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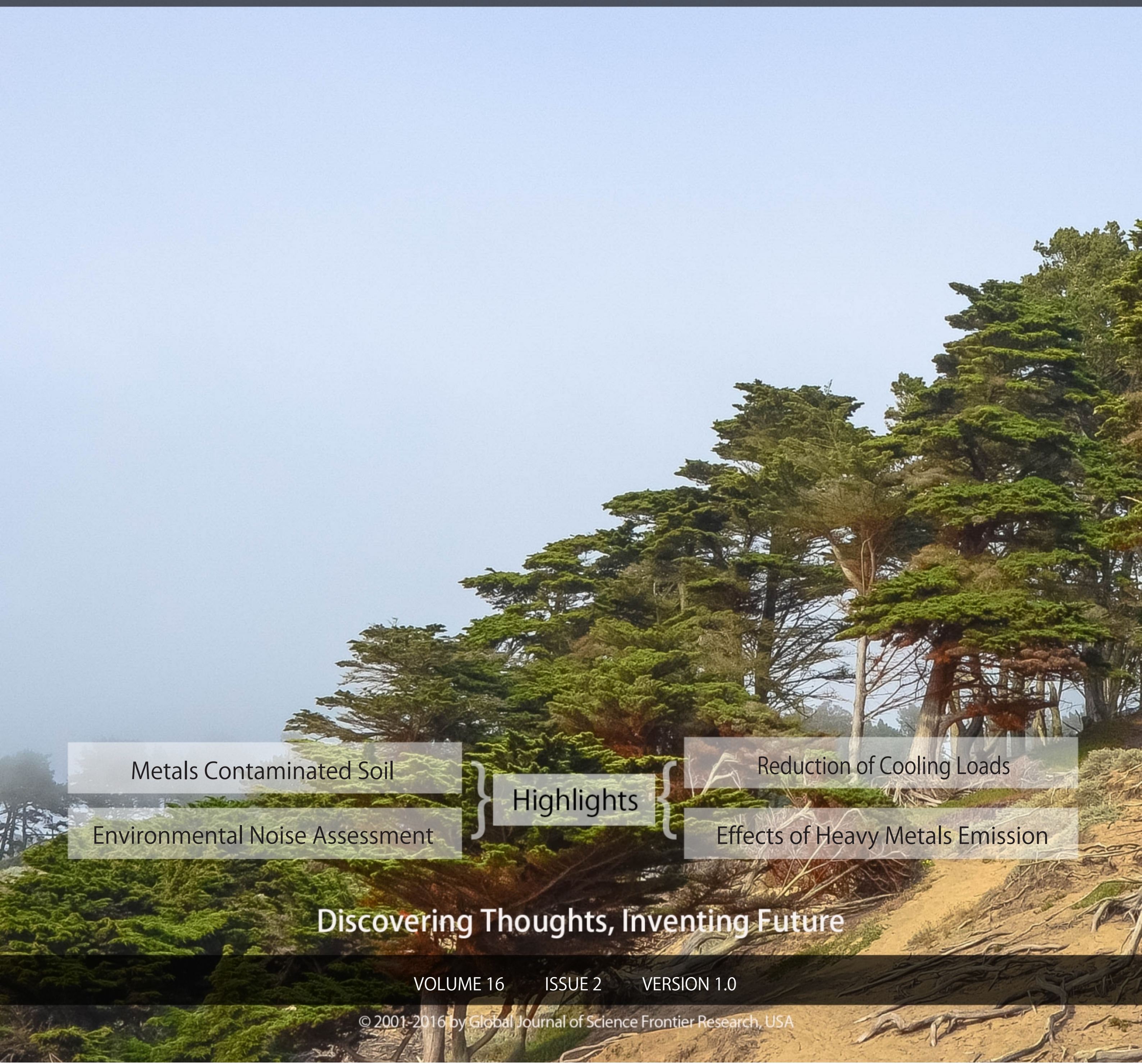

Metals Contaminated Soil

Environmental Noise Assessment

Highlights

Reduction of Cooling Loads

Effects of Heavy Metals Emission

Discovering Thoughts, Inventing Future

VOLUME 16 ISSUE 2 VERSION 1.0

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Effects of Heavy Metals Emission from Al_Dura Power Station on the Soil Surrounding

By Zaid A. Azeez, Ali A. Al-Sallihy & Khalid A. Rasheed
University of Al-Nahrain, Iraq

Abstract- Three selected sites with gradual distances from Al-Daura thermal power station (0.5 km (St. 1), 1Km (St. 2) and 2Km (St.3), were chosen for sampling according to the direction of downwind of site. In addition, one of unpolluted site was chosen for comparison as a control site in Baghdad around 4 Km upwind from Al-Daura thermal power station. The samples were taken for two seasons; the first season was in December 2014 and the second season was in March 2015. The concentrations of some pollutants that originated from Al-Daura thermal power station as air pollutants and heavy metals in the soil were measured. Whereas the results of heavy metals in soil refer to significant differences in the concentrations of Nickel (Ni), Cadmium (Cd), and Copper (Cu) in all three sites comparing with control site, they were higher in site 2 than other sites, while the Lead (Pb) concentration was higher in site 3. There was a significant increase in concentrations of Ni and Pb in the first season than in the second season, whereas no significant differences appeared in the concentrations of Cd and Cu between the two seasons.

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Effects of Heavy Metals Emission from Al_Dura Power Station on the Soil Surrounding

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Abstract- Three selected sites with gradual distances from Al-Daura thermal power station (0.5 km (St. 1), 1Km (St. 2) and 2Km (St.3), were chosen for sampling according to the direction of downwind of site. In addition, one of unpolluted site was chosen for comparison as a control site in Baghdad around 4 Km upwind from Al-Daura thermal power station. The samples were taken for two seasons; the first season was in December 2014 and the second season was in March 2015. The concentrations of some pollutants that originated from Al-Daura thermal power station as air pollutants and heavy metals in the soil were measured. Whereas the results of heavy metals in soil refer to significant differences in the concentrations of Nickel (Ni), Cadmium (Cd), and Copper (Cu) in all three sites comparing with control site, they were higher in site 2 than other sites, while the Lead (Pb) concentration was higher in site 3. There was a significant increase in concentrations of Ni and Pb in the first season than in the second season, whereas no significant differences appeared in the concentrations of Cd and Cu between the two seasons.

I. Introduction

Power generating stations are one of the mega projects, which require not only huge capital investment, but also various natural resources like, fossil fuels and water, thus create an everlasting and immeasurable impacts on the environment and generate tremendous stress in the local ecosystem (Pokale, 2012).

Thermal power stations are one of the main sources of the generation of electricity for any developing country and are the most popular power station present because of its high production and its dependence on fossil fuel or their derivatives as a major fuel. So, it is classified as a high pollution project (Kumar *et al.,*2013).

Various physico-chemical and biological factors control the mobility of metals in soils, one of them is a change in pH, results in a converting the element from one phase to another and thus, permit the estimation of mobility of heavy metals in the soil (Naim *et al*., 2004; Lu and Bai, 2010).

The link between the pH of the soil and heavy metal threshold values reflects the complex interaction between the heavy metals and the various soil properties. Increasing and decreasing pH of the soil influences the chemical reactions in the soil. At low pH, metals generally exist as free cations, at alkaline pH, however, tend to precipitate as insoluble hydroxides, oxides, carbonates, or phosphates (Karathanasis *et al.,* 2005; Gawlik and Bidoglio, 2006; Mamboya, 2007).

The aim of the present study was to determine the effect of the heavy metals exit from Al-Dura thermal power station on the soil surrounding.

II. Materials and Methods

a) Sampling sites

Three sites with gradual distances from Al-Daura thermal power station (0.5, 1 and 2 Km, respectively) were chosen for sampling. In addition, one of unpolluted site was chosen for comparison as a control around 4 Km upwind from Al-Daura thermal power station. All samples were collected for two seasons; the first season was in December 2014 and the second season was in March 2015 (fig. 1).

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Figure 1 : The study area of Al-Daura thermal power station with 4 sampling stations

b) Soils Sampling

Three replicates of soil samples were collected from 0 to 20 cm depth from the top surface of the soil for each site for each season for heavy metals analysis and pH value measurement. The samples were collected in labeled sacks and transported to the laboratory.

c) Soil Samples

The chemical analysis of soil samples has been done in the laboratory with air dried at room temperature for one week, then crushed, sieved using a stainless steel sieve (2 mm) to remove stones and to homogenized elements. Finally, put in oven at 105°C for 3 hours. The resulted powder was stored in plastic sucks until digestion (Lazar *et at*., 2008).

d) Measurement of soil pH

The pH value was measured for each soil sample according to Rayment and Lyons (2011)

e) Analysis of Heavy Metals in Soil

The concentrations of heavy metals (Ni, Pb, Cd and Cu) were determined using Atomic Absorption Spectrometer (AAS). For heavy metals analysis, the chemical digestion of soil samples was done according to Page *et al.*, (1982).

III. Results and Discussion

a) Soil Heavy Metals Measurements

The concentrations of heavy metals were measured in soil samples at 0-20 cm depth from the soil surface to estimation of soil pollution caused by Al-Daura thermal power station.

Nouri *et al.* (2009) reported that the contamination of heavy metals was mainly concentrated in the top 20 cm of soil. El-Ghawi *et al.* (2007) proved that the metals distribution on the top layer of soil is important in relation to the bioavailability for plants and the hazard of entrance of these metals into the food chain. This accumulation of heavy metals on top of soil is within the reason of the organic matter accumulation at this layer which acts as an absorbent factor for these metals.

The data obtained from this study; shown in tables 1-4 included the measurements of the concentrations of Ni, Cd, Cu and Pb.

b) Ni concentration in soil

The present study found that there was a significant increase in the concentrations of Ni in season 1 than season 2, also there were significant differences in the concentrations of Ni among all sites, where site 2 (was 177.79 ± 3.11µg/g) recorded the highest value among all sites. The higher interaction value with a significant difference was found in season 1 at site 2, whereas the lowest value was found in season 2 at the control site.

The concentrations of Ni in all three sites were higher than the worldwide mean abundance of Ni in the soil that was estimated at 20 µg/g (Kabata-Pendias, 2011).

Table 1 : Concentrations of Ni (g/g) in the soil for two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	21.81 ± 1.16	20.47 ± 1.23	21.14 ± 0.81 D
1 (0.5 Km distance)	171.20 ± 2.40	165.56 ± 3.25	168.38 ± 2.21 B
2 (1 Km distance)	181.82 ± 4.37	173.76 ± 3.63	177.79 ± 3.11 A
3 (2 Km distance)	50.23 ± 3.15	44.71 ± 3.31	47.47 ± 2.39 C
Mean ± SE	106.26 ± 21.4 A	101.13 ± 20.8 B	---
*LSD value: Site: 6.386 *, Season: 4.516 * , Interaction of Site × Season: 9.666 * (P>0.05), N.S: Not significant*			

c) Cd concentration in soil

The results in the table 2 show no significant difference has been recorded in the concentrations of Cd in the soil for the two seasons. While there were highly significant differences in the concentrations of Cd among all sites. The mean concentration of Cd in site 2 was 10.02 ± 0.37 μg/g which gave the higher value among all sites. The interaction value was higher with a significant difference in season 1 at site 2, while being the lowest in season 2 at the control site.

The Cd concentrations in all sites for two seasons were higher from the worldwide mean abundance of Cd that is 0.53 μg/g (Kabata-Pendias, 2011).

Table 2 : Concentrations of Cd (μg/g) in the Soil for Two Seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	0.850 ± 0.06	0.730 ± 0.04	0.79 ± 0.04 D
1 (0.5 Km distance)	6.97 ± 0.68	6.81 ± 0.56	6.89 ± 0.39 B
2 (1 Km distance)	10.15 ± 0.49	9.90 ± 0.65	10.02 ± 0.37 A
3 (2 Km distance)	3.84 ± 0.42	3.75 ± 0.43	3.79 ± 0.27 C
Mean ± SE	5.452 ± 1.06 A	5.297 ± 1.05 A	---
*LSD value: Site: 1.017 * , Season: N.S, Interaction of Site × Season: 1.555 * (P>0.05) N.S: Not significant*			

d) Cu concentration in soil

The results of this study show that there was no significant difference in the concentration of Cu in the soil between the two seasons (Table 3), and found that there were significant differences in the concentrations of Cu among all sites, where it was higher in site 2 (was 75.665 ± 2.56 μg/g) than the other sites. While the concentration of Cu in site 3 not differ significantly from the control site. The higher interaction value with a significant difference was found in season 1 at site 2, while the interaction value in season 2 of the control site recorded the lowest value.

The concentrations of Cu in site 3 and control site were within the worldwide mean abundance of Cu (38.9 μg/g), while the mean of the concentrations in sites 1 and 2 were higher from the worldwide mean (Kabata-Pendias, 2011).

Table 3 : Concentrations of Cu (μg/g) in the soil for two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	22.10 ± 1.23	20.93 ± 1.06	21.515 ± 1.19 D
1 (0.5 Km distance)	70.28 ± 1.34	68.10 ± 2.40	69.19 ± 1.60 B
2 (1 Km distance)	77.96 ± 2.41	73.37 ± 2.16	75.665 ± 2.56 A
3 (2 Km distance)	31.31 ± 3.15	28.47 ± 1.15	29.89 ± 1.89 C
Mean ± SE	50.417 ± 2.32 A	47.717 ± 0.69 A	---
*LSD value: Site: 4.24 * , Season: N.S , Interaction of Site × Season: 6.37 * (P>0.05) N.S: Not significant*			

The results in tables 1,2 and 3 showed that the concentrations of Ni, Cd, and Cu in the soil were higher in site 1 and 2, while they were lower in the control site and site 3. The high accumulation of these heavy metals in the soil on site 1 and 2 compared with that in the control site and the global values refers to the pollution of soil near Al-Daura thermal power station that resulted from the combustion of fossil fuel.

Akoteyon, (2012) stated that the release of heavy metals into the environment is not limited to areas adjacent to the point sources, such as the industrial facilities.

e) Pb concentration in soil

There was a significant difference between the two seasons in the mean concentrations of Pb in the soil (Table 4). The concentration of Pb in season 1 was higher than season 2. Also, the results in the same table show that there were significant differences in the concentrations of Pb in all the three sites when compared with the control site. The concentration mean of Pb insite 3 appeared on a higher level compared with all other sites.

The mean concentration in Season 1 showed the higher interaction value in site 3 that was 44.84 ± 2.45 μg/g, while season 2 showed the lowest interaction value in the control site that was 27.78 ± 1.06 μg/g. The overall mean value of Pb for different soils is estimated at 27 μg/g (Kabata-Pendias, 2011).

Table 4 : Concentrations of Pb (μg/g) in the soil for two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	29.47 ± 0.55	27.78 ± 1.06	28.625 ± 0.65 C
1 (0.5 Km distance)	36.35 ± 1.18	32.54 ± 1.39	34.445 ± 1.18 B
2 (1 Km distance)	37.68 ± 1.47	33.71 ± 1.49	35.695 ± 1.29 B
3 (2 Km distance)	44.84 ± 2.45	41.95 ± 1.77	43.395 ± 1.49 A
Mean ± SE	37.085 ± 1.65 A	33.995 ± 1.69 B	---
*LSD value: Site: 3.21 * , Season: 2.27 *, Interaction of Site × Season: 4.76 * (P>0.05), N.S: Not significant*			

The first suspected cause for this elevated value of Pb concentrations in site 3 returned to the emissions from Al-Daura thermal power station, the vehicle exhausts in heavy traffic of Al-Daura main street that was nearest to site 3 add another source of Pb concentrations.

