Pak. J. Weed Sci. Res., 23(1): 41-48, 2017

ASSESSMENT OF PB^{2+} AND CD^{2+} AMONG PLANTED AND NATURAL VEGETATION PRONE TO VEHICULAR POLLUTION

Shamyla Nawazish[1*], Syed Majid Bukhari[2*], Muhammad Arshad Parvez[1], Ikramullah Khan[3], Asma Zaidi[2] and Muhammad Aamir[4]

ABSTRACT

An increased use of vehicles leads to the excessive emissions of smoke which generates pollutants, particularly metallic components such as Pb^{2+} and Cd^{2+}. This problem has been addressed worldwide because of adverse effects of presence of Pb^{2+} and Cd^{2+}in human and natural biota exposed to smoke on roadside. To evaluate the effects of these metal pollutants, a study has been planned to assess the concentration of $Pb^{2+}$and Cd^{2+} in the washed as well as unwashed leaves of some plant species along Motorway (M-3) and National Highway (N-5). Wild vegetation i.e. Cenchrus ciliaris, Calotropis procera, Phoenix roebelenii and Sesuvium portulacastrum were selected for study along M-3 whereas Vichellia nilotica, Parthenium hysterophorus, Cenchrus ciliaris, Nerium oleander and Calotropis procera were selected along N-5. The deposited dust at leaves of selected plant species, before and after washing with distilled water, was digested and detected by atomic absorption spectroscopy (AAS). The ANOVA for mean value of both understudy metals showed maximum distribution of Pb^{2+} (0.001 mgg^{-1}) for C. procera growing along M-3 and 0.00057 mg g^{-1} of Pb^{2+} was recorded N. oleander leaves along N-5. High Cd^{2+} (0.0001 mgg^{-1}) was determined in C. cilliaris leaves along M-3 and 0.000495 $mgg^{-1}$was detected for P. hysterophorus growing along N-5. The maximum and minimum concentrations of Pb^{2+} and Cd^{2+} among leaves of C. cilliaris and N. oleander highlights the potential threat of accumulation and transfer of these metals into the soil and grazers which are directly feed on leaves irrespective of dust or not. The present study revealed that vehicle exhaust is polluting the air and must be deteriorating the health of individuals

Key words: N-5, atomic absorption, Pb^{2+}, Cd^{2+}, ANOVA, M-3

---

[1]Dept. of Environmental Sciences, [2]Dept. of Chemistry, COMSATS Institute of Information Technology, Abbottabad-22060, Pakistan
[3]Weed Science Department, [4]Institute of Development Studies, The University of Agriculture Peshawar, Pakistan
Correspondence author's email: shamyla@ciit.net.pk

Citation: Nawazish, S., S.M. Bukhari, M.A. Parvez, I. Khan, A. Zaidi and M. Aamir. 2017. Assessment of Pb^{2+} and Cd^{2+} among planted and natural vegetation prone to vehicular pollution. Pak. J. Weed Sci. Res. 23(1): 41-48.

INTRODUCTION

Humans always contributed positively to the development and maintained good quality environment and encouraged the new technologies; conversely, anthropogenic activities continuously contaminating the water, soil and air through their lavish life styles. Increased urbanization and use of vehicles have contaminated the environment. Although incomplete burning of solid waste, greenhouse gases are the crucial components for bad quality air, use of automobile vehicles added more Pb^{+2} and trace metals in the air and get deposited on growing fauna. Enormous studies on heavy metals revealed a strong relationship existed between heavy traffic and metal deposition on plants (Sharma *et al.*, 2005; Antognoni *et al.*, 2007; Salam *et al*., 2010). Heavy traffic density contributes high Pb^{2+}, Cd^{2+}, Cr^{2+} and Zn^{2+} in the environment compared to low traffic density (Adelasoye and Alamu, 2016). Heavy metals are found in high concentrations in roadside growing plants and in their leaves (Parekh, 2016). The highest reported metal accumulation index value in *C. camphora* L. depicted its potential against heavy metals along highways (Rolli *et al*., 2016). The soil along roadside has been reported to possess high concentration of Cd^{2+} and is at low risk of addition of Pb^{2+} and Zn^{2+}.

