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Chemical investigation of soil and vegetation in the vicinity of brick kilns in Fateh Jang region of Pakistan

Shaheen Begum[1], Muhammad Adnan[2], Nosheen Akhtar[1], Muhammad Abdul Aziz[2], Saeeda Yousaf[3] and Akash Tariq[2]

[1]Department of Environmental Sciences, Fatima Jinnah Women University, Rawalpindi, Pakistan
[2]Department of Botany, Kohat University of Science and Technology, Kohat, Pakistan
[3]Department of Environmental Science, University of Peshawar, Pakistan

Abstract

Environmental pollution is a serious concern worldwide due to its adverse effect on both human and plants. Brick kilns generate black smoke, which contains trace elements in excess. Once such elements enter into the soil may cause toxicity to plants grown over such soils. The study objective was to assess the effect of black smoke generated from brick kilns on trace elements concentrations in soils and plants grown over such soils in the proximity of brick kilns at Fateh Jang, Rawalpindi. In total, 32 soil samples at a depth of 12 inches and associated plant samples were randomly collected in the vicinity of brick kilns towards all directions. Acid digestion of plants and soil samples was carried out along with heavy metals detection and analysis through Atomic Absorption Spectrometry. Among all heavy metals, cadmium was found to exceed the normal limits of Cd concentration in soil. Among all plant families Ranunculaceae was found to have highest Pb concentration. Euphorbiaceae family has shown high accumulation of Cu and Zn, while Fabaceae family was found good accumulator of Cd and Cr. It is concluded from the present study that smoke coming out of brick kilns contains different heavy metals. Except Cd all heavy metals were found to be in safe limits because some of the brick kilns were not functioning at the time of present research. Strict environmental laws should be implemented for brick kilns industries, plants with high accumulation potential of heavy metals are recommended to be grown in periphery of the kilns and poor quality of fuel may be replaced with less polluting fuels to avoid serious damage to animals, plants and human health.

Keywords: Heavy metals; Environmental pollution; Brick kilns; Atomic Absorption Spectrophotometer.

1. Introduction

Environment pollution is a worldwide problem posing a great threat to human and plants population (Fereidoun et al., 2007). Pollution and its contact with biological species especially animals and plants has dramatically increased now since the human survival on earth (Schell et al., 2006). There are many factors causing pollution including smoke generated from brick kilns that is most common in the developing countries. The demand for bricks has been raised many folds globally particularly Asia because of the fast spreading urbanization in cities. This demand is usually fulfilled from the bricks manufactured in the brick kilns located in peri-urban parts (CATF, 2010). It is estimated that globally there are about 300,000 brick kilns, of which 75% occurs in less developed countries such as Bangladesh, China, India and Pakistan (CATF, 2010). In Pakistan, air pollution is a rapidly growing environmental problem (Azam, 2006). Brick kilns are associated with the environmental pollution in the form of Polyaromatic hydrocarbons (Smith et al., 1996) and sulfur (Biswas et al., 2008). As an estimate, thousands of brick kilns in Pakistan (5000 in Punjab province only) are functional in the outskirts of main cities and towns (Azim et al., 2006; Kamal et al., 2014). In metropolitan area of Peshawar and its surroundings, 400-450 brick kilns are reported (EPA Pakistan, 2007). The main sources of fuel in these brick kilns include poor quality high coal, rough oil, wood and old rubber tyres. These pollution causing fuels create and contribute enormous amount of hazardous gases to the atmosphere because of incomplete combustion and thus affecting the local residents of Peshawar living in the vicinity of these brick kilns (NWFP-EPA, 2004). Most brick kilns use sulpher containing coal and other solid waste material, which results in the production of sulfur-containing (SO_X), nitrogen containing (NO_X), carbon-containing (CO_X) compounds, particulate matter (PM) along with many other organic pollutants (Hassan et al., 2012). Therefore, air pollution from brick kilns can be very hazardous to soil, plants and animals.