Al-Ameri (2011) stated that when Pb is an air pollutant, the larger size particles will be down to the ground and polluted soils or surface waters and the smaller particles will go long distances through air and remain in the atmosphere. Part of these Pb particles will fall back on earth when it is raining.

The distributions of Ni, Cd, Cu and Pb in soil for all three sites and control site are shown in figure 2.

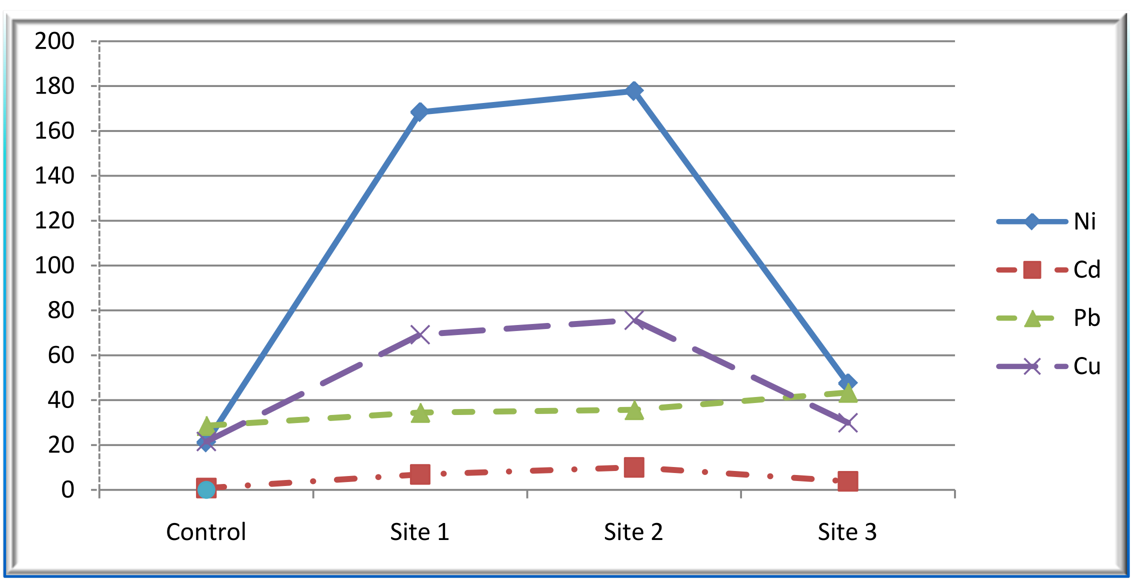

Figure 2 : Distributions of Ni, Cd, Cu and Pb in soil for all three sites and control site

The results of report of the Iraqi Ministry of Environment about heavy metals` pollution in soil, around Al-Daura thermal power station in 2013, showed a high concentration of heavy metals, especially Ni that reached to 110 μg/g (Sahieb *et al.*, 2013).

Habib *et al.,* (2012) measured the concentrations of some heavy metals in soil for many regions of Baghdad and found that the average concentrations of Ni and Pb in the soil of Al-Daura suburbs were 105,and 37 (μg/g), respectively; which agreed with the results in this study.

Also, there was a significant difference in the concentrations of Ni and Pb in season 1 than season 2, whereas no significant differences in the concentrations of Cd and Cu between the two seasons and less in season 2.

Metals from the upper layer of soil were flushed out to some range and hence all the index values were lower in the season 2 compared to season 1 (Rahman, 2012).

Results of Yahaya *et al.* (2009) and Najib (2012) support the results of this study. They found that the average concentration of metals during the dry season (in this study, closer to season 1) in the surface layer of the soil is higher than that in the wet season (in this study, closer to season 2). They explained that the seasonal rainfall may facilitate the reduction of soil solution during the wet season and seasonal variations in patterns of metal deposition. Thus, the precipitation may limit the concentration in soil during the wet season.

The result in the present study differs somewhat from the findings of Onweremadu *et al*. (2007) and Jian *et al.* (2014) who showed that the content of heavy metals in soil in the dry season was comparatively low compared to the wet season.

f) The pH soil measurement

There are many factors affecting the disruption of heavy metals in soil such as pH. The results of pH values for the soil of the study sites are listed in tables 5.

Table 5 : The pH Value (Mean ± SE) of soil in the study sites for the two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	7.55 ± 0.014	7.60 ± 0.17	7.575 ± 0.11 A
1 (0.5 Km distance)	6.75 ± 0.12	6.50 ± 0.08	6.625 ± 0.13 B
2 (1 Km distance)	7.22 ± 0.16	7.33 ± 0.16	7.275 ± 0.11 A
3 (2 Km distance)	7.50 ± 0.16	7.42 ± 0.11	7.46 ± 0.25 A
Mean ± SE	7.255 ± 0.10 A	7.212 ± 0.15 A	---
*LSD value: Site: 0.503 *, Season: N.S , Interaction of Site × Season: 0.741 ** *(P>0.05) N.S: Not significant*			

The results presented in table 5 show that there was no significant difference in the values of soil pH between the two seasons. Also, no significant difference for interaction (seasons * sites) in the soil pH.

In general, all the pH values of soil in the all three sites were near to neutral, Results indicated that Soil pH for sites 2 and 3 not differ significantly from control site which gives 7.275, 7.46 and 7.575, respectively. Whilst site 1 was more acidic 6.625 and differ significantly from all other sites. The cause of the lower pH values of soil, particularly in site 1 due to the acidic rain resulted from the reaction between air sulfur dioxide and oxides of nitrogen with water vapor component originated from thermal power station as mentioned by USEPA (2001).

The results of the neutral pH values of soil in this study agreed with the illustration of Kabata-Pendias (2011), who reported that the neutral values of pH play an important role to keep the accumulation of heavy metals at the top layers of soil, because at the neutral values of pH some heavy metals such as Ni and Pb have a strong relation with the soil solids, and hence its movement towards the deeper layers will be limited.

Sulaiman *et al*. (2014) studied the effect of some characteristics of soil around Kashe power station in Duhok-Iraq and found that the acid rain precipitation that was originated from Kashe power station has an effect on decreasing the pH value of soil samples. They explained that the decrease of pH value was due to the high concentration of SO_2 that dissolved in raindrops to form sulfuric acid (H_2SO_4).

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Towards the Reduction of Cooling Loads in Ghanaian Glazed Office Buildings: Orientation as a Recommendation by the Ghana Green Building Council (GHGBC)

By Christian Koranteng, David Nyame-Tawiah & Jimmy Nkrumah
Kwame Nkrumah University of Science and Technology, Ghana

Abstract- Designing to make use of the climatic conditions of the site has always been a challenge; especially when buildings are to be naturally ventilated. The current study examines how effective orientation is as a parameter for the reduction of cooling loads in multi-storey office buildings. The approach is experimental in nature where a case-study building was selected and a parametric simulation with T as the software was applied. The results indicated among others that whiles the annual cooling load for the actual orientation is 288.43kWh.m^2.a^1; there is an 11.81kWh.m^2.a^1 reduction when the orientation is 270° away from the actual of 0°. Again, in terms of cooling loads per unit floor areas, the 270° angle performed better. This indicates that if attention is paid to orientation and aspect ratio as parameters during the design of a structure, it would go a long way in ensuring that the design behaves sustainably. It is recommended that the orientation along the north and south axis should be adhered to as it aids in the free flow of natural ventilation through the indoor spaces.

Keywords: *cooling loads, glazing, office buildings, GHGBC, orientation.*

GJSFR-H Classification : *FOR Code: 050299*

TOWARDSTHEREDUCTIONOFCOOLINGLOADSINGHANAIANGLAZEDOFFICEBUILDINGSORIENTATIONASARECOMMENDATIONBYTHEGHANAGREENBUILDINGCOUNCILGHGBC

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Towards the Reduction of Cooling Loads in Ghanaian Glazed Office Buildings: Orientation as a Recommendation by the Ghana Green Building Council (GHGBC)

Christian Koranteng [α], David Nyame-Tawiah [σ] & Jimmy Nkrumah [ρ]

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Keywords: cooling loads, glazing, office buildings, GHGBC, orientation.

I. Introduction

Present-day architecture and the advancement of technology have led to the recent influx of heavily glazed commercial buildings all over the world of which Ghana is no exception. Although this development has become the trend for the 21st century design, given the warm-humid climatic condition of Ghana, the energy needs to mitigate the negative effects of this turn of event has become burdensome. In the wake of the worsening energy crisis burdening Ghana at the moment, the challenges that these glazed buildings poses cannot be met in terms of the provision of thermal comfort whiles reducing cooling loads.

Generally, buildings in the Tropics with extensive glazed windows also consume high levels of energy. A building in the Tropics means a confrontation of construction and function with extreme climatic conditions (Lauber, 2005; Givoni, 1997). Discomfort is found most of the time due to the high temperatures and relative humidity levels (Tenorio, 2007). A building's envelope/facade is one component that when thoughtfully designed, can reduce energy use in the building or otherwise. Arasteh et al. (2006) indicated that in recent years, the classical fenestration system concept is changing with the development of high technology buildings with curtain wall systems. With the advent of glass technology, current trends of office buildings involve large glazed facades without any sustainable design principles such as shading, orientation etc.

According to Pino et al. (2012), the size of glazed area on a building highly influences the energy demand. A totally glazed façade building might reach up to 155kWh/m^2 a year on total cooling and heating demands. On the contrary, in a building with a window to wall ratio (WWR) of 20%, with external solar shading and selective glazing, demand might be as low as 25kWh/m^2 a year. Bulow-Hube (2001) also reported that many modern buildings have taken advantage of glass transparency in their design to create a clear view to the outside. When using a high window-to-wall ratio (WWR; ratio of the glazed area with respect to the total area of the exposed envelope), occupants commonly might feel thermal and/or visual discomfort and they will apply their own strategies to mitigate this problem. Tzempelikos and Athienitis (2007), in their study recommended a solution to the above-stated problem. The authors commented that the use of modern glazing, with low solar transmittance and U values, can mitigate this problem but it does not necessarily solve it.

The green star office v1 rating tool is currently being evaluated to be adapted by the Ghana Green Building Council. It is based on the Green Building Council of South Africa's office v1 rating tool (Alfris, n.d.). Significantly, the tool is to influence the design of office facilities by minimizing the impact of buildings on the environment, (Green Star SA office v1 rating tool fact sheet). The rating tool consists of eight categories and an innovative grouping. Four aspect of the rating tool which is directly related to the building and the

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environment are: Indoor air quality, energy, emissions, and materials. Again aspect of the general modelling parameters for the Green Building Council of South Africa (GBCSA) include: Weather data, and building envelope (geometry, fabric, orientation, building form, insulation, and glazing etc.) (Green star SA -v1, 2010).

Orientation has been thought of as one of the major contributing factors of thermal comfort within indoor spaces. Szokolay (2004) specified that east and west facades should not have windows as these facades are known to contribute greatly to heat gains within buildings. The current study assesses orientation as a factor for reducing cooling loads in glazed office buildings in Ghana. The aim is to find out how effective is orientation as a factor to be considered for cooling load reductions.

II. Literature Review

Literature covering this study would include orientation, thermal comfort and tropical architecture. These subject areas will help readers become conversant with the main theme.

a) *Orientation*

The orientation of a building eventually determines how much energy it would use to provide thermal comfort for its occupants'. Seok-Hyun et al. (2013) affirms that the amount of sunshine is affected by the orientation of a building. During summer, the amount of sunshine at the East and West is small but the west requires a larger cooling load in the afternoon because of the afternoon sunshine. The South has a larger amount of sunshine but the solar radiation can be blocked easily by shading. Salmon (1999), establishes the fact that "buildings should be able to respond to changes in climate by the rejection of solar heat and have the thermal integrity to maintain internal comfort, despite the influence of climatic forces acting on the building envelope. Salmon (1999) however establishes that, analyses of sun paths and wind directions have shown that elongated buildings should be oriented to the South. In addition, the best orientation for wind is the Southwest whilst a compromise of 22.5° (south-southwest) should give the best orientation.

Contrary to Salmon's view, Lauber's (2005) recommendation was that the best orientation for buildings in the Warm and Humid countries should be +/- 30° from the prevailing wind direction. The author further states that the shell of air-conditioned buildings must be insulated, windproof and made airtight. This suggests an orientation away from the prevailing wind direction, but there is no precise direction for air-conditioned buildings from Lauber.

Szokolay (2004) also has a different proposal from the above mentioned authors. Szokolay suggested that in order to ensure maximum cross ventilation in a building, the major openings should face within 45° of the prevailing winds. All the above suggestions from these authors are for free- running (naturally ventilated) buildings since in mechanically ventilated buildings, the outdoor conditions do not fully have any effect on the indoor. Hawkes (1996) posited that designers should orient spaces to the direction of the prevailing winds. Aspect ratio which is the ratio of the longer dimension of an oblong plan to the shorter (Szokolay, 2004), is seen to have a relationship with the orientation of a building. Szokolay further explains that depending on the temperature and radiation conditions, North and South walls should be longer than the East and West with an aspect ratio of about 1.3 to 2.0 (op cit).

b) *Thermal Comfort*

Thermal Comfort has a number of definitions from various researchers. ASHRAE (2004) defines thermal comfort as the state of the mind which expresses satisfaction with the surrounding environment. Likewise Pino et al, (2012) also in their study on thermal and lighting behaviour of office buildings in Santiago of Chile, defines thermal comfort as the physical and psychological wellness of an individual when temperature, humidity, and air movement conditions are favourable for the activity that has to be developed.

Thermal comfort is dependent on more than the net balance of heat energy, just as visual comfort is dependent on more than an adequate quantity of light. The sensation of comfort is based on ambient air temperature, on relative humidity, on air motion such as drafts caused by infiltration or convection, and on the temperature and emittance of the surfaces of the space (Wasley and Utzinger, 1996). All of the above definitions are synonymous since they all include the environmental factors (air temperature, air velocity, air humidity and radiation) and the behavioural or personal factors (activity and clothing).

Van Treeck (2011) again in his book, 'Indoor thermal quality performance prediction' assert that the thermal comfort perception for all people all over the world living in different climates and in cultural diversities appears to be statistically uniform if similar environmental and personal parameters are taken into accounts (ASHRAE 2004; De Dear and Brager, 2002; Fanger 1970).

The glass surface temperature impacts the thermal comfort of the occupant who stays near the window; in summer period, the glass surface temperature is higher than the other surface areas and vice versa for temperate climate (Hamza, 2008). According to ASHRAE (2004) there is no difference between inside thermal conditions for comfort during summer and winter periods. However, the preference of an inhabitant for thermal comfort may change during the day. The body has a lower temperature rhythm in the early morning hours and a higher one in the late afternoon. There are also specific thermal comfort standards in air-conditioned buildings.