In historical perspective, plant species proved the indicators of air pollution. Scientific studies have proved that various genera and species as; leaves of *Cinnamomum indica*, *P. guajava* and *B. verigata* were used as indicators of suspended particulate matter (Prabhat, K. R., 2016). Similarly, bark of *M. indica*, *G. arborea* and *P. biglobosa* found rich in Pb^{2+}, Zn^{2+} and Cd^{2+} (Oklo and Asemave, 2012). High Pb^{2+} accumulation in leaves was reported in case of *C. procera* (Shamyla *et al*., 2012). In *T. pallida* (Thiago and Luccia, 2012) pronounced concentration of heavy metals has been reported; also high Cd^{2+} (level) in *P. perfoliatus* grown along the road side has been reported (Constantin *et al.*, 2013). In spite of all scientific measures, air pollution, particularly toxicmetal pollution, entering from vehicular exhaust into the environment has been noticed, were unaddressed at M-3 (motorway) and N-5 (national highway).

MATERIALS AND METHODS

The adapted methodology for the present study is summarized

Sample collection and Analysis

The triplicate leaf samples of each understudy plants were collected from the different sites on the road, 15m apart from each other, at both M-3 and N-5. The *N. oleander* and *V. nilotica* were planted on N-5 at the lowest rate while *P. roebelenii* and *S. portulacastrum* were at green belt on M-3. The unwashed leave samples (0.1g) were collected and dust was removed for metal detection. All collected samples from each plant species were subjected to acid digestion. Both metals Pb^{2+} and Cd^{2+}analyzed by using Atomic Absorption Spectrophotometer. The average concentrations (taken in mgg^{-1}) of Pb^{2+} and Cd^{2+} were compared at 5% significance level.

RESULTS AND DISCUSSION

The Pb^{2+} concentration (0.00085 mgg^{-1}) was high in unwashed leaves of *C. cilliaris* among all planted species on M-3 (Fig. 1) while low value (0.000017mgg-^{1}) was observed in unwashed leaves of *S. portulacastrum*. The level of Pb^{2+}concentration (0.00042mgg^{-1}) in washed leaves of *C. ciliaris* at M-3 marked the clear difference that dust contained high concentrations of Pb^{2+}. The maximum concentration of Pb^{2+}concentration (0.002 mgg^{-1}) was determined in *N. oleander* unwashed leaves, while minimum difference of Pb^{2+} concentration (0.0012 and 0.0011mgg^{-1}) was noticed in washed and unwashed leaves of *P*. *hysterophorus* at N-5 (Fig. 2).