The vegetation is believed to be negatively affected by the deposition of dust and particulate matter that is produced and released as smoke from the brick kilns. The negative effects on vegetation are attributed to the interference with the photosynthetic activity as the deposited dust from brick kilns block the stomatal openings located on leaves and shoots thus creating hurdles to normal gaseous exchange (Creed et al., 1973). Lee et al. (2003) reported damage to the plants in the nearby areas of brick and ceramic manufacturing units in Taiwan. In India, the hazardous effects of fluoride emissions on vegetation have been reported from aluminum based industries and thermal power plants (Narayan et al., 1994). Heavy metals are commonly released with the emissions from the brick kilns. Among heavy metals cadmium (Cd) is the most toxic metal directly damage the nerve cells (Alloway, 1990). The phyto-toxicity of Cd is shown in affecting growth and development of plants by photosynthetic changes associated with the blockage of stomata, enzymatic activities, water retention, mineral uptake, protein metabolism and membrane functioning (Tran and Popova, 2011). The abnormal quantity of heavy metals in vegetation can get into the human body through ingestion and could be very harmful to health e.g. the increased amount of lead (Pb) in body can cause anemia, pale skin, abdominal pain, constipation, nausea, paralysis of the wrist's joints and increased probability of miscarriages. Pb toxicity decreases germination, length, and dry mass of roots and shoots (Munzuroglu and Geckil, 2002). The toxic effects of nickel (Ni) are primarily manifested as the inhibition of plant growth (Seregin and Ivanov, 2001). It is reported that nickel has the accumulation tendency in kidney that causes damage to it (Bethesda, 1993).

Those plants, which are going to be used as medicine or used in the manufacturing of any medicine, need to be assessed for the presence and amount of heavy metals, pesticides, bacteria and fungus as per directives of the World Health Organization. The environmental and health related impacts of heavy metals like Cd, Pb, Cr, Ni and Zn are the focus of research and are major concerns internationally. In Pakistan, air pollution is on continuous rise from the past two decades. It is extremely anticipated to take serious initiatives and research studies for addressing the air pollution and associated effects on plants, soil and water. Screening of plants for heavy metals is also very much needed as they are being used by the local people and animals. This study was therefore designed to evaluate selected heavy metals as pollutants in soil and plants in an unexplored area of Fateh Jang having greater number of brick kilns industries. Literature is very scarce regarding brick kilns industries pollution, therefore the present study will provide valuable information regarding the current level of heavy metal toxicity in the soil and vegetation near brick kilns industries. This study will further provide baseline information for future strategies of controlling heavy metal pollution in the region.

2. Materials and methods

2.1. Study area

Tehsil Fateh Jang (Fig.1) is an administrative subdivision of District Attock, Punjab, Pakistan, which can be traced between 33°10′ and 33°45′ N. and 72°23′ and 73°1′ E (Rehman et al., 2010). The Tehsil is stretched along 866 square miles area and comprised of 203 villages, of which Fateh Jang town has a total of 4,825 human population.

2.2. Soil samples collection and preparation of soil solution

About 32 samples of soil were randomly collected at depth of 12 inches deep. Samples were collected from the surrounding areas of brick kilns at different distances in Fateh Jang. The collected samples of soil were dried in air and grinded in an agate mortar by passing through a 2-millimeter sieve of stainless steel. The samples were later kept at room temperature in sealed polythene bags.

Analysis of the selected heavy metals (Cd, Cr, Cu, Ni, Pb, Zn) was carried out by taking 0.5 g of each grinded sample of soil into digestion with 60 ml of aqua regia (3HCl: 1HNO_3). Each sample was first digested with 15 ml HNO_3 and heated until the appearance of white fumes and volume was reduced to one third. It was then digested with 45 ml of HCl and given heat until white fumes appeared and the volume reduced to one third. The residue was diluted with distilled water up to 50 ml and filtered using whattman filter paper (Gary and Philips, 2000; Moller et al., 2005). Atomic Absorption Spectrophotometer (model 220 Spectra AA Varian) was used to measure heavy metals' concentrations.

2.3. Plant samples collection and preparation of plant extracts

Plants were randomly collected from the surroundings and in the surroundings of brick kilns at different distances in Fateh Jang. All the plants were uprooted and gathered in polythene bags, while their herbarium sheets were also prepared. Plants were later identified with the help of plant taxonomist. Botanical names were corrected by using the online databases "The Plant List" and "Tropicos".