In most thermal comfort studies, temperature have been indicated as the most important parameter since it is temperature that actually determines how occupants feel within spaces. Air temperature is often taken as the main design parameter for thermal comfort. Hence it is essential for occupants' well-being, productivity and efficiency (Adebamowo and Akande, 2010). Heidari and Sharples (2002) have suggested that air temperature alone is a good indicator Beizaee et al. (2012) in their study in UK during the summer found a mean temperature value of 23.9°C in office buildings with a range of 21.6°C to 26°C. Additionally, there was an average PMV value of -0.25 with a range of -1.6 to 0.5 (between cool to neutral).

From a study in Iran by Heidari and Sharples (2002) comparatively analyzing long and short term thermal comfort surveys, the authors reported that during the two short-term studies, the indoor air temperatures ranged from as low as15.4 °C to as high as 32.7 °C with an average of around 30 °C in the hot season and around 20°C in the cool season.

For the long-term study, the mean indoor temperatures during each month of the survey, ranged from approximately 20°C during January to 29 °C during August. The results indicate that in Iran, there are two main seasons, with the cool season around January to March and the hot season occurring from June to August. Ghana's climatic condition is contrary to that of Iran. There are two major seasons in the country: the rainy/cool season (around June to late September) and the dry/hot season (November to late April).

In Ghana, the hottest month of the year is March/April just before the rainy season whiles August is the coolest. In the southern part of the country, the highest mean monthly temperature of about 30°C occurring between March and April and the lowest is 26°C in August (Amos-Abanyie, 2009). Furthermore, comfort temperature as seen from above tends to be higher in tropical Regions (Li et al., 2010).

c) *Building Envelope and Tropical Architecture*

The envelope of any building is the exterior fabric that protects the building's interior from the harsh conditions of the outdoor climate. In other words, the envelope of a building acts as a shell in the transfer of heat from the external (exterior) to the internal (interior) and vice versa. A building's envelope therefore is constituted by the glazing or window area, the door, and the outer wall areas. According to Levine et al. (n.d), the effectiveness of the thermal envelope depends on

- the insulation levels in the walls, ceiling and ground or basement floor, including factors such as moisture condensation and thermal bridges that affect insulation performance;
- the thermal properties of windows and doors; and
- the rate of exchange of inside and outside air, which in turn depends on the air-tightness of the envelope and driving forces such as wind, inside-outside temperature differences and air pressure differences due to mechanical ventilation systems or warm/cool air distribution.

On air- tightness of an envelope, Seok-Hyun et al. (2013) point out that air tightness is important to the performance of windows because this blocks the air flow causing a difference in the indoor and outdoor temperature of buildings. In particular, the windows and outer wall must be of an integrated construction. If it is not an integrated construction, air flow can occur as a result of the different pressures, which can cause heat loss. In modern day construction, it is unfortunate that building envelope designs are developed to meet the client's requirements without much concern to the local climate and with no objective to conserve energy (Al-Tamimi and Syed-Fadzil, 2011). An analysis of the building energy consumption in Hong Kong, Singapore and Saudi Arabia for example gives a result that, the building envelope design, accounts for 36%, 25% and 43% of the peak cooling load respectively (Seok-Hyun et al., 2013; Al-Najem. 2010).

In the tropical region, climatic factor notably affects the microclimate and indoor thermal comfort in a building. Challenges in sustainable buildings are to reduce the input of resources such as energy, materials and water and waste production (Jamaludin et al., 2014). Low or still air movement with high temperature and relative humidity can cause thermal discomfort.

Glazing façade openings makes sense only when rooms are completely air-conditioned. According to research, east and west-facing walls and windows are the most important to shade, as solar heating is most intense on these orientations (Ossen et al., 2008). Solar shade and size are therefore the two factors used in determining openings in the tropics (op cit). The window to wall ratio and shading of windows has also been probed by researchers (Pino et al., 2012) as effective in achieving high energy performance of windows in the tropics. This is corroborated by Binarti, (2009). Buildings in warm and humid climate should be open and filter the climate in a multitude of ways that requires optimization of the relationship between the site, climate and briefing requirements (Jamaludin et al., 2014).

III. Methodology

The Tas simulation software was used as a tool for assessing the different orientations specified in the Green star SA -v1 handbook. It specifies four orientations thus; the actual (orientation of the building), actual + 90°, actual + 180° and actual + 270°. A single case multi-storey office building located in Accra was selected for the simulation exploration, thus the XGL

Tower. It's a 13 storey fully glazed structure with a basement for parking and storage. The selection was based on the following rational:

- It's 100% glazed façade, all of which is exposed to the outdoor climate with no external shading;
- Representative of current design trends in Ghanaian high-tech office buildings; and
- Located within a fast growing commercial suburb within the capital city of Ghana.

The situation of the XGL building in Accra, Ghana with an external view is shown in Figure 1.

In the T as (EDSL,2008) simulation programme, the 3d modeller was used to model the building by first drawing out the building plan with the information gathered on the building elements and spaces as well as the original drawn out designs of the building (Fig. 2).

Fig.1 : Location and external view of case study building.

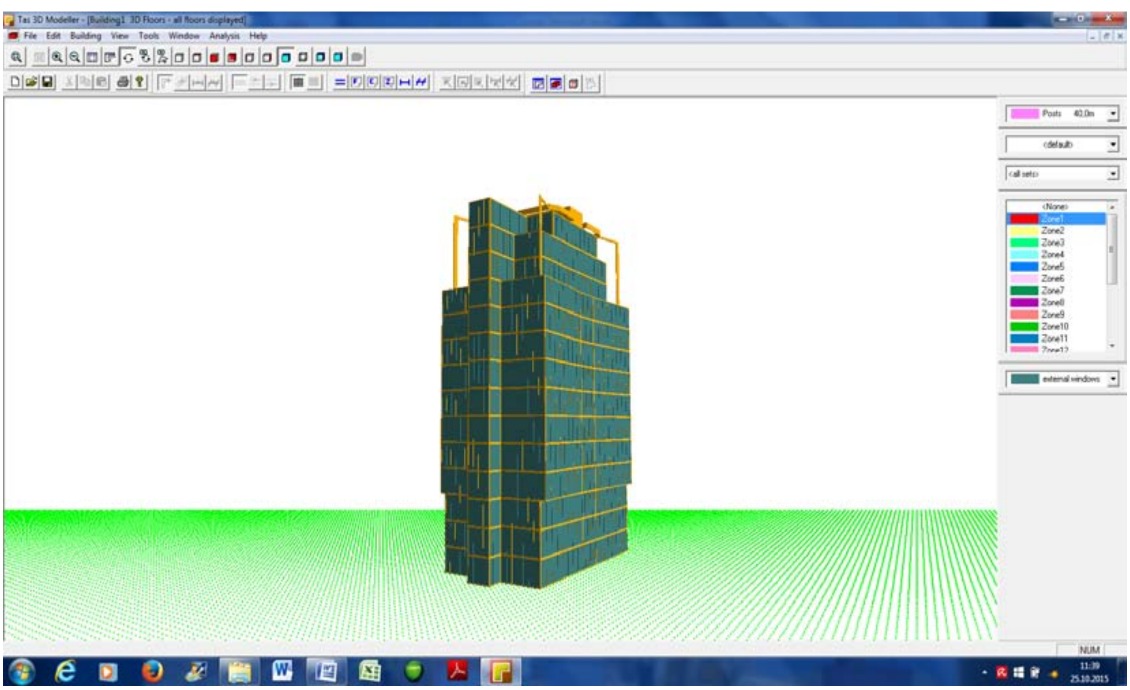

Fig. 2 : Model of the XGL Building in T as (Author's construct)

IV. Results and Discussions

Presented here are results from the simulation assessment. The GHGBC handbook which is based on the Green Star Council of South Africa specifies that aside the case study building's orientation; other orientations should also be simulated. The specified orientations are the actual orientation plus 90 °, actual +180 ° and actual +270 °. The simulated results show different cooling loads for the diverse orientations. Figure 3 shows the annual cooling loads for the different orientations whilst figure 4 illustrates the cooling loads per unit floor area for the various months.

The orientation of the case study building is 0° with the longer sides facing north and south. The annual cooling load for the actual orientation is 288.43kWh.m².a¹. When the orientation is changed by adding 90° to the actual, the cooling load increases by 5kWh.m².a¹. Even though the building is 100% glazed all round, and east-west orientation increases the cooling loads.

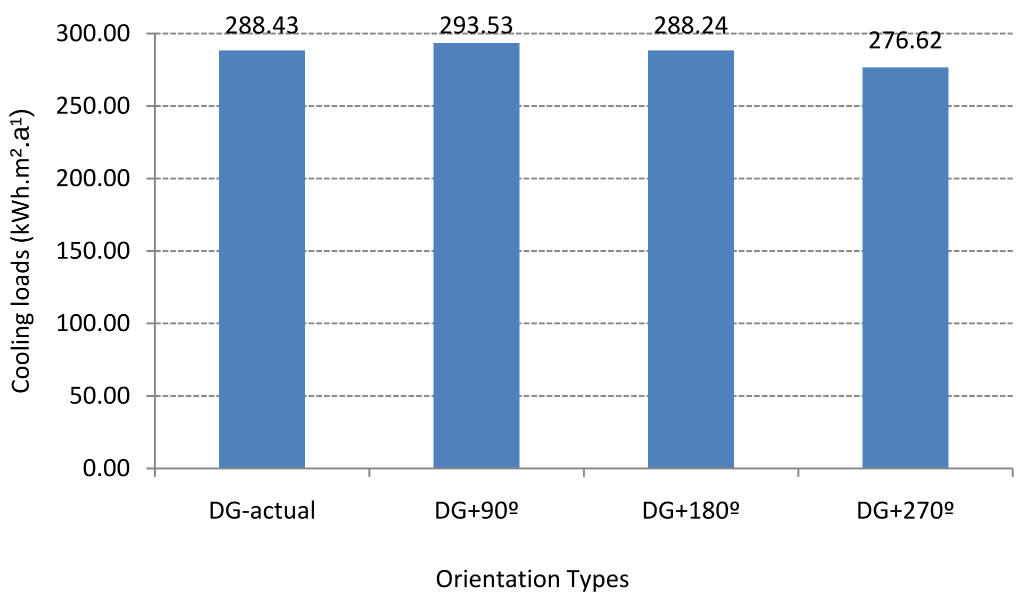

Fig. 3 : Annual cooling loads for the different orientations

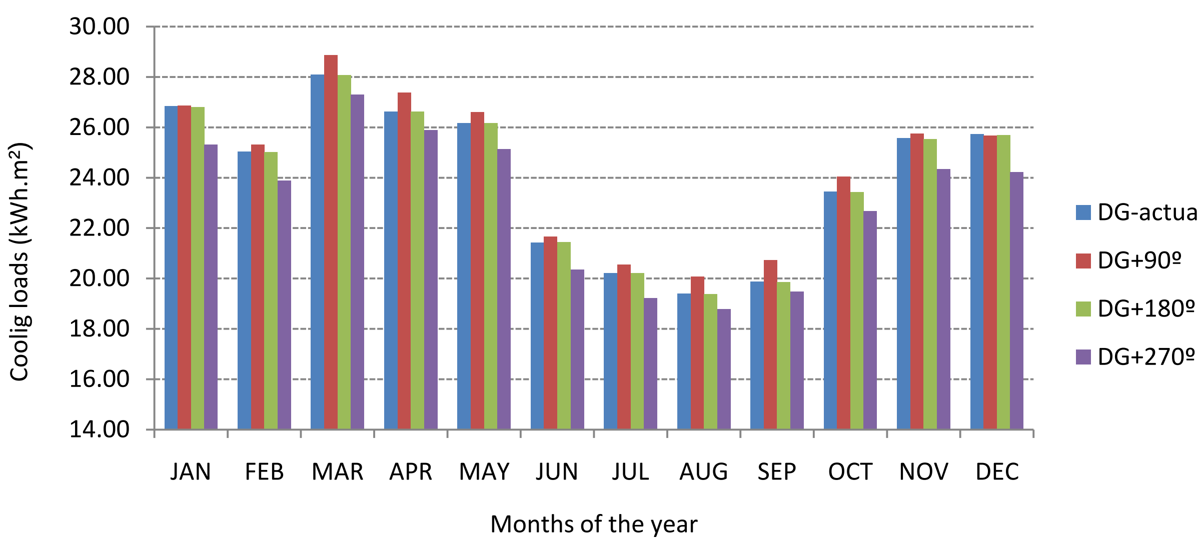

Fig. 4 : Cooling loads per unit floor areas for each month

Since the building has no overhangs, there is no protection for the glazing materials. According to Rathi (2012), south, east and west orientations should be designed for windows with deeper overhangs for protection against direct heat gain. The larger size of windows for these orientations could be designed with sun control devices to gain protection in summer. The author further posits that the window openings and overhangs should be designed specific to direction of exposure of the wall. The north side can be provided with large windows and shallow overhangs since this orientation will provide natural daylight without direct solar heat gain.

Szokolay (2004) explained that depending on the temperature and radiation conditions, north and south walls should be longer than the east and west with an aspect ratio of about 1.3 to 2.0. Lauber's (2005) recommendation was that the best orientation for buildings in the Warm and Humid countries should be +/- 30° from the prevailing wind direction. The author further states that the shell of air-conditioned buildings must be insulated, windproof and made airtight. This suggests an orientation away from the prevailing wind direction, but there is no precise direction for air-conditioned buildings from Lauber. If the eastern orientation is shaded, perhaps the cooling loads would be reduced.

Figure 5 show the solar gains for each orientation. The east and west orientations (SG+90 and SG+270) have the highest solar gains. A study conducted by (Lam et al., 2008) on the impact of solar radiation on facades in the tropics revealed that the north and south has the lowest sun intensity and this varied from 43.6 W/m^2 and 74 W/m^2 respectively.