The highest concentration of Cd^{2+} (0.000025mgg^{-1}) was recorded in *C. ciliaris* and low concentration of Cd^{2+} was measured in *C. procera* grown along M-3 (Figure 3) whereas reverse trend was observed in case of *C. procera* for Cd^{2+}concentration (0.00007 mgg^{-1}) (Figure 4) on N-5. The lowest concentration for Cd^{2+} (0.00002 mgg^{-1}) was measured in unwashed leaves of *P. hysterophorous* at N-5. An exceptional trend has been observed among the washed and unwashed leaves of *C. cilliaris.* That showed Cd^{2+}concentration (0.00004 mgg^{-1} for washed and (0.00003 mgg^{-1}) for unwashed of dry weight. This negligible difference might be due to the more uptake of Cd^{2+} from soil by narrow leaves. The extent of accumulation and deposition was related with distribution and morphology of plant species (Shamyla *et al*., 2012). Same trends were recorded in leaves of *L. ovalifolium* in Damascus. The positive interaction was recorded with temporal variations, 7.120 mgg^{-1} of Pb^{2+} in February and 7.66 mgg^{-1} in July while Cd^{2+} concentration varied from 0.33mgg^{-1} to 0.373 mgg^{-1}, respectively (Rita, 2014). In another study, 0.084mgg^{-1} Pb^{2+} found in *A. conyzoides* whereas 0.0462mgg^{-1} of Pb^{2+} was reported in *R. communis*; Shakya and Ram in 2013 calculated the average values for Pb^{2+} and Cd^{2+} i.e. 0.245 mgg^{-1} and 0.284 mgg^{-1} at Nepal Highway. Lot of research work has been done in different cities of Pakistan in this regard. The Pb^{2+}concentration was 0.399 mgg^{-1} in leaves of *Cannabis* and 0.41mgg^{-1} in *D. sisso* (Manzoor *et al*., 2013), 0.226 mgg^{-1} of Pb^{2+} was reported in leaves of *A .indica* at Nigeria road (Kolo *et al*., 2014). The 0.0105 mgg^{-1} of Cd^{2+} was obtained from stolon of *C. dactylon* and 0.0046 mgg^{-1} Cd^{2+} was reported in *P. Petrocarpum* leaves (Ramakrishnaiah *et al*., 2014); in lettuce leaves (0.1278$mgg^{-1}$and 0.143 mgg^{-1}) of Cd^{2+} was recorded around the industrial sector of Serbia (Milan *et al.*, 2014). High concentration of Pb^{2+} (0.484 mgg^{-1}) and low concentration (0.4546 mgg^{-1}) of Cd^{2+} found *Ziziphus* leaves along roads and industries of Saudi Arabia (Fathy *et al*., 2014). The Pb^{2+} concentration (0.4848 mgg^{-1}) and Cd^{2+} (0.17 mgg^{-1}) concentration extracted from leaves dust of *P. judaica* at Turkish highways was reported (Osama *et al*., 2012).