Post identification of plant species, they were dried under the shade, sliced into smaller pieces and crushed by using grinder. Two grams of each crushed sample of plants were taken separately in Pyrex beaker. Further, 10 ml of HNO_3 (nitric acid) was poured in to the beaker and left for 24 hours, which was then subjected to hot plate on slow heating for the evaporation of HNO_3. Afterwards, we added four ml of perchloric acid to the beaker and slowly heated it until the perchloric acid evaporated. Later we added 10 ml of aqua regia (HCl and HNO_3) in 3:1 ratio for intensive extraction and were heated until the evaporation of aqua regia. The solution in each beaker was filtered and a 50 ml volume of each filtrate was taken finally, which were used for the determination of heavy metals through AAS.

2.4. Preparation of stock solutions

It was necessary for the heavy metals determination to calibrate AAS with the standard solutions of known concentration. For this purpose 1000 mg/l of standard stock solutions of each heavy metal was prepared by using standard protocols. Working standard fractions of 5, 10 and 15 mg/l were prepared from the aforementioned standard stock solutions for each heavy metal. Prior heavy metals concentrations were determined in the soil and plant extracts, working standards were used in the AAS for calibration. Afterwards, all the acid digested samples of soil and plants were run on AAS.

3. Results

3.1. Heavy metals in soil

Lead (Pb) has been termed as harmful for animals, microorganisms and plants if consumed in higher quantity. The acceptable concentration for food stuff is considered not to be exceeding 1 mg/kg. The average Pb concentration of all soil samples was 1.28 mg/kg. Individual soil samples have shown Pb ranged from 0.77 mg/ kg (S27, 28) to 2.13 mg/kg (S8, 9, 10). Copper (Cu) is amongst the vital elements for both plants and animals. In our study average concentration of Cu in all collected soil samples was 0.37 mg/kg. Individual sample have shown concentration range between 0.17 mg/ kg (S2) to 0.55 mg/kg (S8, 9, 10). Zinc (Zn) is an essential trace element in nutrition. The concentration of Zn in soil samples varied from 0.82 mg/ kg (S2) to 3.36 mg/kg (S4). The average concentration of Zn in all collected samples was 1.52 mg/kg (Table 1).

Cadmium (Cd) is considered highly toxic and can cause severe health related problems. Average concentration of Cd was 0.09 mg/kg in soil samples and ranged between 0.01 mg/kg (S1) to 0.10 mg/kg (S3, 8, 10, 22, 26). Nickel (Ni) was found in range between 0.18 mg/kg (S2, 4, 11, 13, 19, 21) to 0.30 mg/kg (S22 and 26) (Table 1). Chromium (Cr) is regarded as highly environmental toxic in terms of pollution across the world. Average concentration of Cr in all collected samples was 0.08 mg/kg. Individual samples showed maximum concentration 0.09 mg/kg (S5, 6, 8, 9, 15, 18, 22, 26, 30, 32) while lowest concentration recorded was 0.01 (S4, 7) (Table 1).

Table 1. Heavy metal concentrations (mg/kg) in soil samples of Fateh Jang.