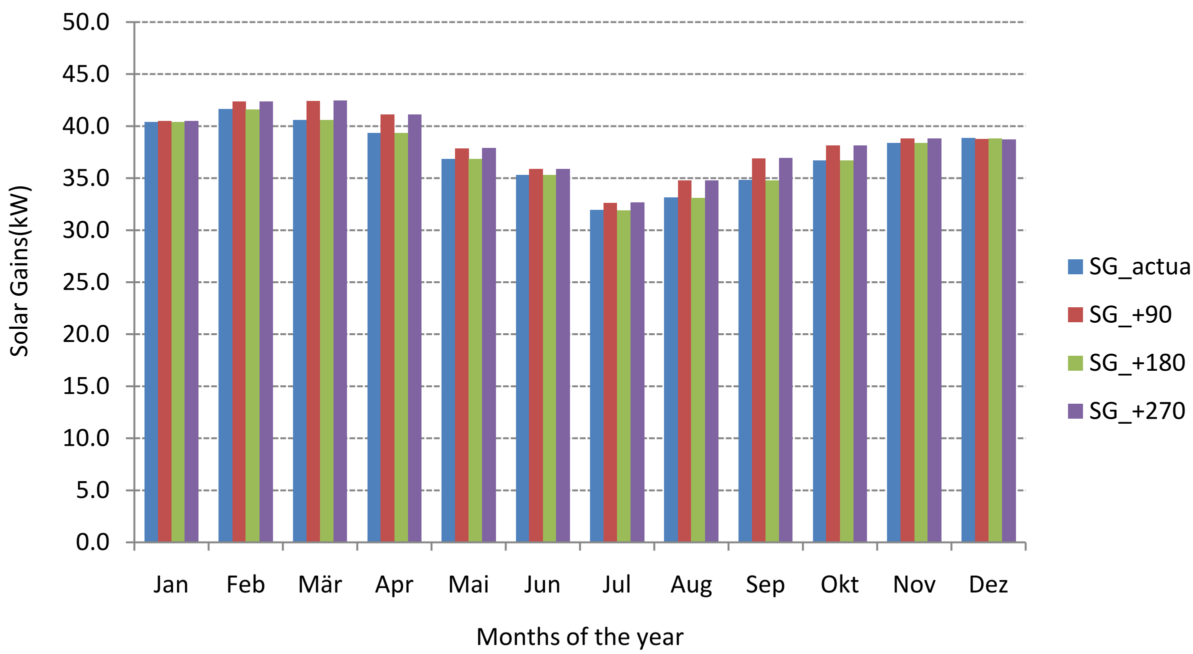

Fig. 5 : Simulated solar gains from the different orientations

The eastern and western facades received the highest intensities and this varied between 86.1 W/m^2 and 89.6 W/m^2. Per these results, it could be deduced that the optimized orientation of buildings is to orient away from directions with high solar radiation. This finding corroborates that of Lam et al. (2008). From the findings, all the facades have high solar gains. This is as a result of the absence of external shading and roof overhangs which could provide some protection against the sun's rays. Solar heat gain plays a major role in determining the thermal performance of a building and increasing or decreasing solar gains can be of crucial importance in design problems (Bouchlaghem, 1996). Khakzar (2014) also hypothesises that solar radiation enters through the external skin on the south face and heats the air in the cavity between the double panes. A large window area means a hefty hot surface. The Center for Sustainable Building Research (CSBR, 2011) stated that East and west are usually the least favorable orientations since they permit little control over solar radiation. Ossen et al. (2008) also share an akin opinion. A south orientation is most likely to permit day lighting throughout the school day, although the indirect and ambient light through north-facing glazing can also be substantial.

Together with intense solar radiation, this will cause any occupant seated close to the window to suffer extreme discomfort. Hwang et al, (2009) suggests that changing the glazing area may have a positive impact on thermal comfort, but lowers other aspects of comfort, such as visual comfort in this studied case. Lam and Hui, determined that in cooling dominated office buildings in Hong Kong, the solar heat gain accounts for just over 50% of cooling loads due to building envelope heat gains (Lam and Hui, 1993). They suggested that most parameters like WWR and SHGC which related to building load vary linearly with the total building energy consumption.

V. Conclusion and Recommendations

Orientation as a recommendation by the GHGBC has been the subject of an intensive simulation in the current study. The aim was to find out how effective orientation is as a factor to be considered for cooling load reductions. The results show that considering the current building with double glazing, a 270° orientation reduces the cooling loads by 11.81kWh.m^2.a^1 in comparison with the base case cooling loads. In terms of the cooling loads per unit floor area, the 270° again provided the minimum cooling loads. However, solar heat gains were high for the 90° and 270° orientations. It is therefore important to determine the maximum permissible areas of glass and the glazing type to be used in buildings when heat gain by solar factor is part of the design criteria.

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Assessing the Phytoremediation Potential of the Grass; C*hrysopogon Aciculatus* for the Heavy Metals: Cr, Co, Cd, Cu, Pb, Zn, Ni and Mn

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Abstract- Bioaccumulation ability of the grass C*hrysopogon aciculatus* for the heavy metals cobalt (Co), manganese(Mn), copper(Cu), lead(Pb), chromium(Cr), cadmium(Cd), nickel(Ni), and zinc(Zn) was studied. Samples of soil and the grass (fresh) were collected from No. 1 Alu avenue off Ahmad Bello way, Nasarawa L. G. A. of Kano State, Nigeria. Collection was made in August to September, 2015. Samples of the grass collected were washed with tap water, carefully separated into roots and shoots, dried at room temperature to a constant weight and grounded. This was then digested using aqua-regia (HNO_3 and HCl) in the ratio of 1:3 and analyzed for the said metals using AAS. The soil was equally treated using same reagent and analyzed for same metals.

Keywords: soil, grass, roots, shoots, environment, pollution, metals, AAS.

GJSFR-H Classification : FOR Code: 059999

Strictly as per the compliance and regulations of :

Assessing the Phytoremediation Potential of the Grass; *Chrysopogon Aciculatus* for the Heavy Metals: Cr, Co, Cd, Cu, Pb, Zn, Ni and Mn

Garba, S. T. [α], Idi, A. M. [σ] & Baba, A. [ρ]

Abstract- Bioaccumulation ability of the grass *Chrysopogon aciculatus* for the heavy metals cobalt (Co), manganese(Mn), copper(Cu), lead(Pb), chromium(Cr), cadmium(Cd), nickel(Ni), and zinc(Zn) was studied. Samples of soil and the grass (fresh) were collected from No. 1 Alu avenue off Ahmad Bello way, Nasarawa L. G. A. of Kano State, Nigeria. Collection was made in August to September, 2015. Samples of the grass collected were washed with tap water, carefully separated into roots and shoots, dried at room temperature to a constant weight and grounded. This was then digested using aqua-regia (HNO_3 and HCl) in the ratio of 1:3 and analyzed for the said metals using AAS. The soil was equally treated using same reagent and analyzed for same metals. The results indicates that levels, of the metals in the soil, can be arranged in increasing order as; Cd < Cu < Zn < Cr < Ni < Mn with Mn having the highest value of 0.0673ppm whereas Cd had the least value of 0.0025ppm. Similarly the levels of the metals in the root ranged between 0.0023 - 0.0159µg/g. Ni in the root has the highest value of 0.0286 µg/g followed by Zn (0.0159ppm), then Mn 0.0154 µg/g. Cd had the least value of 0.0023µg/g. In the shoot, Mn has the highest value of 0.0185 µg/g followed by Ni 0.0126 µg/g then Cr 0.0105 µg/g. Zinc had 0.0094 µg/g followed by Cu 0.0004 µg/g whereas Cd has the least value of 0.0001µg/g. In all the samples analyzed, Pb and Co were found below detection limit. Mn had the translocation factor (TF) value greater than one (1.20). This shows that the grass plant is capable of absorbing and translocating Mn from the soil to the shoot. Hence the value of Mn 0.0185ppm in the shoot was observed to be the highest of all the metals determined in the grass parts. *Chrysopogon aciculatus* therefore may have the ability of remediating soil of excess Mn.

Keywords: soil, grass, roots, shoots, environment, pollution, metals, AAS.

I. Introduction

The quality of life on Earth is linked inextricably to the overall quality of the environment. It is very difficult to define soil quality, as soil composition can vary from place to place. Soil quality is concerned with more than the soil's constituents and composition, but how it functions in a specific environment. The major functions of a soil are generally recognized to include the ability to protect water and air quality, the ability to sustain plant and animal productivity, and the ability to promote human health (Doran and Parkin, 1994; Chen and Mulla, 1999). The release of contaminants into the environment by human activities has increased enormously over the past several decades. The relatively sudden introduction of pollutants into the recipient ecosystems has clearly overpowered their self-cleaning capacity and, as a consequence, resulted in the accumulation of pollutants. Soil pollution by heavy metals is a significant environmental problem worldwide. The various countries confronted with contaminated soil differ considerably in awareness of the problem and in the measure and the technologies to tackle it (Rulkens *et al.*, 1998; Alloway, 1995).

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a) *Heavy Metal Pollution of Soil*

Heavy metal pollution of surface soils due to intense increase in technology, industrialization and urbanization has become a serious concern in many developing countries (Mireles et al. 2012; Wei and Yang, 2010). The accumulation of heavy metals in surface soils is effected by many environmental occurrences which include parent material and soil properties, as well as by human activities, such as industrial production, traffic, farming, and irrigation. Metals are somewhat unique in that they do not undergo either chemically or biologically induced degradation that can alter or reduce their toxicity over time (Knox *et al.*, 2002). The term "heavy metal" is arbitrary and imprecise. Some authors (Raskin *et al.*, 1994), simply, defined "heavy metal" as any element that has metallic properties such as ductility, conductivity, density, stability as cations, ligand specificity, etc. with an atomic number greater than 20. Several metals are essential for biological systems and must be present in a certain concentration range. They provide essential cofactors for metallo-proteins and enzymes and, consequently, too low concentrations lead to a decrease in metabolic activity. At high concentrations however, metals can act in a deleterious manner by blocking essential functional groups, displacing other metal ions, or modifying the active conformation of biological molecules (Collins and Stotzky, 1989). Besides, they are toxic for both higher organisms and microorganisms. Nonessential metals are tolerated at very low concentrations and inhibit metabolic activity at higher concentrations. Large areas of land can be contaminated by heavy metals released from smelters, waste incinerators, industrial wastewater, and from the application of sludge or municipal compost, pesticides, and fertilizers. Irrespective of their sources in the soil, accumulation of heavy metals can degrade soil quality, reduce crop yield and the quality of agricultural products, and thus negatively impact the health of human, animals, and the ecosystem (Jarüp, 2003;Nagajyoti et al., 2010).

b) *Decontaminating Heavy Metal Contaminated Soil*

Presently, the conventional techniques used to remediate contaminated soils tend to be inefficient (Rock, 1997; McNicoll and Baweja, 1995). Physical removal of contaminated soil and washing of those soils with solvents are expensive, and has met with mixed results (Cookson, 1995). The use of ''bioreactors'' has been attempted, but the contaminated soils must still be brought to the reactor for the cleanup. This process is expensive, and it damages the natural structure and texture of the soil. The various countries confronted with contaminated soil differ considerably in awareness of the problem and in the policies and the technologies to tackle it (Rulkens *et al.*, 1998). Alternatively, in situ bioremediation technique has been attempted; it is a general concept that includes all those processes and actions that take place in order to biologically transform an environment, already altered by pollutants (heavy metals), to its original status. Bioremediation uses primarily microorganisms or microbial processes to degrade and transform environmental contaminants into harmless or less toxic forms. (Garbisu and Alkorta, 2003; Cookson, 1995; Alexander,1999). Microorganisms can detoxify metals by valence transformation, extracellular chemical precipitation, or volatilization. They can enzymatically reduce some metals in metabolic processes that are not related to metal assimilation (Lovley, 1993). Several bacteria couple the oxidation of simple organic acids and alcohols, hydrogen, or aromatic compounds, to the reduction of Fe (III) or Mn(IV). Bacteria that use U (VI) as a terminal electron acceptor may be useful for uranium bioremediation (Lovley, 1993). The reduction of the toxic selenate and selenite to the much less toxic elemental selenium may be exploited for selenium bioremediation (Garbisu et al., 1997). Biomethylation to yield volatile derivatives such as dimethylselenide or trimethylarsine is a well-known phenomenon catalyzed by several bacteria, algae and fungi (White et al., 1997).

c) *Phytoremediation*

Phytoremediation that uses the remarkable ability of plants to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues appears very promising for the removal of pollutants from the environment (Garbisu and Alkorta 2003). Since most of plant roots are located in the soil, they can play an important role in metal removal via filtration, adsorption and cation exchange, and through plant-induced chemical changes in the rhizosphere (Wright and Otte 1999). There is evidence that plants can accumulate heavy metals in their tissues such as Sebera acuminate and Thlaspi caerulescens (Cunningham and Ow 1996), Arabidopsis thaliana (Delhaize 1996), Typha latifolia, and Phragmites australis (Ye et al. 2001). T. latifolia and P. australis have been successfully used for phytoremediation of Pb/Zn mine (Ye et al. 1997). Metal accumulation by plants is affected by many factors. Variations in plant species, the growth stage of the plants and element characteristics control absorption, accumulation and translocation of metals. Furthermore, physiological adaptations also control toxic metal accumulations by sequestering metals in the roots (Guilizzoni, 1991).

With in the field of phytoremediation, different categories have been defined such as, among others, phytoextraction, phytofiltration (rhizofiltration, blastofiltration), phytostabilization, phytovolatilization, phytodegradation (phytotrans formation), plant-assisted bioremediation (plant-assisted degradation, plant-aided in situ biodegradation, phytostimulation, enhanced rhizosphere degradation, rhizodegradation) (Alkorta et al., 2004). The phytoextraction technique for instance, uses the uptake capabilities of plants, it represents one of the largest economic opportunities for phytoremediation. Plants can accumulate metals that are essential for growth and development (such as Cu, Mn, Fe, Zn, Mo, and possibly Ni) and also some that have no known biological function (Cd, Cr, Pb, Co, Ag, Se, Hg) (Brooks, 1998; Raskin *et al.*, 1994). Plants have been described as solar-driven pumping stations (Cunningham *et al.*, 1995) which can actually remove these contaminants from the environment. As a result, metal removal by vegetation can be greatly enhanced by the judicious selection of plant species. The knowledge about the abilities of different plant species or tissues to absorb and transport metals under different conditions will provide insight into choosing appropriate plants for phytoremediation of the polluted regions. This research work therefore is aimed at assessing the non-amended phytoextraction potential of the native grass; Part Harcourt grass (*Chrysopogon aciculatus)* for the heavy metals: cobalt (Co), manganese (Mn), copper (Cu), lead (Pb), chromium (Cr), cadmium (Cd), nickel (Ni), and zinc (Zn).

d) *Sample Collection*

The grass plant sample was collected by uprooting gently from the soil. Collection was made in the morning hours in order to get the samples fresh, avoid damages to the plants parts (the roots) and to avoid contamination by other plants specie. The soil around the grass plant was also collected. Soil collection was done using hand trowel from the surface to the sub surface portion of the grass plant at a depth of 0-10cm beneath the root of the grass. Four different samples at three different locations within the same vicinity were collected and pulled together to represent a sample. Samples were collected from, No:1 Alu avenue off Ahmadu Bello way, Nassarawa L.G.A, Kano State, Nigeria, located between the latitude 11º58'37"N 8º33'45"E / 11.97694ºN..

e) Sample Preparation and Analysis

The fresh butches of the grass sample collected were carefully washed with tap water, separated into roots and shoots. These were then dried at room temperature to a constant weight, grounded and sieved using 2mm nylon mesh. To 1.0g of the powdered plant samples placed in an acid washed crucible, 15ml of aqua-regia acid (HNO_3 and HCl) solution in ratio of 1:3 was added. The corresponding solution was heated gently until white fumes had appeared. This was then cooled and 10ml of distilled water was added and heated again in a water bath to insure complete dissolution. The mixture was then filtered into a 50ml volumetric flask using with watt man filter paper No.1. The clear solution was diluted up to the 50ml mark with distilled water. The soil sample was equally digested with same volume of aqua-regia solution using 1.0g of the sieved sample (Radojevic and Bashkin, 1999). Analysis of the samples for the metals: Mn, Zn, Cu, Co, Ni, Cr, Pb, and Cd were carried out using a bulk scientific Atomic Absorption Spectrophotometer (AAS) model NO. AA-6800. Standard working solution of the elements of interest was prepared for standard calibration curve. The concentration of each metal was extrapolated from the standard calibration curve.

f) Statistical Data Handling

All statistical data handling were performed using Excel 2007. Differences in heavy metal concentrations among the different samples were detected using One-way ANOVA. A significance level of ($P \leq 0.05$) was used throughout the study.

g) Results and Discussion

Phytoremediation, the use of plants to extract, sequester, and/or detoxify pollutants, has been reported to be an effective, non-intrusive, inexpensive, environment-friendly accepted technology to remediate polluted soils (Weber et al., 2001). Phytoremediation is widely viewed as the ecologically responsible alternative to the environmentally destructive physical remediation methods currently practiced (Meagher, 2000).