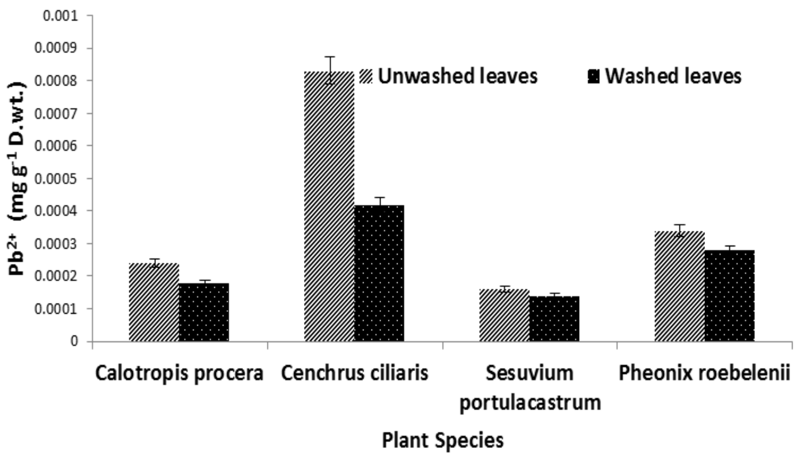

Figure 1. Pb^{2+} concentration at M-3 among various plant species

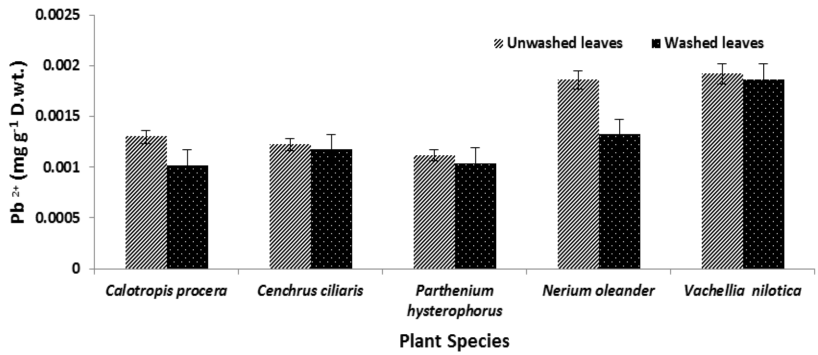

Figure 2. Pb^{2+} concentration at N-5 among various plant species

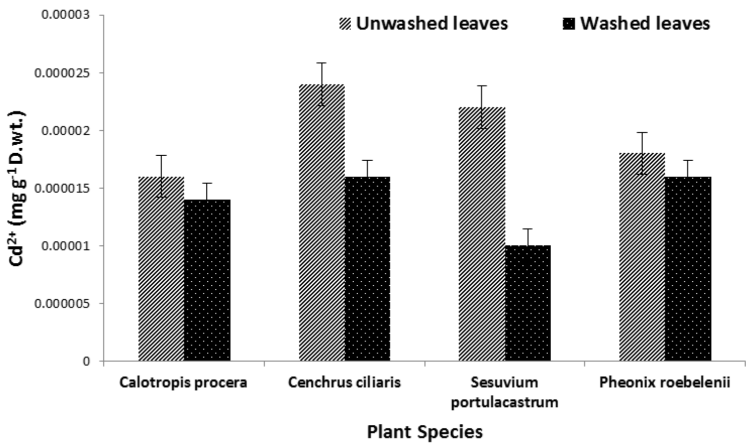

Figure 3. Cd^{2+} concentration at M-3 among various plant species

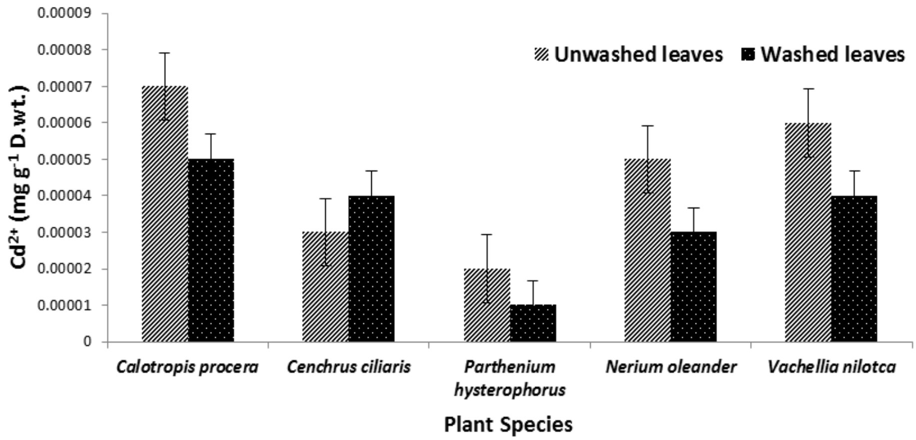

Figure 4. Cd^{2+} concentration at N-5 among various plant species

CONCLUSION

The present findings clearly indicate that some plant species accumulate more Pb^{2+} and some are being accumulating more Cd^{2+}. The key factor is increased fuel consumption for vehicles that deteriorates the quality of air. The detrimental and vigorous effect of *P. hysterophorous* exotic plant species was introduced in the year 2007. It accumulates Cd^{2+} in very low amount within the leaves as well as from soil. Secondly, plant can remove the heavy metals from the soil and air by adsorption mechanism. The *S. portulacastrum* planted in the central green belt of M-3 might present itself as a Pb^{2+} lover plant and may clean the air by detoxifying the metal ions. It is the best plant species which should be studied furtherin order to explore the detoxification mechanism for metal pollutants. On the other hand, the plantation of *N. oleander* would be appreciated along the roads due to its morphological specification of broad leaves. It seems that *N. oleander* possesses unpleasant odor which protects the plant leaves from grazers. It is a dire need of the time that the *N. oleander* should be preferably planted along M-3 and N-5; it might have less interaction with traffic density.

REFERENCES CITED

Abdussalam, C. R. P., A. K. Salim and T. Puthur. 2010. Distribution of bio-accumulated Cd and Cr in two *Vigna* species and the associated histological variations. J. Stress Physiol. Biochem. 6: 4-12.

