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ACCUMULATION OF HEAVY METALS IN PLANT LEAVES (*SALIX ALBA*) AND ITS EFFECT ON CHLOROPHYLL CONTENT NEAR THE DIESEL GENERATORS ASSOCIATIONS IN IRAQ

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Abstract

The air pollution by Emissions of Generators working by Diesel fuel due to the absence of National electricity, Iraq's Plants and people breathe heavy metals due to government negligence for its People is consider the most risk environmental problems, especially when precipitate on soil surface and transport to the plants. So that, the A current study was conducted to determine the effects of heavy metals on plant growth of plants and how to detect pollution by variables including chlorophyll content, the study was carried out in Baghdad city, identified more than two regions for each of the both sides more than two main sites for each region.

Salix alba plants was chosen to evaluating the pollution on the plants because its being of the most common trees in the Baghdad s' streets . Primary content in plants was measured as total chlorophyll recorded a height concentration (132.7mg/g) in *Salix alba* leaves in un-polluted areas while chlorophyll decreased in polluted areas and values reached to 11.88 (mg/g), chlorophyll a recorded a height concentration (87.47m/gm) in *Salix alba* leaves in un-polluted areas while chlorophyll a decreased in polluted areas and values reached to10.01(mg/g). chlorophyll b recorded a height concentration.

(45.23mg/g) in *Salix alba* leaves in un-polluted areas while chlorophyll b decreased in polluted areas and values reached to (1.87mg/g).

Heavy metals concentrations in the leaves of reached to maximum concentration Cu , Cd, Pb and Cr (78.8, 35.9, 31.8, 10.4) ppm respectively in *Salix alba* leaves in un-polluted areas while decreased in polluted areas and values reached to (48.3, 16.1, 12.3, 3, 2.1) ppm respectively compared with control (3-15, 1-10, 1-5, < 0.1-1) respectively . the increase in concentration of pollutants (heavy metals) affected on the chlorophyll content. This study period in the following order: Cu > Cd > Pb > Cr.

Key words: Heavy metals , pollution , *Salix alba* plant , chlorophyll content , Diesel engine

Introduction

Diesel engine source for industrial activities, construction and energy facilities. The researchers reported adverse effects of diesel engine emissions on the human of health as well as heavy metal. Heavy metals can be define that elements with a specific gravity that is not less than five times the specific gravity of water, which is expressed as 1- 4°C, which refers to mineral elements with an atomic weight greater than 55.8 g/mol; It cannot be metabolized, so the bioaccumulation is transmitted by the food chain to humans. Many researchers say that plants in the city of Baghdad have discovered a significant rise in the concentration of heavy metals in different sampling media (Kabata, A.; Pendias, H.; D.C. 2001).

Willows {*Salix alba*} are trees light demanders and has moisture loving plants can be grow of the from requesting trees and have moisture-loving plants that can grow in marshlands. The genus *Salix alba* was divided into 32 series, as this tree center grows abundantly in China, Iraq and the Soviet Union. The properties of these trees are easy and cheap to establish in clippings, build fertility among the poor and depleted of the soil, as well as great value for wildlife especially birds and insects. They respond well to regular coppice, providing a sustainable source of diversity material for uses. These trees are suitable for the accumulation of heavy plant elements and heavy metals. Use these trees in plant

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treatment to remove heavy metals (chromium, nickel, copper, zinc, , etc.) from contaminated water, air and soil deposits. (Yulia, Michael & Martin 2004; Greger, Landberg 1999; Chandra, Quratul, Dr. Bhanwar, Ajmer 2016).

Heavy metals affect on the plant to reaches the indicators of the start of toxicity appear on the plant during the discoloration of chlorophyll pigment and caused chlorosis. Chlorophyll is one the main Photosynthetic Pigment with four rings of quaternary role consisting consist of the central magnesium Mg^{+2} and long hydrophobic phytol tail (Nilay, Sudipta 2017).