Plants grown in metal-contaminated soils take up metal ions in varying degrees. This uptake is largely influenced by the bioavailability of the metals which is in turn determined by both external (soil-associated) and internal (plant-associated) factors.

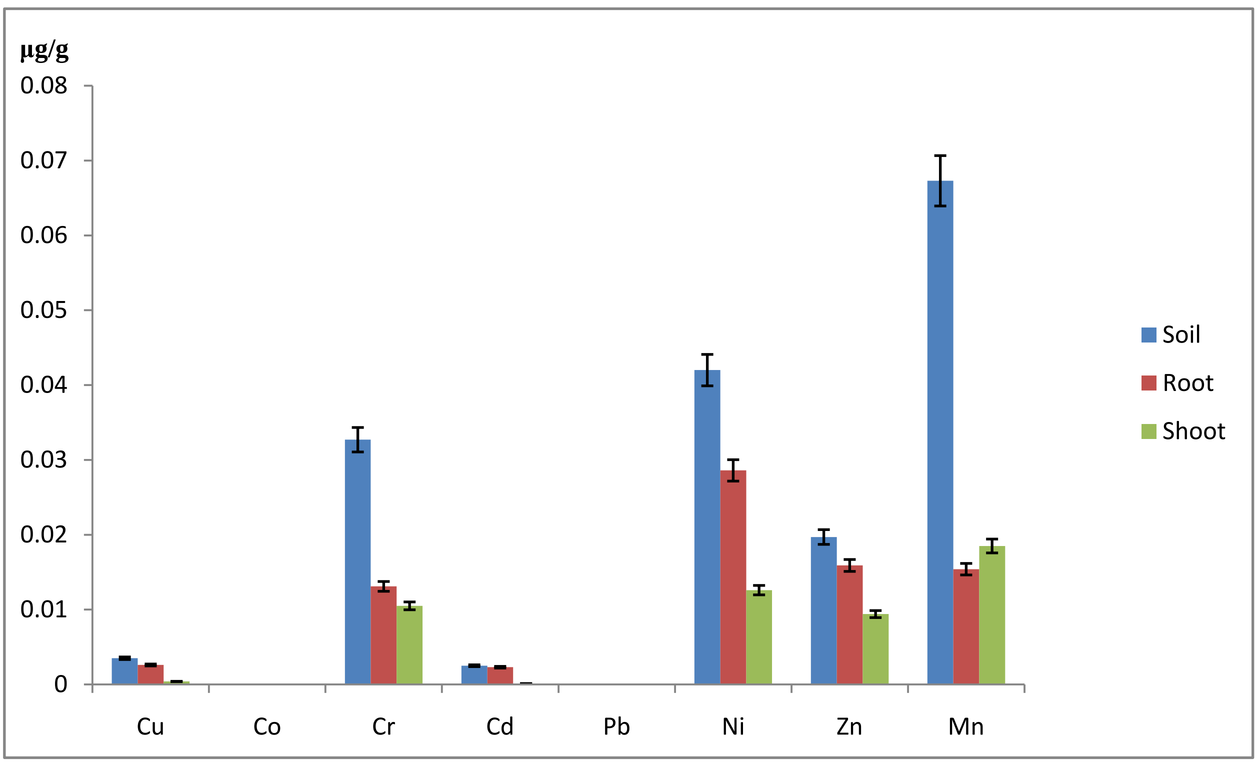

Fig. 1 : Levels (µg/g) of Elements Determined in the Soil, Root and Shoot of the grass

Figure one above gives the levels of the metals; Mn, Zn, Ni, Pb, Cd, Cr, Co, and Cu determined in the soil, roots and shoots of the grass *Chrysopogon aciculatus*. The result obtained indicates that levels of the metals in the soil, can be arranged in increasing order as; Cd < Cu < Zn < Cr < Ni < Mn with Mn having the highest value of 0.0673µg/g whereas Cd had the least value of 0.0025µg/g. Similarly in the grass sample, the levels of the metals in the root ranged between 0.0023 - 0.0159 µg/g. Nickel in the root has the highest value of 0.0286 µg/g followed by Zn (0.0159 µg/g), then Mn 0.0154 µg/g. Cadmium had the least value of 0.0023 µg/g in the shoot, Mn has the highest value of 0.0185 µg/g followed by Ni 0.0126 µg/g then Cr 0.0105 µg/g. Zinc had 0.0094 µg/g followed by Cu 0.0004 µg/g whereas Cd has the least value of 0.0001µg/g. In the entire sample analyzed, Pb and Co were found to be below detection limit.

Plant species differ widely in their ability to accumulate heavy metals. Figure 1 show that, with the exception of Mn, the root of the grass accumulate higher concentrations of metals than shoots, which indicated greater plant availability of the substrate metals, as well as interior limited mobility of the plant. This is consistent with previous observations (Garba et al., 2011; Garba et al., 2012a). Garba et al. (2012b) reported that the concentrations of heavy metals in the root tissues of *penisetum pedicellatum* from polluted areas were usually found to contain higher concentrations of most metals compared to the aboveground parts. Fitzgerald et al. (2003) observed that monocotyledonous species contained higher concentrations of Pb in the roots compared to shoots. In comparison with the ranges of metal concentrations in the soil and in the root, the concentrations of Cu, Cr, Zn and Ni in shoots were maintained at low levels (Fig. 2). The results presented in the study suggest that this metal-tolerating strategy is widely evolved and exists in plant species when they grow in metal-contaminated areas. The elevated metal concentrations in the root and low translocation to the shoot in the grass species examined might also suggest that, the grass may be capable of rather well-balanced uptake and translocation of metals when grown on heavily metal polluted conditions.

h) Chrysopogon aciculatus

Chrysopogon aciculatus (Retz.) Trin. (Fig, 3), is a perennial grass with a creeping rhizome (Paria and Chattopadhyay, 2005). It's culm is divided into creeping base and erect portion. The creeping base is covered with imbricate scale like old sheaths. Sheaths are long, striate, sometimes purple - tinged and imbricate (Singh et al., 2001). Leaf blades are flat. Panicles are reddish purple, narrowly elliptic and long. It is usually found in sunny, dry, exposed areas such as roadsides, lawns, pasture, bank of rivers, water courses, etc (Noltie, 2000). It is a common weed found almost throughout the year. The grass has a potential to spread quickly as the creeping rhizomes grow over open areas. Cattle eat this species in default of anything else. It can tolerate grazing, mowing and trampling by animals (Kabir and Nair, 2009). It is a very good soil binder and so prevents soil erosion. This can be difficult to eradicate if it becomes established (Ambasta and Rana, 2013).

Fig. 3 : Chrysopogon aciculatus (Retz.) Trin

It has been reported that plants for phytoextraction, i.e., metal removal from soil, should have the following characteristics: (i) tolerant to high levels of the metal, (ii) accumulate reasonably high levels of the metal, (iii) rapid growth rate, (iv) produce reasonably high biomass in the field, and (v) profuse root system (Garbisu et al. 2002).

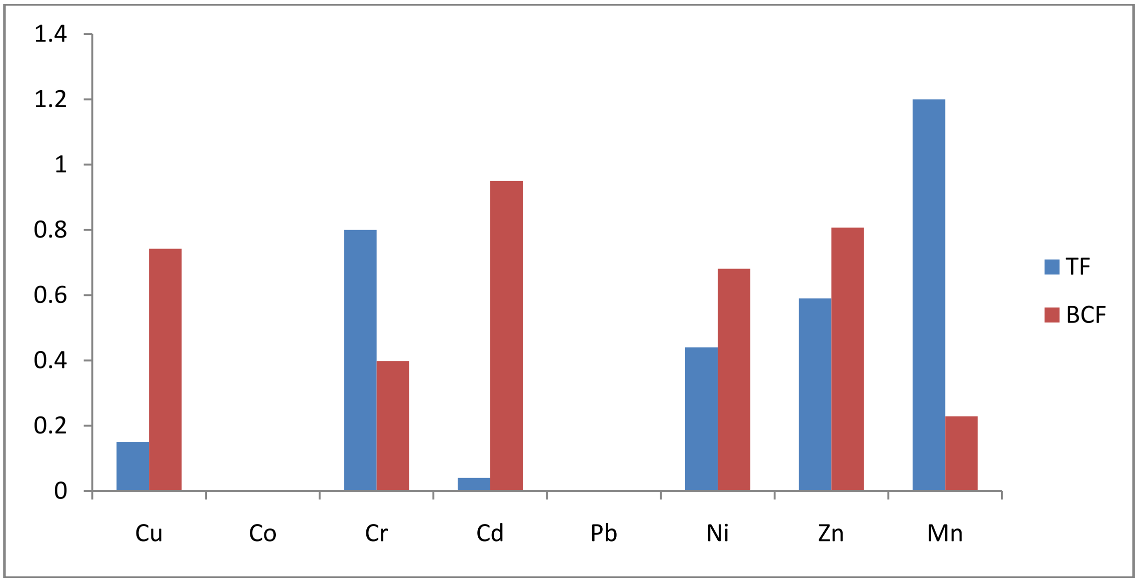

Fig. 2 : Biological Concentration Factor (BCF) and the Translocation Factor (TF)

The translocation factor (TF) which determine the ability of the grass to remediate the soil if its calculated value is one (1.0) or above. It was described as ratio of heavy metals in plant shoot to that in plant root (McGinty, 1996; Moffat, 1995) were found to be less than one for all the metals except Mn which has 1.20. This shows that the grass plant is capable of absorbing and translocating Mn from the soil via the root to the shoot. Hence the value of Mn 0.0185 μg/g in the shoot was observed to be the highest of all the metals determined in the grass plant parts (fig. 2). The grass may also be used in one of the phytoremediation technique; phytostabilization. This is because the level of the metal Ni was found at a higher concentration in the roots although the translocation factor (TF) was found to be less than one (1). Phytostabilization, is referred to as in-place inactivation, is primarily used for the remediation of soil, sediment, and sludges (United State Protection Agency, 2000). It is the use of plant roots to limit contaminant mobility and bioavailability in the soil. The plants primary purposes are to (1) decrease the amount of water percolating through the soil matrix, which may result in the formation of a hazardous leachate, (2) act as a barrier to prevent direct contact with the contaminated soil and (3) prevent soil erosion and the distribution of the toxic metal to other areas (Raskin and Ensley, 2000).

II. Conclusion

Phytoextraction as the name implies is not a magic solution, commercially, it is gaining appeal because it is cheaper than conventional clean-up methods. But it is not an easy technology just consisting of picking up some plants and placing them in the metal polluted area. On the contrary, it is highly technical, requiring expert project designers with plenty of field experience that carefully choose the proper species and cultivars for particular metals (and combinations of them) and regions, and manage the entire system to maximize pollutant removal efficiency.

Form the result obtained and the transfer factor calculated, it shows that the grass plant (C*hrysopogon aciculatus)* may have the ability of phytoextracting excess Mn from polluted soil.

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Heavy Metal Effects from Al-Dura Power Station on Plant *Citrus Aurantium* L.

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Abstract- Three selected sites with gradual distances from Al-Daura thermal power station (0.5 km (St.1), 1km (St.2) and 2km (St.3) were chosen for sampling according to the direction of downwind of site. In addition, one of unpolluted site for comparison as control site in Baghdad around 4 Km upwind from Al-Daura thermal power station. The samples were taken for two seasons; the first season was in December 2014 and the second season was in March 2015.The results of heavy metals in plant tissues showed a high concentration of Ni, Cd and Cu in the leaves and root of *Citrus aurantium* L. in all the three sites; the highest concentrations were in site 2, while the Pb concentrations in site 1 and 2 were less from that of the site 3. There was no significant difference in the concentrations of Cd and Pb between the two seasons, while there was a significant increase in the concentrations of Ni and Cu in the second season than in the first season. The chlorophyll and protein content in *Citrus aurantium* L. trees were higher in the control site than the other three sites. Site 2 recorded the lowest value. There were significant increases in chlorophyll and protein content in the second season than that in the first season.

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HEAVYMETALEFFECTSFROMALDURAPOWERSTATIONONPLANTCITRUSAURANTIUML

Strictly as per the compliance and regulations of :

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Ali A. Al-Sallihy [α], Khalid A. Rasheed [σ] & Zaid A. Azeez [ρ]

Abstract- Three selected sites with gradual distances from Al-Daura thermal power station (0.5 km (St.1), 1km (St.2) and 2km (St.3) were chosen for sampling according to the direction of downwind of site. In addition, one of unpolluted site for comparison as control site in Baghdad around 4 Km upwind from Al-Daura thermal power station. The samples were taken for two seasons; the first season was in December 2014 and the second season was in March 2015.The results of heavy metals in plant tissues showed a high concentration of Ni, Cd and Cu in the leaves and root of *Citrus aurantium* L. in all the three sites; the highest concentrations were in site 2, while the Pb concentrations in site 1 and 2 were less from that of the site 3. There was no significant difference in the concentrations of Cd and Pb between the two seasons, while there was a significant increase in the concentrations of Ni and Cu in the second season than in the first season. The chlorophyll and protein content in *Citrus aurantium* L. trees were higher in the control site than the other three sites. Site 2 recorded the lowest value. There were significant increases in chlorophyll and protein content in the second season than that in the first season.

I. Introduction

Heavy metals constitute an ill-defined group of inorganic chemical hazards, and those are most commonly found at contaminated sites such as chromium (Cr), lead (P b), zinc (Zn), arsenic (As), cadmium (Cd), copper (Cu) and nickel (Ni). Soils are the major sink for heavy metals released into the environment by many anthropogenic activities and unlike organic contaminants which are oxidized to carbon by microbial action. Most metals do not undergo microbial or chemical degradation, and their total concentration in soils persists for a long time after their introduction. Heavy metal contamination may pose hazards to the ecosystem through direct ingestion or contact with contaminated soil, the food chain, irrigation from contaminated ground water (Ling, *et al.* 2007).

Heavy metals such as copper and zinc are essential to maintain the metabolism of the plant and animals. However, others, such as Cd, Ni and Pb are all toxic elements. At higher concentrations, both groups of heavy metals can lead to poisoning. They accumulate rapidly and deplete slowly (Wuana. *et al.*, 2010).

An assessment of toxic concentrations and effects of heavy metals on plants is very complex because it depends on so many factors. Some of the most important factors are the proportions of related ions that are present in solution and their compounds. Although plants adapt easily to chemical stress, they may also be very sensitive to an excess of a particular heavy metal. Toxic concentrations of these heavy metals in plant tissues are very difficult to establish (Kabata-Pendias, 2011; Soydam *et al.,* 2011).

Citrus aurantium L.is sensitive to high concentrations of metals, toxicity causes retarded growth, leaf burn and yellowing starting near the tip, the yellowing is very bright, scattered over the leaves. In severe cases, gum spots appear on the lower leaf surfaces with leaf drop occurring prematurely. Leaf drop is heavy and dieback follows. Other symptoms can include twig dieback, feeder roots may also become darkened and exhibit restricted growth. Changes in chlorophyll content, lipid content and losses of polypeptides involved in photochemical activities and damage to DNA molecules (Futch and Tucker, 2000; Kabata_Pendias, 2011).