Soil Samples	Pb	Cu	Zn	Cd	Ni	Cr
S1	1.14	0.36	1.28	0.01	0.27	0.05
S2	0.99	0.17	0.82	0.09	0.18	0.04
S3	2.05	0.41	1.27	0.10	0.18	0.06
S4	1.12	0.23	3.36	0.09	0.18	0.01
S5	1.06	0.42	1.28	0.09	0.19	0.09
S6	1.06	0.42	1.28	0.09	0.19	0.09
S7	1.20	0.37	1.17	0.07	0.22	0.01
S8	2.13	0.55	1.73	0.10	0.20	0.09
S9	2.13	0.55	1.73	0.10	0.20	0.09
S10	2.13	0.55	1.73	0.10	0.20	0.09
S11	1.56	0.37	1.43	0.09	0.18	0.08
S12	1.56	0.37	1.43	0.09	0.18	0.08
S13	1.56	0.37	1.43	0.09	0.18	0.08
S14	1.25	0.19	0.90	0.09	0.20	0.08
S15	1.56	0.37	1.43	0.09	0.20	0.09
S16	1.56	0.37	1.43	0.09	0.20	0.09
S17	1.56	0.37	1.43	0.09	0.20	0.09
S18	1.56	0.37	1.43	0.09	0.20	0.09
S19	0.93	0.40	1.71	0.07	0.18	0.08
S20	0.93	0.40	1.71	0.07	0.18	0.08
S21	0.93	0.40	1.71	0.07	0.18	0.08
S22	0.93	0.36	1.73	0.10	0.30	0.09
S23	0.93	0.36	1.73	0.10	0.30	0.09
S24	0.93	0.36	1.73	0.10	0.30	0.09
S25	0.93	0.36	1.73	0.10	0.30	0.09
S26	0.93	0.36	1.73	0.10	0.30	0.09
S27	0.77	0.36	0.87	0.09	0.18	0.08
S28	0.77	0.36	0.87	0.09	0.18	0.08
S29	1.08	0.51	1.35	0.09	0.18	0.08
S30	1.18	0.28	1.79	0.07	0.19	0.09
S31	1.18	0.28	1.79	0.07	0.19	0.09
S32	1.18	0.28	1.79	0.07	0.19	0.09
Average	**1.28**	**0.37**	**1.52**	**0.09**	**0.21**	**0.08**

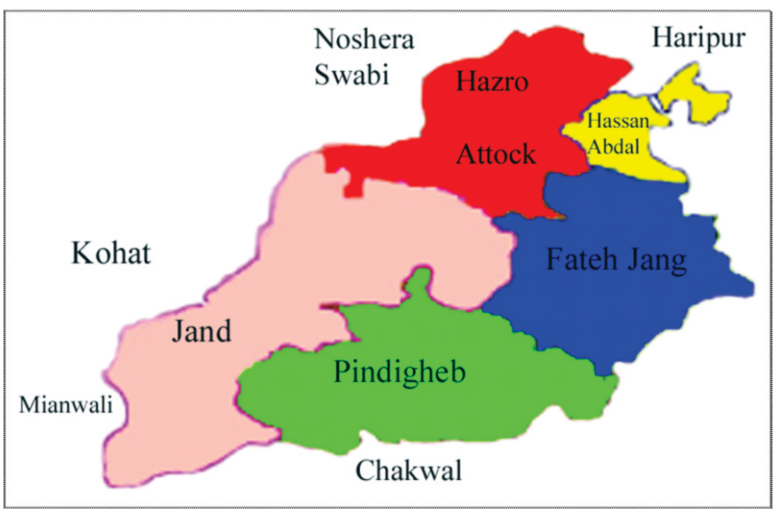

Fig. 1. Geographical location of Fateh Jang district.

Table 2. Heavy metal concentrations (mg/kg) in plant species.

Plant species/ Family name	**Sample Codes**	**Pb**	**Cu**	**Zn**	**Cd**	**Ni**	**Cr**
*Dalbergia sissoo*Roxb. ex DC.	P1	2.30	0.39	1.99	0.04	0.10	0.01
Fabaceae	P30	0.49	0.38	2.19	0.03	0.34	0.04
Ranunculus muricatus L.	P3	3.88	0.43	1.76	0.10	0.13	0.01
Ranunculaceae	P13	2.46	0.38	1.70	0.03	0.30	0.04
	P22	2.96	0.38	1.50	0.10	0.22	0.08
Calotropis gigantea (L.) Dryand.	P4	2.07	1.19	3.89	0.03	0.11	0.02
Apocynaceae	P14	1.14	0.55	2.24	0.03	0.10	0.01
	P21	2.56	0.10	1.56	0.09	0.11	0.05
Triticum aestivum L.	P5	1.12	0.48	1.31	0.07	0.21	0.01
Poaceae	P16	1.46	0.55	1.73	0.04	0.10	0.01
	P20	0.38	0.32	1.36	0.09	0.32	0.07
Cannabis sativa L.	P6	3.09	0.50	1.63	0.05	0.12	0.02
Cannabaceae	P19	2.56	0.10	1.56	0.09	0.11	0.05
Ficuscarica L.	P8	1.72	0.55	3.85	0.06	0.13	0.01
Moraceae	P24	0.51	0.20	0.73	0.04	0.41	0.05
	P27	1.68	0.38	1.72	0.03	0.11	0.10
Acacia arabica (Lam.) Willd.	P9	0.75	0.43	2.70	0.04	0.11	0.01
Fabaceae	P28	0.62	0.71	2.53	0.09	0.41	0.04
Zizyphus nummularia (Burm. f.) Wight &Arn.	P10	1.39	0.40	2.34	0.07	0.22	0.02
Rhamnaceae	P32	2.01	0.19	1.35	0.06	0.12	0.02
Thuja orientalis L.	P12	2.23	0.49	2.96	0.07	0.21	0.01
Cupressaceae	P31	1.12	0.28	1.10	0.05	0.26	0.06
Brassica campestris L.	P17	2.65	0.32	3.62	0.06	0.10	0.02
Brassicaceae	P26	0.92	0.20	1.10	0.09	0.61	0.01
Euphorbia helioscopia L.	P18	1.47	1.14	4.46	0.07	0.50	0.04
Euphorbiaceae	P23	1.59	0.36	1.01	0.04	0.11	0.08
Salvia moorcroftiana Wall. exBenth.	P2	1.78	0.47	1.66	0.05	0.20	0.02
Lamiaceae	P7	2	0.50	1.54	0.05	0.12	0.03
	P15	2.09	0.63	2.72	0.02	0.44	0.03
	P25	1.41	0.52	1.85	0.02	0.51	0.06