Effect of heavy metals in the plant may cause inhibition of pigment synthesis and change with color include defects of chlorophyll synthesis resulting in leaves Chlorination and chlorophyll change A, B and total chlorophyll (Gangwar Singh, Srivastava and Maurya2011; Huang, Wang, Yang and Gupta 2013: Viehweger and Geipel 2010).

Materials and Methods

Salix alba leaves plant in two sites (control and pollution).

acetone solution is 80 % reagent used in this work.

DDI (doubled –ionized distil water).

Balance, heater, beaker, cylinder, filter paper.

TBA (Thiobarbituric acid), TCA Trichloro acetic acid

Nitric acid - Perchloricacid.

FAAS (flame atomic absorption spectroscopy) Sense AA.

Spectrophotometer PYE –Unicom type SP8-100 UV –ViS.

Preparation heavy metal samples

Samples were placed in PE bags and transported to the laboratory for analysis. All samples were washed with tapewater followed by DDI (deionized double distilled water). Samples were cut into small pieces and dried at 105°C for 18 hours (Robert & Glandys 1987). After drying the samples the ground was in powder form. About 1.0 g of each sample in triplicate taken in digestion tubes, soaked in 40ml of nitric acid and perchloric acid (3:1) and left overnight to get full contact of the material. The next day, the samples were first digested at 120°C for 2 hours and then 180°C on the heating digester until the solution was transparent. Digestion stopped when the sample solution was reduced to 2-3 ml. Refrigerated samples were transferred to 100 ml. Volumetric flask and volume are raised to the mark with. 0.1 M HNO3. Finally wash with DDI water (HEATH and PACKER 1996) According to the instruction manual of the tool provided by the manufacturer, a heavy metal analysis was performed using an atomic spectrophotometer.

Results and Discussion

In plants emerge as an important field of research in recent years due to increased environmental pollution(Sharma, Hundal, Sharma, Bhardwaj 2014) The results of this study are toxic effects of heavy metals on plants Salix s alba and early sensors while determining chlorophyll content. More than one area in the city of Baghdad was selected to analyze heavy metals and the plant's ability to absorb the toxicity generated by civil generators because of the lack of electricity supplied to homes to resort to diesel generators. Shown in Table 1 below. The mean (average) of 5 replicates + SD (*) statistically of the significant at $p < 0.05$.

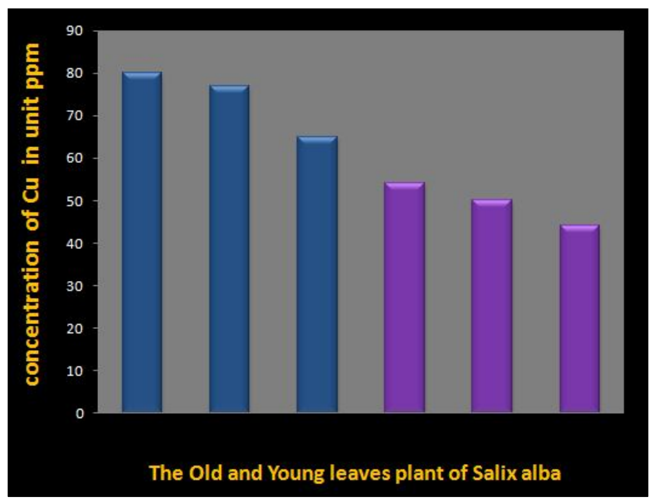

Fig. 1: Show accumulation heavy metal (copper) in *Salix s alba* leaves plant.

Table 1: Effect of heavy metals(concentrations) in *Salix alba* leaves plant . (ppm). All the values are average of five replicates ± S.D(*).