The aim of the present study is to determine the concentrations of some heavy metals in the areas near to Al-Daura thermal power station like(Nickel (Ni), Cadmium (Cd), Lead (Pb) and Copper (Cu)) their effects on the *Citrus aurantium* L. plant.

II. Materials and Methods

a) Sampling sites

Three sites with gradual distances from Al-Daura thermal power station (0.5, 1 and 2 Km, respectively) were chosen for sampling. In addition, one of unpolluted site was chosen for comparison as a control around 4 Km upwind from Al-Daura thermal power station. All samples were collected for two seasons; the first season was in December 2014 and the second season was in March 2015 (fig. 1).

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Author ρ : Ministry of Health and Environment

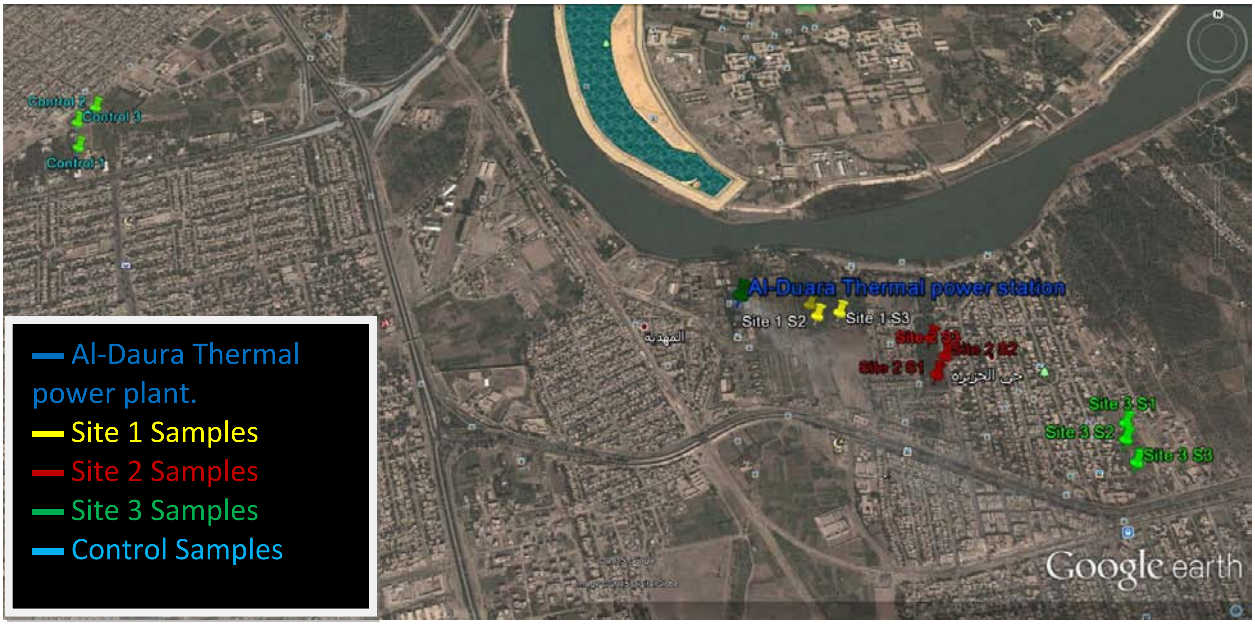

Figure 1 : The study area of Al-Daura thermal power station with 4 sampling stations

b) *Plant sampling*

Citrus aurantium L trees were selected in all three suspected polluted sites and for control site with large number and can be easily specified. Roots and leaves were used to measure the concentration of heavy metals in plants. For chemical analysis, three replicates of plant of leaves and roots were taken from each site in each season.

The chemical analysis of sour orange (*Citrusaurantium* L.) plants include measuring the concentration of heavy metals (Ni, Pb, Cd and Cu) using AAS device. The plant samples were prepared for measuring according to (APHA, 1998).

c) *Chlorophyll Content Analysis*

Chlorophyll pigment contents were determined according to (Goodwin, 1976):

d) *Protein Content Analysis*

Protein content was measured according to Biuret method and preparation of reagents was done according to Layne (1957).

III. Results and Discussion

a) *Ni Concentration in Citrus aurantium L. (Leaves and Roots)*

The results in table 1 shows a significant increase in the concentrations of Ni in the leaves of *Citrus aurantium* L. in season 2 than season 1. While, no significant difference appeared in the concentrations of Ni in the root of *Citrus aurantium* L. (Table 2). At the same time, there were significant differences in Ni concentrations in *Citrus aurantium* L. among all sites. The concentration of Ni in leaves and roots in site 2 was higher than other sites.

The interaction (Seasons × sites) for the leaves and roots were significant, the higher values were in season 2 at site 2, while the lowest interaction values were in season 1 at the control sites.

Table 1 : Concentrations of Ni (μg/g) in the leaves of *Citrus aurantium* L. for the two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	5.74 ± 0.49	5.92 ± 0.84	5.83 ± 0.44 D
1 (0.5 Km distance)	28.19 ± 2.10	32.90 ± 1.15	30.545 ± 1.50 B
2 (1 Km distance)	34.88 ± 1.20	37.73 ± 1.90	36.305 ± 1.19 A
3 (2 Km distance)	12.55 ± 1.21	13.80 ± 1.09	13.175 ± 0.78 C
Mean ± SE	20.34 ± 3.57 B	22.587 ± 4.00 A	---
*LSD value: Site: 2.849 *, Season: 2.014 *, Interaction of Site × Season: 4.247 * (P>0.05) N.S: Not significant*			

Table 2 : Concentrations of Ni (µg/g) in the root of *Citrus aurantium* L. for the two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	3.84 ± 0.44	4.80 ± 0.36	4.32 ± 0.33 D
1 (0.5 Km distance)	19.60 ± 1.18	24.28 ± 1.79	21.94 ± 1.42 B
2 (1 Km distance)	25.06 ± 2.43	27.43 ± 1.79	26.245 ± 1.45 A
3 (2 Km distance)	8.97 ± 0.82	9.12 ± 0.72	9.045 ± 0.49 C
Mean ± SE	14.37 ± 2.60 A	16.407 ± 2.95 A	---
*LSD value: Site: 2.931 *, Season: N.S , Interaction of Site × Season: 4.464 **			
(P>0.05) N.S: Not significant			

b) Cd concentration

The results in tables 3 and 4 refer that there were no significant differences between two seasons in the concentrations of Cd in leaves and roots of *Citrus aurantium* L., whereas, there were significant differences among all sites, the highest concentrations were in site 2 (0.79 ± 0.04 for leaves and 1.065 ± 0.06 for roots) and the lowest concentrations were in the control site.

There were significant interactions between seasons and sites; higher concentration was in the site 2 of season 2, whereas and the lowest was in the control site in both seasons for leaves and roots.

Table 3 : Concentrations of Cd (µg/g) in the leaves of *Citrus aurantium* L. for the two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	0.000 ± 0.00	0.00 ± 0.00	0.00 ± 0.00 D
1 (0.5 Km distance)	0.620 ± 0.06	0.710 ± 0.06	0.665 ± 0.04 B
2 (1 Km distance)	0.730 ± 0.06	0.850 ± 0.04	0.79 ± 0.04 A
3 (2 Km distance)	0.210 ± 0.04	0.270 ± 0.04	0.24 ± 0.04 C
Mean ± SE	0.39 ± 0.09 A	0.457 ± 0.10 A	---
*LSD value: Site: 0.093 *, Season: 0.065 * , Interaction of Site × Season:0.142 **			
(P>0.05) N.S: Not significant			

Table 4 : Concentrations of Cd (µg/g) in the roots of *Citrus aurantium* L. for the two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	0.066 ± 0.03	0.07 ± 0.01	0.068 ± 0.03 D
1 (0.5 Km distance)	0.780 ± 0.10	0.820 ± 0.03	0.80 ± 0.05 B
2 (1 Km distance)	0.960 ± 0.04	1.170 ± 0.07	1.065 ± 0.06 A
3 (2 Km distance)	0.280 ± 0.03	0.322 ± 0.02	0.301 ± 0.02 C
Mean ± SE	0.67 ± 0.11 A	0.595 ± 0.13 A	----
*LSD value: Site: 0.120 *, Season: N.S, Interaction of Site × Season: 0.179 **			
(P>0.05), N.S: Not significant			

c) Cu concentration

The results in table 5 showed no significant difference in the concentrations of Cu in the leaves between the two seasons, while a significant difference between seasons in roots were shown (Table 6). Also, a significant difference in the concentrations of Cu in leaves and roots for all three sites appeared when compared with the control. The highest concentrations of Cu in plants were in site 2 (50.015 ± 1.50 and 46.135± 2.15 µg/g for leaves and roots, respectively), in the same time there was no significant difference between site 1 and 2. The higher significant interaction for the leaves and roots was recorded during season 2 at site 2, while the lowest value was in season 1 at the control site.

Table 5 : Concentrations of Cu (μg/g) in the leaves of *Citrus aurantium* L. for the two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	17.80 ± 0.71	18.46 ± 1.44	18.13 ± 0.73 C
1 (0.5 Km distance)	43.75 ± 2.99	48.46 ± 1.83	46.105 ± 1.89 A
2 (1 Km distance)	48.70 ± 2.41	51.33 ± 1.90	50.015 ± 1.50 A
3 (2 Km distance)	25.92 ± 2.95	28.31 ± 0.93	27.115 ± 1.48 B
Mean ± SE	34.042 ± 3.95 A	36.64 ± 4.19 A	---
*LSD value: Site: 4.37 *, Season: N.S, Interaction of Site × Season: 6.47 ** *(P<0.05) N.S: Notsignificant*			

Table 6 : Concentrations of Cu (μg/g) in the roots of *Citrus aurantium* L. for the two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	13.48 ± 0.82	14.80 ± 0.88	14.14 ± 0.61 C
1 (0.5 Km distance)	41.70 ± 1.62	44.62 ± 1.32	43.16 ± 1.14 A
2 (1 Km distance)	42.40 ± 2.74	49.87 ± 1.28	46.135 ± 2.15 A
3 (2 Km distance)	21.80 ± 1.128	22.10 ± 1.32	21.95 ± 0.82 B
Mean ± SE	29.845 ± 3.86 B	32.847 ± 4.47 A	---
*LSD value: Site: 3.21 *, Season: 2.27 *, Interaction of Site × Season: 4.81 ** *(P>0.05) N.S: Not significant*			

The results in tables 1,2,3,4,5 and 6 shows a significant difference in the concentrations of heavy metals (Ni, Cd and Cu) in leaves and roots of *Citrus aurantium* L. at all three sites when compared with the control and they were higher than the permissible values that were estimated 0.1–5 ; 0.05-0.2 and 5-30 μg/g for of Ni, Cd and Cu respectively (Kabata-Pendias, 2011).

The increases in the concentrations of heavy metal in the studied plant resulted from its growth in the polluted soil with heavy metals. Site 2 showed high concentrations of Ni, Cd and Cu in plant tissues. This result meets with the results of Doganlar and Atmaca (2011) who showed a high ability of Citrus plant to absorb the heavy metals from polluted soil, which may cause genotoxicity in plant and leads to a human health hazard.

d) Pb concentration

There was no significant difference between season 1 and 2 in the concentrations of Pb in the leaves of *Citrus aurantium* L. (Table 7). While there was an increase with a significant difference in the concentrations of Pb in the root of *Citrus aurantium* L. in season 2 when compared to season 1 (Table 8). Results indicated a significant difference in the concentrations of Pb in the leaves and roots of *Citrus aurantium* L. among sites; the highest concentration was in site 3. Also, the higher interaction value of Pb with a significant difference was in site 3 at season 2, while the lowest interaction value was in the control site at season 1. The plants in all sites for two seasons were within a permissible value, which was estimated at 5-10 μg/g for Pb in the plant, except the plant on site 3 that was higher from the permissible level (Kabata-Pendias, 2011).

Table 7 : Concentrations of Pb (μg/g) in the leaves of *Citrus aurantium* L. for the two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	6.60 ± 0.51	6.91 ± 0.21	6.755 ± 0.26 D
1 (0.5 Km distance)	9.78 ± 0.27	10.39 ± 1.04	10.085 ± 0.50 C
2 (1 Km distance)	11.20 ± 0.81	12.30 ± 0.79	11.75 ± 0.56 B
3 (2 Km distance)	14.21 ± 0.81	15.60 ± 0.65	14.905 ± 0.56 A
Mean ± SE	10.447 ± 0.86 A	11.3 ± 0.99 A	---
*LSD value: Site: 1.469 *, Season: N.S, Interaction of Site × Season: 2.23 ** *(P>0.05) N.S: Not significant*			

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Table 8 : Concentrations of Pb (µg/g) in the roots of *Citrus aurantium* L. for two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	5.21 ± 0.56	5.34 ± 0.71	5.275 ± 0.41 C
1 (0.5 Km distance)	8.03 ± 0.45	8.22 ± 0.44	8.125 ± 0.28 B
2 (1 Km distance)	8.15 ± 0.32	9.94 ± 0.59	9.045 ± 0.50 AB
3 (2 Km distance)	9.28 ± 0.23	10.85 ± 0.83	10.065 ± 0.52 A
Mean ± SE	7.667 ± 0.48 B	8.587 ± 0.69 A	---

*LSD value: Site: 1.167 *, Season: 0.825 *, Interaction of Site × Season: 1.589 **
(P>0.05), N.S: Not significant

The distributions of heavy metals concentrations in *Citrus aurantium* L. leaves and roots for all three sites and control site were shown in figures 2 and 3.