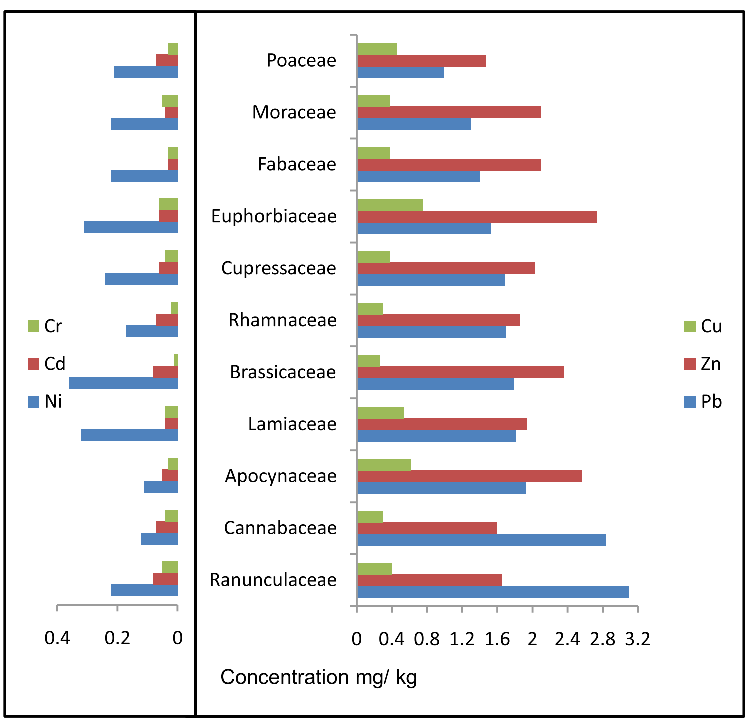

Fig. 2. Average concentrations of heavy metals in studied plant families of Fateh Jang region.

4. Discussion

4.1. Heavy metals concentration in soil samples

Concentration of heavy metal was normal in all studied samples compared to that of normal agricultural land soil. According to scientific reports, the accumulation of heavy metals through sedimentation, impaction and interception is a long process, as our study has also proved that the levels of such metals are not crossing the normal level. Our study is in line with the findings of other studies worked on the heavy metals accumulation and determination (Alloway, 1990; Kelly et al., 1996). Normal level of heavy metals in studied soil samples might be due to the minimum time of accumulation from variety of contaminating sources (Li et al., 2001). As we have observed that some of the kilns were recently non functional, so could be the factor of lower concentration in the studied soil samples. However, alteration in redox potential, pH and ionic strength of soil solution could also be responsible for shifting the holding capacity of heavy metals by soils (Gerringa et al., 2001). Ligand competition further complicates this process forming other cations (Amrhein et al., 1994; Norrstrom and Jacks, 1998). Soil redox potential influenced by rainfall, changes in land use and bioactivity in surface soil while in vadose zones it fluctuate due to changes in the water table (Boul et al., 1997). So the above mentioned different factor may greatly contribute to the availability of the metals in the soil in the studied areas.