Site of Plant	Plant name	Cu	Cd	Pb	Cr
A old leaves	*Salix alba*	78.8±0.01	35.9±0.02	31.8±0.02	10.4±0.04
B	*Salix alba*	76.5±0.01	27.8±0.01	29.7±0.01	8.4±0.04
C	*Salix alba*	69.3±0.02	25.7±0.03	20.3±0.01	5.2±0.03
A young leaves	*Salix alba*	53.8±0.02	18.8±0.04	17.8±0.01	3.7±0.03
B	*Salix alba*	50.5±0.04	17.5±0.04	15.7±0.02	2.8±0.03
C	*Salix alba*	48.3±0.02	16.1±0.02	12.3±0.02	2.1±0.02
Control *in unit mg kg*$^{-1}$	*Salix alba*	3-15	1-10	1-5	<0.1-1

A : The polluter is within walking distance of 1 meter
B : The polluter is within walking distance of 2 meter
C : The polluter is within walking distance of 4 meter

The results showed were significant difference between more than sites, this different attributed to reason for this pollutants emitted (heavy metals) resulting from diesel generators were causing increase in heavy metals observed in table 1. the concentration of heavy metals Cu, Cd, Pb and Cr in old leaves *Salix alba* increased 78.8, 35.9, 31.8 and 10.4 ppm respectively while in young leaves *Salix alba* the concentration of heavy metals Cu, Cd, Pb and Cr were 53.8, 18.8.17.8 and 3.7 ppm respectively. Heavy metal Pb, Cd, Cu and Cr in old leaves *Salix alba* levels decreased at 69.3, 25.7, 20.3 and 5.2 ppm while in young leaves *Salix alba* were 48.3, 16.1, 12.3 and 2.1 ppm continuously compared to control 3-15 1-10, 1-5, < 0.1-1 mg kg^{-1}.

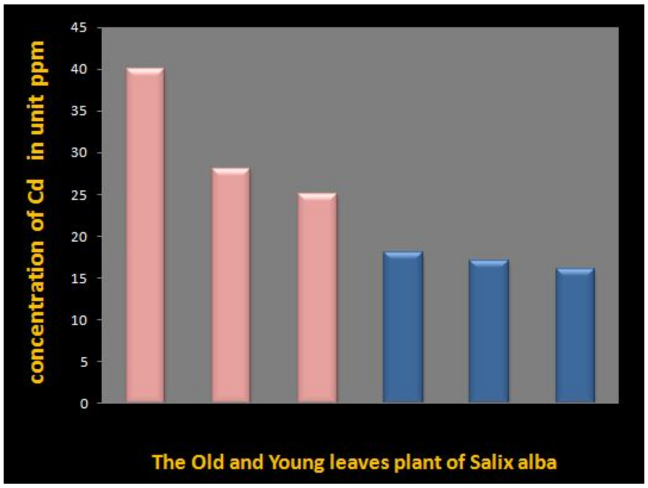

Fig. 2: Show accumulation heavy metal (cadmium) in *Salix s alba* leaves plant.

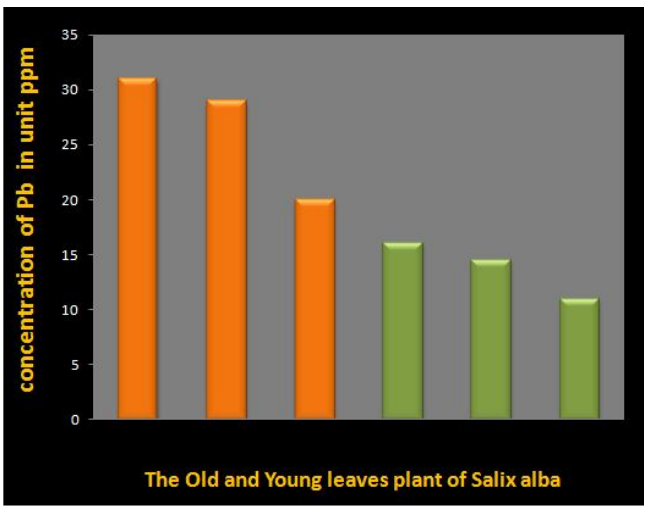

Fig. 3: Show accumulation heavy metal (lead) in *Salix s alba* leaves plant.