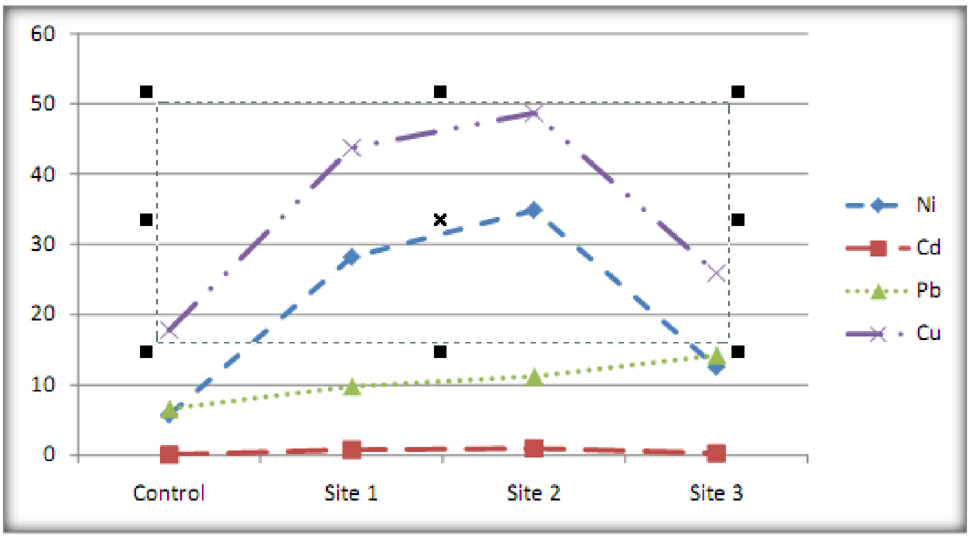

Figure 2 : Distributions of heavy metals concentrations in the leaves of *Citrus aurantium* L. in the three sites and control site

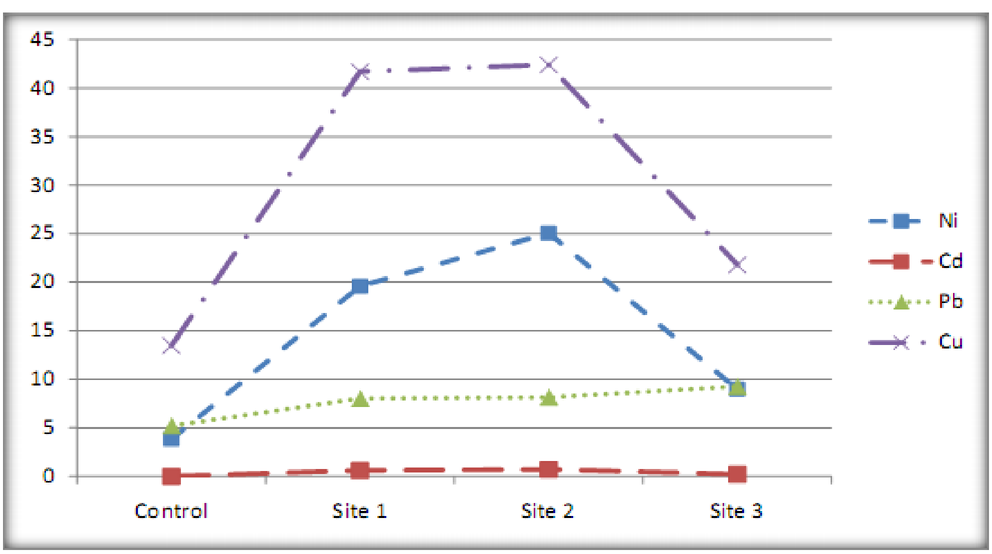

Figure 3 : Distributions of heavy metals concentration in the roots of *Citrus aurantium* L. in the three sites and control site

In this study, it has been found that there was a slight significant increase in most of the heavy metals in plant tissues in season 2 more than that in season 1. The amounts of rainfall throughout the seasons and increase the influence of ambient temperature have important effects on enhancing the response of Citrus trees to the uptake of metals(Table 9).

Table 9 : Weather of study area for two seasons

Season	Mean of Air Temperature (ºC)	Mean of Air Maximum Temperature (ºC)	Mean of Air Minimum Temperature (ºC)	Total Monthly Rainfall (mm)	Relative Humidity (%)	Mean of Wind Speed (m/s)
December (2014)	13.9	19.6	8.1	3.9	65	2.4
March (2015)	17.9	25.4	9.7	26.1	43	3

Iraqi Meteorological Organization, (2015).

In subtropical climates, Citrus plants show higher stem water potential when it is a warmer weather with more rain. In contrast, a reduction in stem water potential is found when it is a colder weather with less rain, in which plants may get fewer levels of some trace elements from the soil solution (Ribeiro and Eduardo, 2007).

Al-Safawe *et al.* (2014) found that the Citrus trees grow in the industrial areas and main streets were containing high concentrations of heavy metal in their tissues. While, Kabata-Pendias (2011) reported that in general, plants readily take up the heavy metals dissolved in soil solutions, and it also may absorb heavy metals by aboveground parts from aerial deposition.

e) Chlorophyll Content in the leaves of Citrus aurantium L.

The results in table 10 show that the chlorophyll content of *Citrus aurantium* L. leaves in season 2 were higher than season 1 with a significant difference. Ribeiro and Edurdo, (2007) stated that the photosynthetic activity of citrus trees was affected during the winter season when growing in a subtropical climate, under both low temperatures and drought.

A significant difference in interaction value of chlorophyll was recorded during season 2 at the control site that was 2631 ± 40.07 µg/g, while the lowest interaction value was in season 1 at site 2 that was 1986 ± 23.79 µg/g.

Table 10 : Chlorophyll Content (µg/g)in the leaves of Citrus aurantium L. for two seasons

Site	Season		Mean ± SE
	1 December 2014	2 March 2015	
Control	2504 ± 4.93	<u>2631</u> ± 40.07	2567.5 ± 29.97 A
1 (0.5 Km distance)	2161 ± 22.64	2192 ± 19.05	2176.5 ± 14.94 C
2 (1 Km distance)	<u>1986</u> ± 23.79	1993 ± 14.04	1989.5 ± 12.45 D
3 (2 Km distance)	2385 ± 21.96	2391 ± 10.50	2388 ± 10.96 B
Mean ± SE	2259 ± 60.90 B	2301 ± 69.9 A	---
*LSD value: Site: 46.58 *, Season: 32.94 *, Interaction of Site × Season: 54.46 ** *(P>0.05), N.S: Not significant*			

The chlorophyll content in the leaves of *Citrus aurantium* L. in the control sites was higher than the three sites with a significant difference, while the lower value was in site 2. This might be due to that chlorophyll synthesis is a breakdown in plants as an effect of an elevation of heavy metals in this site. Tables 1-8, which reported the increasing of the concentrations of heavy metals in site 2 compared with other sites; *i.e.* a decrease in the chlorophyll content was detected in parallel with an increasing in the pollution level. The results of this study agree with the results of Yurekli and Porgali (2006); Bhardwaj *et al.* (2009) and Doganlar *et al.* (2012) who found that the heavy metals cause a decrease in the content of photosynthetic pigment in many plant species including *Citrus aurantium* L. due to the peroxidation of the photosynthetic membrane and inhibition of chlorophyll biosynthesis enzymes.

Doganlar and Atimaca (2011) reported that the chlorophyll content was decreased 15 -66 % in industrial and urban street plants as a result of air pollutants and heavy metals such as Ni, Pb and Zn. Also, Peralta-Videa *et al.* (2004) and Kiran and Sahin (2005) stated that in addition to the effects of heavy metals on physiological and morphological characteristics of plants like inhibition of seed germination and root-shoot development; these elements caused a major biochemical changes such as the formation of reactive oxygen species (ROS) that resulted in altered levels of enzymatic and non-enzymatic antioxidants, and depression of plant proteins and pigment content.

f) *Protein Content in the leaves and roots of Citrus aurantium L.*

The results presented in tables 11 and 12 show that the protein content in the leaves and roots of *Citrus aurantium* L. was higher in season 2 than season 1 with a significant difference for. Touchette and Burkholder (2002) found that proteins in plants increased with the progression growing season. The higher interaction value with significant difference was found in season 2 at the control site, whereas the lowest value was found in season 1 at site 2.

In this study, the protein content of *Citrus aurantium* L. leaves and roots in all three sites were decreased compared with that in the control site. The higher decrease with a significant difference in protein content was in sites 1 and 2 compared to site 3 and the control site because of the increasing of pollutants from Al-Daura power station in these sites.

Table 11 : Protein content (μg/g) of the leaves of *Citrus aurantium* L. for the two seasons

Site	Season		Mean
	1 December 2014	2 March 2015	
Control	362.13 ± 3.22	379.29 ± 3.97	370.71 ± 4.35 A
1 (0.5 Km distance)	355.40 ± 4.21	364.90 ± 4.61	306.15 ± 2.91 C
2 (1 Km distance)	298.19 ± 2.72	309.13 ± 4.25	303.66 ± 5.67 C
3 (2 Km distance)	312.22 ± 3.23	323.80 ± 5.22	318.01 ± 3.77 B
Mean ± SE	331.98 ± 8.36 B	344.28 ± 7.69 A	---
*LSD value: Site: 9.26 *, Season: 6.553* , Interaction of Site × Season: 13.66 * (P>0.05) N.S: Not significant*			

Table 12 : Protein Content (μg/g) of the roots of *Citrus aurantium* L. for the two seasons

Site	Season		Mean
	1 December 2014	2 March 2015	
Control	268.58 ± 4.62	291.22 ± 5.81	279.9 ± 3.95 A
1 (0.5 Km distance)	251.50 ± 4.59	257.61 ± 3.67	254.55 ± 2.96 B
2 (1 Km distance)	243.44 ± 7.41	247.39 ± 4.28	245.415± 3.93 B
3 (2 Km distance)	267.21 ± 5.05	271.60 ± 4.52	269.405± 2.99 A
Mean ± SE	257.68± 4.74 B	266.95 ± 2.80 A	---
*LSD value: Site: 10.36 * , Season: 7.32 * , Interaction of Site × Season: 14.78 * (P>0.05), N.S: Not significant*			

The presence of high levels of heavy metal ions causes a wide range of cellular responses including changes in genes expression and synthesis of metal-detoxifying peptides (Yousefi, 2009). While, Bhardwaj *et al.* (2009) found that the protein content, total soluble sugar as well as photosynthetic pigments was decreased as concentrations of heavy metals increased in comparison with the control plants.

The use of composted sewage sludge which contains a high metals concentration could result in an increase in the metal accumulation in the plant leaves and roots. Such phenomenon has an effect on the plant development, biomass, protein and chlorophyll content (Kevresan *et al.,* 2001).

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Environmental Noise Assessment of Fuelless and Gasoline Power Generating Set

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Abstract- Noise pollution which is an unwanted sound is one of the most dangerous environmental pollution because it usually leads to damage of auditory and even leads to stress for human in most cases. This research work investigate environmental noise produce by fuelless power generating set and gasoline power generating set of the same capacity (1KVA). The materials used for this research work includes, 1KVA Gasoline Generating set, 1KVA Fuelless Generating set, Extech sound meter, meter rule, load box, multimeter and stop watch. Extech Instrument Sound Level Meter and meter rule was used to determine the sound performance of the electrical machines. The result of the research revealed that the sound performance analysis for fuelless Power generating set is within the allowable range set (38.4dB) by Occupational Safety and Health Administration (OSHA) Federal Safety regulations (2007) compared to gasoline power generating set with 66.5dB. In wrapping up the investigation on the fuelless and gasoline generating set in terms of noise assessment, the analysis has clearly revealed that fuelless generating set noise is better than gasoline power generator of the same capacity.

Keywords: *environmental pollution, fuelless generator, gasoline generator, assessment.*

GJSFR-H Classification : *FOR Code: 059999p*

ENVIRONMENTALNOISEASSESSMENTOFFUELLESSANDGASOLINEPOWERGENERATINGSET

Strictly as per the compliance and regulations of :

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Keywords: environmental pollution, fuelless generator, gasoline generator, assessment.

I. Introduction

Maini (1998) has discovered that the fuelless engine usually runs very smooth and quiet and the best part of the design is that it is free from air pollution, since there is no emission of dangerous gas like Carbon monoxide (CO), carbon-dioxide (CO_2), etc. The speed are adjustable or can be built to run at one speed with engine which does not run on any type of gasoline, oil or other combustible fuel. The free electrical energy produced by the fuelless generators is replaced back into the motor and reused by the motor. While a power generator is a device that converts mechanical energy to electrical energy for use in an external circuit.

Joseph (1997) has observed that noise is a hazard that human being expose to every day without consideration. It can cause physical problems such as permanent hearing loss, as well as psychological traumas, like stress. More and more requirements by regulating bodies, like OSHA (Occupational Safety and Health Administration), are being applied to every facet of daily life in order to reduce noise pollution. There are two general methods which can be used to achieve the required noise levels; active and passive noise control. Active noise control (ANC) is specific in its application. It works well for the control of low frequency noise sources. ANC requires state-of-the-art electronic hardware and precise computer software. Today it remains one of the more expensive forms of noise control, often requiring large amounts of engineering time and costly control systems. The most cost effective and widely used form of noise suppression is still passive noise control. Passive control is achieved by the use of barriers, enclosures or some type of acoustical material. Barriers are large panels that interrupt the direct "line of sight" from the noise source to the receiver (Oldham and Hilarby, 1991).

Dennis (2007) has cited by Adewumi (2014) has described sound has what the human ear hears while noise is simply unwanted sound. Sound is produced by vibrating objects and reaches the listener's ear as pressure waves in the air or other media. Sound is technically a variation in pressure in the region adjacent to the ear. When the amount of sound becomes uncomfortable or annoying, it means that the variations in air pressure near the ear have reached too high an amplitude. The human ear has such a wide dynamic range that the decibel (dB) scale was devised to express sound levels. The dB scale is logarithmic because the ratio between the softest sound the ear can detect and the loudest sound it can experience without damage is roughly a million to one or 1:106.

Cummins (2007) has clearly revealed sources of generator set noise. Six major noise sources from generator set was discussed;

i. *Engine noise* – This is mainly caused by mechanical and combustion forces and typically ranges from 100 dB(A) to 121 dB(A), measured at one meter, depending on the size of the engine.
ii. *Cooling fan noise* – This results from the sound of air being moved at high speed across the engine and through the radiator. Its level ranges from 100 dB(A) to 105 (A) dB at one meter.
iii. *Alternator noise* – This is caused by cooling air and brush friction and ranges from approximately 80 dB(A) to 90 dB(A) at one meter.

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iv. *Induction noise* – This is caused by fluctuations in current in the alternator windings that give rise to mechanical noise that ranges from 80 dB(A) to 90 dB(A) at one meter.

v. *Engine exhaust* – Without an exhaust silencer, this ranges from 120 dB(A) to 130 dB(A) or more and is usually reduced by a minimum of 15 dB(A) with a standard silencer.

vi. Structural/mechanical noise – This is caused by mechanical vibration of various structural parts and components that is radiated as sound.

MIT (2015) has identified that the ear has three main parts. They are called the outer, middle, and inner ears. The *outer ear* consists of the organ on the side of our heads that we usually call simply "the ear". (The scientifically accurate name for this structure is the pinna.) Also included in the outer ear is the ear canal. This is the hollow tube that leads from the pinna into the head. It terminates in the eardrum which is technically known as the tympanic membrane. The purpose of the external ear is to transmit sounds from the outside world into the more internal parts of the auditory system. While one can simply think of the pinna and ear canal as a simple funnel for collecting sounds, in reality they perform some important functions. The pinna has various ridges and folds that act to reflect and absorb certain frequency components of the sound wave . Because the pinna is not circularly symmetric, sounds which come from different directions will have slightly different spectral characteristics. (This means that certain frequencies will be slightly louder or softer depending on the direction they enter the ear.) As a result, sounds which come from above our heads seem slightly different than sounds coming from below. This allows us to localize (pinpoint the direction of) a sound source. We therefore immediately look up when someone calls us from an upper story window.

