they were all non-lawn plants, while the Phllanthaceae family had 2 different species with 3% occurrence and they were all non-lawn plants. From the observation it was noticed that Poaceae family had the highest number of species and percentage occurrence, while the Phllanthaceae family had lowest number of species with and percentage occurrence. The total number of species found in this Mechanic Workshop was 65 comprising of 5 families.

Table 4, the Species compilation of plants found within Agbons auto mechanic workshop, were *Eleusine indica*, *Eragrostis tenella*, *Cyperus esculentum*, *Commenlina erecta* and *Mitrcarpus villosus*. The Poaceae family had 40 different species with 59% occurrence and they were all lawn plants, the Cypereceae family had 16 different species with 24% occurrence and they were all non-lawn plants, the Commelliaceae family had 8 different species with 12% occurrence and they were all non-lawn plants, while the Rubiaceae family had 4 different species with 7% occurrence and they were all non-lawn plants.

From the observation it was noticed that Poaceae family had the highest number of species and percentage occurrence, while the Rubiaceae family had lowest number of species with and percentage occurrence. The total number of species found in this Mechanic Workshop was 68 comprising of 4 families. This was also in agreement with Anoliefo *et al*. (2008), who reported that plant species growing in and around 38 metal welding workshops in Benin City, Nigeria, were surveyed. *Eragrostis tenella* occurred most frequently in all the sites, followed by *Amaranthus spinosus*, *Eleusine indica*, while *Cucurbita pepo* occurred least. The family Poaceae, was identified in all the sites visited.

The frequency of occurrence of any particular plant species was used as an indicator of tolerance to heavy metals. Margalef index (R1) showed the richest locations in the study to be workshops at Ekenwan Road Quarters with a value of 2.87, followed by those at Ikpoba Hill (2.75). Shannon-Weiner's diversity index (H) which reveals the location with the most species diversity, showed that Ekenwan Road gave the most diverse with a value of 2.43, followed by Ikpoba- Hill (2.17). Wire Road was least diverse in plant species (1.33). Ugbowo quarters had the highest evenness index of 0.96, followed by Sapele Road (0.95), with Wire Road being the location with least evenness (0.82). Cadmium (Cd) and lead (Pb) occurred in soil samples obtained from the sites. Six of the ten locations (Ekenwan, Plymouth, Siluko, Sapele, Sakponba and Ikpoba Hill Road Quarters) had elevated cadmium in soil samples obtained outside the workshops, with the highest concentration of 1.2 mg/kg detected at Ikpoba. Lead concentration was highest at Ugbowo (53 mg/kg). Metal-tolerant plants obtained in the present study are suggested as possible phyto-remediating agents.

CONCLUSION

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 phytoremediation strategies and management for spent engine oil contaminated soils.

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