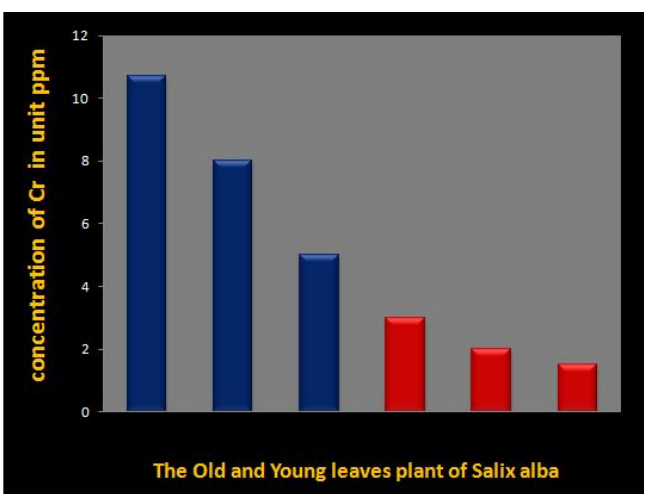

Fig. 4: Show accumulation heavy metal (chromium) in *Salix s alba* leaves plant.

The greater the distance from the generator the less the accumulation of heavy elements in the plant and The

Table 2: Concentration of Chlorophyll a and Chlorophyll a(mg/g) in *Salix alba* spp. (mg / g). All the values are average of 5 replicates ± S.D(*).

Regions	Treatment	Chlorophyll a (mg/g) unit	Chlorophyll b unit(mg/g)	Total Chlorophyll unit(mg/g)
Baghdad	A	87.47± 0.034 *	45.23± 0.022*	132.7± 0.026*
	B	69.65 ± 0.032*	38.54 ±0.032*	108.1± 0.031*
	C	38.33±0.034*	21.98±0.33*	60.31± 0.035*
	A	81. 43 ±0.042*	40.98±0.040*	122.41 ±0.042*
	B	63.28 ±0.040*	30.87±0.042*	94.15±0.042*
	C	32.16 ± 0.036*	18.87±0.035*	51± 0.035*
	A	77.35 ± 0.02*	34.45±0.003*	111.8 ± 0.011*
	B	59.87±0 .03*	27.05 ± 0.04*	86.92 ± 0.037*
	C	28.1±0.022*	14.78 ± 0.031*	42.88 ± 0.041*
	A	68.91±0.02*	30.76 ± 0.023*	99.67 ± 0.031*
	B	53.56 ±0.027*	24.12 ± 0.021*	77.68 ± 0.032*
	C	21.23±0.031*	12.20 ± 0.023*	33.43 ± 0.017*
	A	60.75±0.03*	26. 43 ± 0.021*	87.18 ± 0.026*
	B	59.23±0.022*	20.10 ± 0.021*	79.33 ±0.03*
	C	19.44±0.031*	10.94 ± 0.004*	30.38 ± 0.03*
	A	56.58±0.02*	20.12 ± 0.022*	76.7 ± 0.025*
	B	54.87±0.024*	17.40 ± 0.022*	72.27 ± 0.03*
	C	19.10±0.04*	9.97 ± 0.034*	29.07 ± 0.035*
	A	54.4 ± 0.032*	17.86 ±0.042*	72.26 ± 0.032*
	B	50.43 ± 0.04*	10.15 ±0.031*	60.58 ±0.032*
	C	18.38 ±0.03*	8.54 ±0.025*	26.92 ±0.040*
	A	48.59 ±0.025*	13.53 ±0.020*	62.12 ±0.030*
	B	47.87 ±0.022*	8.10 ±0.032*	55.8 ±0.033*
	C	16.33 ±0.028*	4.98 ±0.028*	21.31±0.030*
	A	40.21 ±0.022*	10.49 ±0.025*	50.7 ±0.033*
	B	38.14 ±0.021*	6.20 ± 0.026*	44.34 ± 0.034*
	C	14.72 ±0.034*	3.97 ±0.042*	18.69 ±0.022*
	A	30.58 ±0.035*	5.19 ±0.044*	35.66 ±0.031*
	B	17.43 ±0.034*	3.98 ±0.04*	21.41 ±0.028*
	C	10.01 ±0.02*	1.87 ±0.032*	11.88± 0.025*