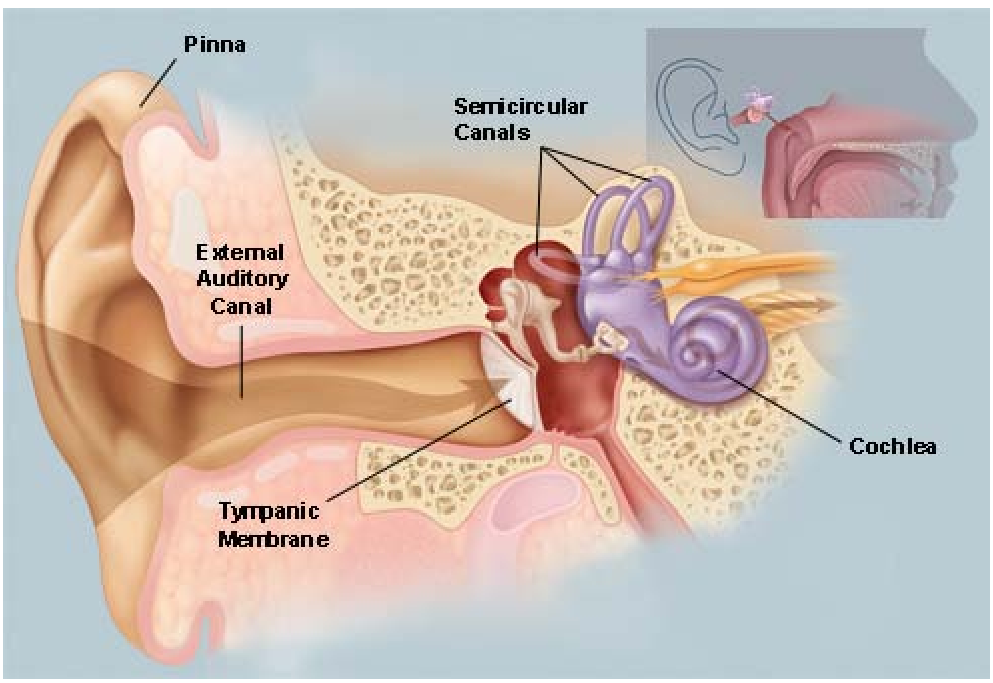

Figure 1 : Human Ear (Source: WebMD 2014)

Barry (2015) has discovered that the dynamic range of the auditory system, which is the interval between the softest and loudest sounds that the ear can hear, is more than 120 decibels. The decibel is the log of the ratio of two quantities multiplied by 10. This means that the ear can hear sounds whose strength lies anywhere within a range of over 12 orders of magnitude. The ear is sensitive enough that it can detect sounds which are so weak that the air molecules move less than the diameter of an atom! But yet it is also able to handle much louder sounds without overloading and saturating ("maxing out") which would cause undesirable distortion. This is accomplished by means of an automatic gain control system (AGC) which attenuates the response to louder sounds.

II. Materials

The materials used for this research work includes, 1KVA Gasoline Generating set, 1KVA Fuel less Generating set, Extech sound meter, meter rule, load box, multimeter and stop watch.

1KVA Fuelless Power Generating Set

1KVA TIGMAX Gasoline Generating Set

III. Methods

Extech Instrument Sound Level Meter and meter rule was used to determine the sound performance of both fuel less and gasoline generating set (1KVA). Five different runs were set for distance of 5m, 10m and 15m respectively. The result of the sound are stated below in Table 1 -4.

Sound Performance Analysis Result

Table 1 : Sound Performance at distance of 5 meters apart

Trial	Distance from property line (m)	Time (Sec)	Fuel less Noise level (dB)	Gasoline Noise (dB)
1	5	60	50.9	66.9
2	5	120	50.5	66.5
3	5	180	49.2	66.4
4	5	240	50.6	66.5
5	5	300	50.7	66.4
		Mean	50.38dB	66.54dB

Source: Field Work (2015)

Table 2 : Sound Performance at distance of 10 meters apart

Trial	Distance from property line (m)	Time (Sec)	Fuel less Noise level (dB)	Gasoline Noise (dB)
1	10	60	44.5	63.5
2	10	120	43.9	62.9
3	10	180	44.2	63.1
4	10	240	43.6	62.4
5	10	300	44.2	62.5
		Mean	44.08dB	62.88dB

Source: Field Work (2015)

Table 3 : Sound Performance at distance of 15 meters apart

Trial	Distance from property line (m)	Time (Sec)	Fuel-less Noise level (dB)	Gasoline Noise (dB)
1	15	60	37.1	54.5
2	15	120	38.3	55.2
3	15	180	38.8	54.3
4	15	240	38.5	54.4
5	15	300	39.3	55.2
		Mean	38.4dB	54.72dB

Source: Field Work (2015)

Table 4 : Mean Noise Level Performance for Fuel less and Gasoline Generating Set

Trials	Time (Sec.)	Distance (Meter)	Fuel-less Sound (dB)	Gasoline Sound (dB)
5	300	5	50.38	66.54
5	300	10	44.08	62.88
5	300	15	38.4	54.72

Source: Field Work (2015)

IV. Discussion

The above Table 4 revealed that in terms of sound performance fuel less generator is better than gasoline generating set as the noise level ranges from 38.4dB at distance of 15meters away from the building to 50.38dB which is still in range of quite to moderately loud as reported by Dennis (2007). While that of gasoline generating set ranges from 54.72dB to 66.5dB which is moderately loud according to typical noise level chart by Dennis (2007).

According to Occupational Safety and Health Administration (OSHA) Federal Safety regulations (2007) as cited in Dennis (2007) explained sound as what the human ear hears; noise is simply unwanted sound. Sound is produced by vibrating objects and reaches the listener's ear as pressure waves in the air or other media. Sound is technically a variation in pressure in the region adjacent to the ear. When the amount of sound becomes uncomfortable or annoying, it means that the variations in air pressure near the ear have reached too high amplitude. With maximum noise levels permitted at a property line that range from 52 dB(A) to 72 dB(A), depending on location and zoning, and untreated generator set noise levels that approach 100 dB(A) or more, it is clear that generator set noise mitigation will be a subject of great importance.

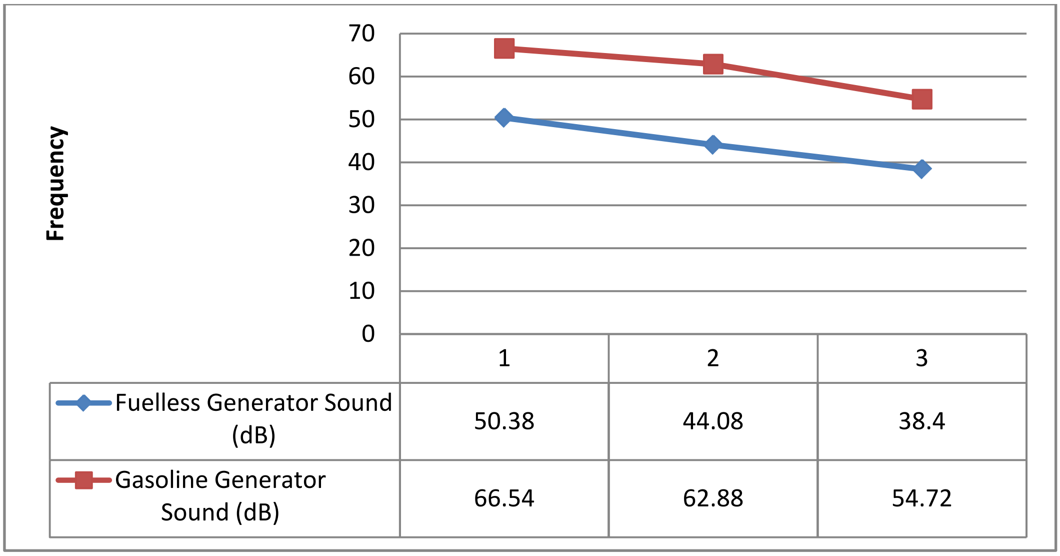

Figure 2 : Noise level variation between fuel less Generating set and Gasoline type

V. Conclusion

In wrapping up the investigation on the fuel less and gasoline generating set in terms of noise assessment, the analysis has clearly revealed that fuel less generating set noise is better than gasoline power generator of the same capacity. It was also discovered that both of the power generating set must be place at distance of 15m away from the user in order not to have any health related issues like ear defect, blood related diseases among others, due to the environmental issues associated.

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Removal of Toxic Metals Contaminated Soil using Different Amendments and Sunflower Species (*Helianthus Annuus*)

By Sumedha Chauhan & S. S. Yadav
M.J.P. Rohilkhand University, India

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Species *Helianthus Annuus* (Sunflower) grown in contaminated soil and after washing with tap water. The soil were mixed with different amendments (SSP, $CaCo_3$, FYM and $CaCo_3$+ FYM).After harvesting the plants were treated with Di–Acid solution and prepare sample with double distal water. The observed uptake of concentration of Cu (72480μg pot^{-1}), Ni (2660 μg pot^{-1}) and Zn(8217 μg pot^{-1}) in sunflower species at flowering.

GJSFR-H Classification : *FOR Code: 059999p*

REMOVALOFTOXICMETALSCONTAMINATEDSOILUSINGDIFFERENTAMENDMENTSANDSUNFLOWERSPECIESHELIANTHUSANNUUS

Strictly as per the compliance and regulations of :

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Sumedha Chauhan α & S. S. Yadav σ

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I. Introduction

Heavy metals input to arable soils through fertilizers courses increasing concern for their potential risk to environmental health. Lu et al (1992), reported that the phosphate fertilizers were generally the major source of trace metals among all inorganic fertilizers and much attention had also been paid to the concentration of Cu, Ni and Zn in phosphate fertilizers.

Agriculture use of pesticides was another source of heavy metals in arable soils from non-point source contamination. although pesticides containing Cd, Hg and Pb had been prohibited in 2012,there were still other trace elements containing pesticides in existence, especially Cu and Zn. A survey also showed that heavy metal concentration in surface horizon and in edible parts of vegetables increased over time. Pandey et al (2000), reported that the metal concentration in soil increased from 8-12 mg kg^{-1} for Cd and Zn 278-394 mg kg^{-1}.

They also suggested that if the trend of atmospheric deposition is continued, It would lead to a destabilizing effect on sustainable agricultural practice and increase the dietary intake of toxic metals. The vegetables and crops growing in such area constitution risk due to accumulation of metals in India (Sinha et al,2006)

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II. Soil Pollution Control and Remediation

Conventional approaches employed for control and remediation of metals from contaminated sites include.

a) Fixation

The chemical processing of soil to immobilize the metals, usually followed by treatments of the soil surface to eliminate penetration by water.

b) Land filling

The excavation transport and deposition of contaminated soils in a permitted hazardous waste land.

c) Leaching

Using acid solutions as proprietary leaching agent to leach metals from soil followed by the return of clean soil residue to site (Krishnamuthy; 2000)

d) Green cut technology

This technology can be used for the remediation of metal contaminated sites. The bio-availability of metals to plants is affected by different factors such as soil and plant characteristics and various environmental factors. Green cut technology is another emerging low-cost in site technology. Emerging low-cost in sit technology employed to remove pollutants from the contaminated soils.

III. Materials and Method

FYM, SSP, $CaCo_3$, and combination of $CaCo_3$ + FYM for each pots samples. Each pot samples were added with urea and KCl for N, for the potash KCl will be add in the form of KCl. Sample pots were used to prepare a samples.

(a) Apparatus- AAS(Atomic adsorption spectrophotometer) for metal analysis.P^H mettry, mental heater, sample collection bottle, Whatman filter papar, Conical flask.
(b) Processing of the soil and pot filling- Collection of soil from an agricultural land .The soil samples were air-dried and sieved to give < 2mm particle size.4 kg soil was taken in with mixed with fertilizer solution and N,P, and K nutrient were applied as per the set.

(c) Collection and processing of Plant and soil samples- After the harvest of the plants was dried, the collected biomass and it was first dried at 70˚C in oven for loss of moisture. Dry weight of both biomass and make a powder from and digestion for the determination of heavy metal digestion of a sample were analyzed Zn, Cu and Ni toxic metals using AAS (GBC 904 AA)

IV. Result and Discussion

Table 1 : FYM, SSP, $CaCo_3$ and $CaCo_3$ + FYM achieve heavy metal in plant the concentration were shown in table -1

S.N.	Treatment Composition	Mean metal Uptake (µg pot^{-1})	Using treatments
1.	Cu	6497	4 Kg soil + Cu
2.	Cu + FYM	6137	4 Kg soil+Cu+ FYM
3.	Cu + SSP	8760	4 Kg soil+ Cu + SSP
4.	Cu + $CaCo_3$	10290	4 Kg soil+ Cu + $CaCo_3$
5.	Cu + $CaCo_3$ + FYM	3790	4 Kg soil+ Cu + $CaCo_3$ + FYM
6.	Ni	1590	4 Kg soil+Ni
7.	Ni+ FYM	2670	4 Kg soil+Ni+ FYM
8.	Ni + SSP	2060	4 Kg soil+ Ni+ SSP
9.	Ni + $CaCo_3$	3040	4 Kg soil+Ni + $CaCo_3$
10.	Ni + $CaCo_3$ + FYM	2920	4 Kg soil+ Ni + $CaCo_3$ + FYM
11.	Zn	4790	4 Kg soil+Zn
12.	Zn + FYM	8860	4 Kg soil+Zn+ FYM
13.	Zn + SSP	7151	4 Kg soil+Zn + SSP
14.	Zn + $CaCo_3$	8370	4 Kg soil+Zn + $CaCo_3$
15.	Zn + $CaCo_3$ + FYM	8100	4 Kg soil+Zn + $CaCo_3$ + FYM

Table 2 : Interaction effect of amendments ad metals on metal uptake in Sunflower (*Helianthus Annuus*) (µg pot^{-1})

S.N.	Amendments	Cu metal	Ni metal	Zn metal	mean
1.	FYM	61370	2630	8860	24287
2.	SSP	87670	2043	7517	32410
3.	$CaCo_3$	10190	3040	8373	7235
4.	$CaCo_3$ + FYM	37930	2927	8117	16325
	mean	72480	2660	8217	

V. Plant Sample

soil were mixed with different manner like Cu, Cu + FYM, Cu+ SSP, Cu + $CaCo_3$ and Cu + $CaCo_3$ + FYM, and for Ni metal Ni, Ni + FYM, Ni+ SSP, Ni + $CaCo_3$ and Ni + $CaCo_3$ + FYM, and also for Zinc metal Zn, Zn + FYM, Zn+ SSP, Zn + $CaCo_3$ and Zn+ $CaCo_3$ + FYM. In plant sample pots metal were mixed at the range of 0 and 20 Zn + 10 Cu + 25 Ni (mg/kg) soil. In different compression mean amendments and metals interaction metal uptake were Cu (72480), Ni (2660) and Zn (8217) µg pot^{-1} for the sample mixture of sunflower (*Helianthus Annuus*).

VI. Conclusion

Toxic heavy metal contamination of arable soil showed several problem including phototoxic effect of elements like Cd, Zn and Cu. Sunflower is the best plant species to carry out phytoextraction of Cu in the presence of SSP amendments. Motior M. Rahman, Sofian M., Azirum and Amru N. Boyce (2013) also found that the Pb and Cu uptake ability of sunflower was appreciably greater than Indian mustard and amaranthus.

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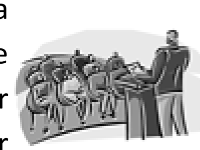

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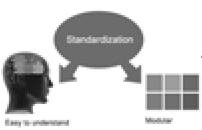

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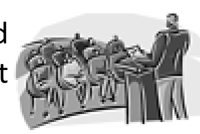

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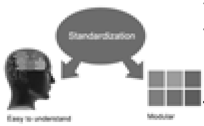

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3. Submission of Manuscripts,

4. Manuscript’s Category,

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- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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