Lead (Pb)

Lead is considered very harmful for flora and fauna but mostly for microbes. The recommended amount of lead in food materials is about 1 mg/kg. In normal agricultural soil the recommended concentration of Pb is 10 mg/kg (Bohn et al., 2001). Our results showed that the concentration of lead is below the recommended concentration level of agricultural soil, however slightly above what is recommended for food materials. Level of lead in the body increases producing variety of symptoms such as pale skin, anemia, abdominal pain, paralysis, kidney damage due to long term exposure. Due to its accumulation in body, nervous system could also get affected causing severe problems such as coma, delirium and even deaths can occur. Constant contact to lead can affect fertility of individuals and elevate birth defect or miscarriage chances (Radojovic and Valadmir, 1999).

Copper (Cu)

Pesticides, industries, fertilizers and sewerage sludge are the most common source of distributing copper in soil. In plants, toxic concentration of this metal lies between 20-100 mg/kg in range. According to Adriano (1986), the value of Cu in uncontaminated soil is 60 mg/kg. Therefore, in all the studied soil samples Cu concentration is far below than the uncontaminated soil. Looking the overall concentration of Cu in the studied samples, the range of the concentration of every sample was in safe limit when compared with the normal range recommended for agricultural lands soil (20 mg/kg) (Bohn et al., 2001). Grinding, cutting and melting of copper produce smoke or dust, which upon inhaling might cause serious health disorders such as flue, skin and hair discoloration, and metal fumes fever. It has also been reported that copper fumes inhalation is also involved in causing irritation of respiratory tract coupled with nausea (Hussain, 2006).

Zinc (Zn)

Zinc is used in variety of processes such as galvanization, alloy formation and in making a defensive covering to avoid corrosion. This metal is normally used in preparing sodium hydrosulfite, cleaning fats for soaps preparation and bleaching bone glue. Breathing zinc can causes throat dryness, weakness, cough, fever, vomiting etc. Zn concentration in all samples is not crossing the toxic level of 160 mg/kg (Adriano, 1986) as well as the recommended level for normal agricultural soil of 50 mg/kg (Bohn et al., 2001). Following the comparison of selected soil samples with that of the recommended limit for normal agricultural soil, we have concluded that the limit of this metal is in the safe limit in the brick kilns surroundings. Zn plays crucial role in increasing belated sexual growth and wound healing process. Lack of Zn in body can cause loss of senses of smell and touch while its recommended concentration is 12–15 mg (Radojovic and Valadmir, 1999).

Cadmium (Cd)

Cadmium is a poisonous heavy metal, which can cause serious health defects. Phosphate fertilizers, combustion of fossils fuel and non-ferrous smelters are some of the main causes of cadmium in soil (McGrath and Smith, 1995). Toxic concentration of cadmium is between 3–5 mg/kg range in soil (Zheljazkov, 1995). In normal agricultural soil, the concentration of Cd is 0.05 mg/kg (Adriano, 1986). The average Cd Concentration in the studied soil sample (0.09 mg/kg) was found higher than the proposed value for normal agricultural soil by Bohn et al. (2001). According to Adriano (1986), the value of Cd in uncontaminated soil is 1.0 mg/kg that is almost near to the value as calculated in soil samples of Fateh Jang. Soil affected with Cd is considered to pose serious risk to health. However, the level of Cd in studied samples of soil is below the critical concentration, and hence not considered poisonous for the plant species of studied region.

Nickel (Ni)

The presence of Nickel in the environment is due to the combination of oxygen and sulfur. Ni is present in soil and mostly released from volcanoes. Ni concentration in all samples of soil is not in the toxic level because in normal agricultural soil and in uncontaminated soil Ni concentration is 40 mg/kg (Bohn et al., 2001; Adriano, 1986). High concentration of Ni can cause moist skin problem term as nickel itch. Ni and its salt forms are generally not poisonous but it has been recognized as suspected cancer causing agent. It is also involved in damaging nasal cavities and lungs.