A : The polluter is within walking distance of 1 meter
B : The polluter is within walking distance of 2 meter
C : The polluter is within walking distance of 4 meter

closer we get to the generator the greater the accumulation of heavy elements in the plant , accumulation of heavy metals with high concentration in the Baghdad plant in compared to the control values due to pollution of Baghdad plant, where paper tissue stores the largest amount of Heavy metals. The descending order of heavy elements in the leaves indicates that Cu> Cb> Pb> Cr indicates systematic absorption of trace elements from leaves. In plants, concentrations of toxic heavy metals that inhibit growth and change a number of physiological and biochemical properties Where the leaf plant tissues store the largest amount of heavy metals The descending

Fig. 5: Show chlorophyll a in *Salix s alba* leaves plant.

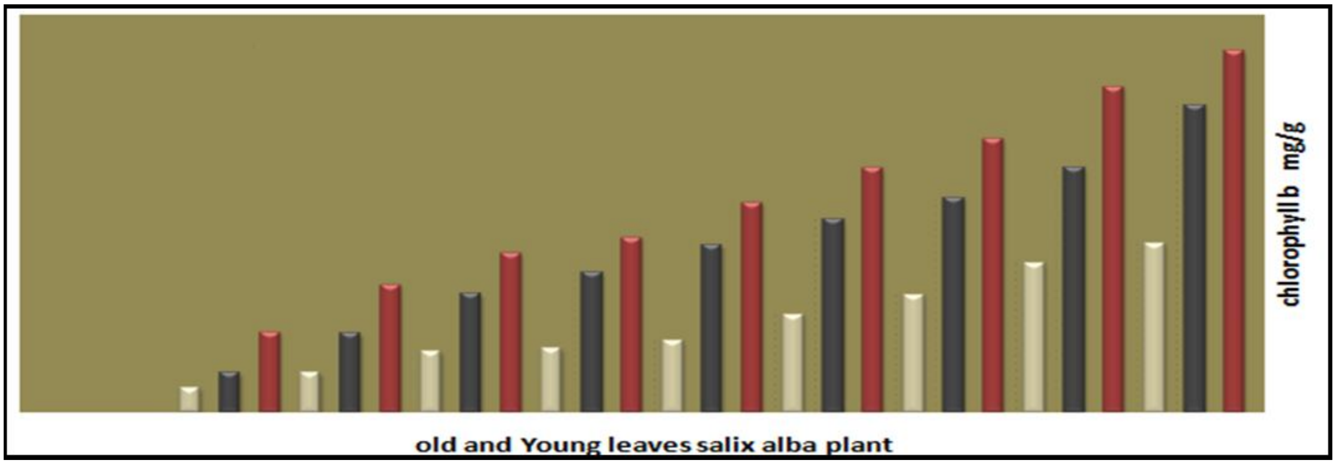

Fig. 6: Show chlorophyll b in *Salix s alba* leaves plant.