Adelasoye, K.A. and L.O. Alamu. 2016. Accumulation of heavy metal pollutants in soil andvegetation and their effects on soil microbial population on roadsides in Ogbomoso, Nigeria.J. Environ. Sci. Water Resource. 5(1): 1-7.

Antognoni, C.G.L., F. Pari, E.P. Fonti, A. Gnes and A. Speranza. 2007. Active biomonitoring of heavy metal pollution using *Rosa rugose*plants. Environ. Pollut. 149: 239-245.

Constantin, M.L.M., M. Laurentiu and A. Tudorache. 2013. Plants accumulating heavy metals in the Danube River wetlands. J. Environ. Health Sci. Engg. 11: 39.

Fathy, M.A.S., S.El-N. Fahd and R.A. Abdulmohsin.2014.Heavy metals contents in Ziziphus tree leaves under the effect of different industrial activities. J. Agric. Sci. 6(1): 110-115.

Kolo, A.B., B.G.I. Waziri and M.A. Idris. 2014. Assessment of Neem tree (*Azadirachta indica*) leaves for pollution status of Maiduguri environment, Borno State, Nigeria. The Int. J. Engg. Sci. 3: 31-35.

Manzoor, I. K., J. Akhtar and R. Kausar. 2013. Study of Pb concentration in roadside plants (*Dalbergia sissoo* and *Cannabis sativa*) in region of Quetta. Sci. Int. 25(2): 347-352.

Milan, M. R., S. Stankovic, S. Zoran, R. Milos and T. Marina. 2014. The accumulation of metals in *Polygonum aviculare* L. in area of the Kraljevo city. Kragujevac J. Sci. 36: 175-184.

Oklo, D. A. and K. Asemave. 2012. Heavy metal contents of tree barks as indicator of pollution in Makurdi metropolis, Benue State – Nigeria. Int. J. Toxicol. Appl. Pharmacol. 2(4): 45-48.

Osama, A.E. and Z. leblebici. 2012. Spreading pellitory (*Parietaria judaica* L.): A possible biomonitor of heavy metal pollution. Pak. J. Bot. 44: 123-127.

Parekh, H., P. Mitesh and K. K. Tiwari. 2016. A detailed study of heavy metal accumulation across highway plant species. Res. J. Agric. Environ. Manage. 5(1): 32-36.

Prabhat, K. R. 2016. Biodiversity of roadside plants and their response to air pollution in an Indo-Burma hotspot region: implications for urban ecosystem restoration. J. Asia-Pacific Biodiv. 9(1): 47-55.

Ramakrishnaiah, D.P., H.Y. Ramachandra and K. Naveen. 2014. Leaves of higher plants as indicators of heavy metal pollution along the urban roadways. Int. J. Sci. Technol. 3(6): 340-346.

Rita, S.M. 2014. The pollution of tree leaves with heavy metal in Syria. Int. J.Chem. Tech. Res. 6(4): 2283-2290.

Rolli, N.M., S.B. Gadi and T. P. Giraddi. 2016. Bioindicators: Study on uptake and accumulation of heavy metals in plant leaves of state highway road, Bagalkot, India. J. Agric. Ecol. Res. Int. 6(1): 1-8.

Shakya, P. R and A. R. Pradhananga.2013.Determination and contamination assessment of Pb, Cd, and Hg in roadside dust along Kathmandu-Bhaktapur road section of Arniko highway. Nepal Res. J. Chem. Sci. 3(9): 18-25.

Shamyla, N., H. Mumtaz, A. Muhammad, Y.A. Muhammad and J. Amer. 2012. Effect of automobile related metal pollution (Pb^{2+} & Cd^{2+} on some physiological attributes of wild plants. Int. J. Agr. Biol. 14: 953–958.

Sharma, P. and R.S. Dubey. 2005. Lead toxicity in plants. Braz. J. Plant Physiol. 17: 35-52.

Thiago, P.B.and D. Luccia. 2012. Determination of heavy metals in the bioindicator plant *Tradescantia pallida* var. *Purpurea*. J. Environ. Engin. Ecol. Sci. 1323: 1-4.