Chromium (Cr)

Chromium is considered as the most known environmental pollutant throughout the world. It accumulation into the soil is through various sources including steel industries, tanneries, sewage sludge and fly ash. It is also present in motor vehicles in the form of plating and alloy and considered most likely source of it (Frank et al., 1976). The concentration of this metal in all soil samples was far below when compared with normal agricultural soil (20 mg/kg) (Bohn et al., 2001). Critical concentration of Cr in the range between 5-30 mg/kg is toxic both to flora and fauna, and can cause drastic yield reduction. Its elevated level may cause variety of disorders such as stomach ulcers, respiratory infections, kidney damage, liver imbalance and even mortality can occur (Zheljazkov, 1995).

4.2. Heavy metals concentration in plant families

Normal range of Pb in plants is 5-10 mg/kg, Cu 5-30 mg/kg, Zn 27-150 mg/kg, Cd 0.05-0.2 mg/kg, Ni 0.1-5 mg/kg and Cr 0.1-0.5 mg/kg (Kabata-Pendias and Pendias, 2001). Most concentrations of studied heavy metals in collected plants are within the normal range when compared with the aforementioned values. In our study the plants showed different concentration of elements. Some plants showed high accumulation for one element while the same plant showed lower accumulation for the other element and vice versa. As in the results, among the all plants, average concentration of Pb was higher in Ranunculus muricatus (3.10 mg/kg) and Cannabis sativa (2.83 mg/kg), but in all other plants the concentration was lower as compared to these two plants. In case of Cu, comparatively higher concentration was found in Salvia moorcroftiana (1.81 mg/kg) while other plants showed the limit below 1 mg/kg. Zn concentration was higher in Thuja orientalis. Higher concentration of Cd was observed in Ranunculus muricatus and Brassica campestris. Euphorbia helioscopia showed high Cr concentration as compared to other plants. Findings of the present study regarding the accumulation of heavy metals in plant tissues are contradictory with the findings of Chunilall et al. (2005). They suggested that rate of accretion of metals varies with plant species due to their inherent controls and quality of soil (Chunilall et al., 2005). Large number of factors control metal accumulation and bioavailability including soil and climatic conditions; plant genotype and agronomic management (Kabata-Pendias and Pendias, 2001). Micronutrient availability depends upon elevated pH of soil, therefore basic medium soil of studied area played important role in decreasing micronutrients availability in soil. Soil texture is also responsible for affecting metal absorption of soil. Metal absorption in soil also depends upon various factors such as organic carbon contents, metallic cation exchanging capacity etc. (Ghosh and Singh, 2005). Toxic elements also get accumulated in high pH soil and decrease concentration of essential metals for plants that lead toward less absorption by plant tissues (Liu et al., 2005).

5. Conclusions

It is concluded that smoke coming out from the brick kilns is rich in trace elements e.g. lead, zinc, copper, cadmium, nickel and chromium. Cadmium was found to exceed the normal limits of Cd concentration in soil that could be hazardous in future. Ranunculaceae had highest amount of Pb while Fabaceae family was found to accumulate less Pb concentration. Euphorbiaceae family has shown high accumulation of Cu and Zn while Cruciferae has shown less accumulation potential of Cu and Poaceae for Zn. Cd was found highest in family Fabaceae while Ni was found highest in Brassicaceae and lowest in Apocynaceae. Cr contents were high in Fabaceae member while lowest concentration was recorded in Brassicaceae. Less heavy metal contamination in the study area is due to that some of the brick kilns were not functional at that time of study. There is a greater tendency of Cd contamination in soil in future when all the factories will be operating.

6. Future recommendation

More studies on the smoke quality, quantity of trace elements in smoke, role of plant dust in elemental composition may be taken into consideration. Based on this study plantation of non fodder species in surroundings of brick kilns in the study area is recommended. It is further suggested that the Government should give incentives to encourage brick kiln owners to convert the old and traditional technology to newer technology for switching the use of rubber tyres, and poor quality fuel to environmental friendly fuels in brick kilns. The use of filters is recommended in the brick kilns to mitigate the adverse impacts of smoke.

Competing Interests

The authors declare no competing interests.

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