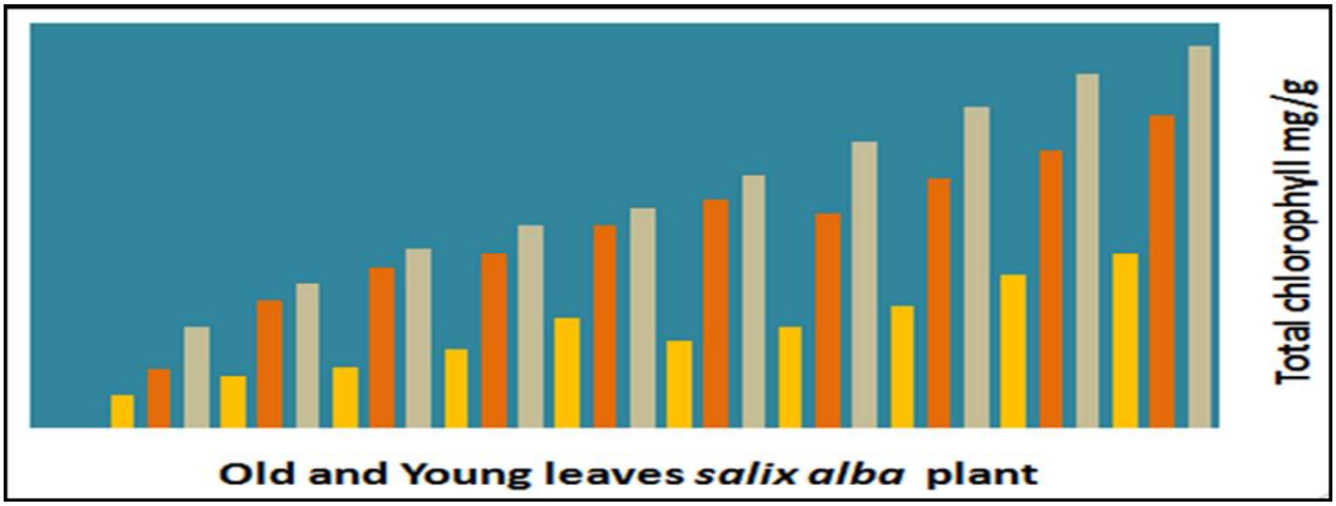

Fig. 7: Show Total chlorophyll in *Salix s alba* leaves plant.

order of heavy elements in the leaves indicates that Cu > Cd > Pb > Cr indicate a systematic absorption of trace elements from leaves. In plants, concentrations of toxic heavy metals that inhibit growth and change a number of physiological and biochemical properties. The heavier elements in the leaves of the old plant are more important than the new elements in the long period that absorbed the heavy elements while the new elements have a shorter duration These heavy metals come from many different sources we will identify on all heavy metals.

Copper (Cu): The study showed that highest value reached is the element copper and the reason for this is one of the most important micronutrients of the plant and that the highest concentration of leaves was older than modern and the reason is that the length of time was longer to collect heavy metals can Become toxic in high concentration (Gang, Vyar and Vgas. 2013; Shah, Yun-shan, Shah, Mughal and Naveed 2014; Salt, Smith and Raskin, 1998) these metals come from many different sources during waste or produced primarily in metallurgical, electrical, construction , product to non-ferrous metals, electronic, electrical equipment, heat exchanger wires and wind in engines, transformer, generator and pesticides were previously. (Salt, Smith, and Raskin, 1998) cooling water into antifreeze additives and diesel engine had higher emissions of Cd Cu, Pb Cr, Fe (Moore, Ramamoorthy 1984) This is another reason that increases the concentration of copper. The Fig. 1 illustrates accumulation heavy metal (copper) in *Salix s alba* leaves plant.

Fig. 8: Shows symptoms of leaf chlorosis and yellowness in plants.

Cadmium (Cd) is an essential element in the metabolism of the plant and may by finding a strong product diesel fuel smelting and found in batteries, Tires, paint dyes so valve gaskets of the high -pressure gas cylinders and the effect of electrochemical of electrochemical reactions at a wide range of temperatures, low speed Discharge and simplicity of battery from recharge. (Dwivedi, Agarwal and Sharma 2006; Salt, Smith and Raskin, 1998) Fig. 2 illustrates the accumulation of heavy metals (cadmium) in the Salix s alb leaf plant.

Lead (Pb): It is known that unnecessary metal for plant metabolism can be caused by mining and smelting, and the burning of leaded gasoline (Baker, A., 1993). This can be attributed to anthropogenic sources such as additives used during the refining process, absorption of minerals from storage tanks, supply vessels and the rock source from which that crude is extracted and makes water pipes, paints, printing alloys and good corrosion resistance properties as technical oil additives. Important sources of lead emission The environment mining industry has caused this element to accumulate in plant leaves (Gisbert, Ros, Deharo, Walker, Bernal, Serrano, Navarro 2003). Fig. 3 shows the accumulation of heavy metals (lead) in the Salix s alba plant. The Fig. 3 show accumulation heavy metal (lead) in *Salix s alba* leaves plant.

Chromium (Cr) is one of the most important pollutant can be found in tanning and plate industries. used in electroplating processes (Gisbert, Ros, Deharo, Walker, Bernal, Serrano, Navarro 2003) ferroalloys production, Ferrochromium alloy is widely used in production for stainless steel and heat resistant for petrochemical industry, turbines as well as cutting of the tools, decorative (Salt, Smith and Raskin, 1998) In plants, toxic chromium concentrations that inhibit growth and alter Physiological and biochemicals (Mohammed, F 2009) the main source of chromium in waste is processing of galvanic metal coatings and polishing. High - lubricity diesel reduces

Fig. 9,10: Shows show found diesel engine from plant.

friction of piston and cylinder rings as well as exhaust valves and crank shafts during operation of the diesel engine and hinders the wearing of gears, pressure rings (C. Sharma, P. Sharma and R. Tripathi 2003; A.K. Agarwal 2007; Y. Wang, H. Liu and C.F.F. Lee 2016; R. Habib, M. Salih and Z. Muhanad 2012) These heavy metals can come from many different sources. The Fig. 4 illustrates accumulation heavy metal (chromium) in *Salix s alba* leaves plant.

Chlorophyll is found in chloroplasts of green plants . Chlorophyll is not a single molecule but contains a family of related molecules, there are types of chlorophyll a, b and c, Chlorophyll a is the molecule found in all plant cells, concentrations of any heavy metal essential and nonessential may lead to toxic symptoms and growth inhibition in the plants. This decrease in photosynthesis efficiency in plant may be decrease in plant growth and biomass production in the table 2 and Figures 5, 6 and 7 showing the effects heavy metals on chlorophyll a and b.

In general, the greater the distance from the generator, the less accumulated of heavy elements in the plant and The closer we are to the generator the more accumulated of heavy elements in the plant. Heavy metal has adverse effects on the content and functions of the photosynthesis pigments. Heavy metal damage leads to inhibition of photosynthesis (pigment synthesis chlorophyll and chlorosis leaves plant, this can be symptoms of leaf chlorosis and yellowness in plants grown in high dosage of heavy metals in artificially polluted plants (Y. Wang, H. Liu and C.F.F. Lee 2016). As in Fig. 8, 9 and 10 show found diesel engine from plant.

Heavy metals reduces chlorophyll contents reduced the growth of chlorophyll. Experiment was designed to simulate heavy metals pollution by diesel fuel and to analysis mixed effect of these pollutants on *Salix s alba* plant properties, photosynthesis and heavy metals. These damages that cause air pollutants occurring significantly in the leaves of plants and include chlorosis and necrosis of leaves (R. Habib, M. Salih Muslim (2012); P. Marques, O. Rangel and P. Castro 2009; Abolghassem Emamverdian, Yulong 2017; M. Radojevic, V. Bashkin 2006; Stewart, Max Grimshaw, Parkinson, Quarmby 1974; Viehweger and Geipel 2010; Kupper *et al.*, 1996, 1998, 2002b; PIOVÁR, J. Stavrou, adukova, Kimakova and Backor 2011) these findings correspond to researcher Lada Kacálková1, Pavel, Jiøina 2014).

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