Available online at www.sciencedirect.com

ScienceDirect

APCBEE Procedia 10 (2014) 275 – 280

Procedia APCBEE

www.elsevier.com/locate/procedia

ICESD 2014: February 19-21, Singapore

Effect of Anthropogenic Activities on Accumulation of Heavy Metals in Legumes Crops, Riyadh, Saudi Arabia

Mohammed Nasser Alyemeni* and Ibraheem Almohisen

Department of Botany and Microbiology, King Saud University, Riyadh 11451, Saudi Arabia
Shqra University, College of Science and Humantarion Studies, Qwaieah 11971, Saudi Arabia

Abstract

The objective was to look at the effect of anthropogenic activities on the accumulation of heavy metals; in four legumes crop plants. *Pisum sativum* L., *Vicia faba* L., *Glycine max* and *Vigna sinensis*, during summer and winter plants exposed to five levels of ambient air pollution by quantifying heavy metals (Cu, Mn, Pb and Zn) concentrations in the leaves, pods and grains. Results indicated that air pollution significantly increased the heavy metal concentrations in the leaves, pods and grains. Toxic concentrations were found in the plants grown at L3, L4 and L5.

Selection and peer review under responsibility of Asia-Pacific Chemical, Biological & Environmental Engineering Society

Keywords: Human activities, Heavy metals, Legumes, Crops, Ambient Air Pollution, Riyadh, Saudi Arabia

1. Introduction

The rapid urbanization and industrialization has been accompanied by environmental changes caused by heavy traffic and industrial activities in Saudi Arabia particularly in Riyadh city. Legume pods and grains are rich in protein and are therefore widely used as protein sources for human and animals [1] [2]. Traffic and industrial activities emissions contain airborne particulate-bound heavy metals [3] which deposited in roadside soils and also enter plants directly via rain and dust or to be taken up from the soil through the root system [1] [4]. Industrial activity has polluted the soil with a variety of heavy metals, such as Cd, Cu and Zn,

* Corresponding author. Tel.: +966-11-75868
E-mail address: mnyemeni5571@yahoo.com

Selection and peer review under responsibility of Asia-Pacific Chemical, Biological & Environmental Engineering Society
doi:10.1016/j.apcbee.2014.10.052

which affect crop production [5]. Farmaki and Thomaidis [6] reported increased in concentrations of the heavy metals Pb, Cu, Zn, Pt and Pd in the urban environment, including the topsoil, highways and streets. Çelik, et al. [7] reported four times higher concentrations of trace metals Fe, Pb, Cu and Mn in roadside plants compared with the control sites plants. Klumpp, et al. [8] reported Significant accumulation of Pb and Cu in plants from traffic-exposed sites in city centers or close to major roads and moderate to low levels at suburban or rural sites. Heavy metal toxicity in plants results in chlorosis, weak plant growth and decreased crop yield and may be accompanied by reduced nutrient uptake and plant metabolism disorders [9].

This study was conducted to assess the accumulation of five heavy metals in the edible portions and leaves of four legumes crops under conditions of urban air pollution. The results of this study may be important to increasing understanding of the levels of air pollution in the Riyadh area using crops.

2. Materials and methods

2.1. Experimental site and plant materials

Five experimental sites were located in different parts of Riyadh city to represent a gradual density of populated areas to high and low anthropogenic activities compared with an area away from the city centre and reflected the control site (Dirab) (Table 1). Two winter plants *Pisum sativum* L. and *Vicia faba* L., and two summer season *Glycine max* and *Vigna sinensis* were used.15 seeds were sown in 40 cm plastic pots with a mix of 50% clay and 50% sand, and the pH was adjusted to 8.4. After germination, five uniform plants per pot were selected, and 10 pots for each species were transferred to each experimental site. Plants were exposed to ambient air during the winter for periods of three months, and the summer species were exposed during the summer. (0.5 g) Dried samples of leaves, pods and grains were digested with concentrated HNO_3 and $HClO_4$ in a Teflon Digestion Vessel (Savillex, USA) Cu, Mn, Pb and Zn concentrations were measured with inductively coupled plasma-atomic emission spectroscopy (Perkin–Elmer Optima 4300 DV, USA) using the method of Kim, et al. [10].

Table 1. Traffic density and industrial activities in experimental sampling locations

Sampling location No.	Sampling location description	Traffic density (TD)
L1	Control	Very low
L2	Low TD	122775
L3	High TD	946348
L4	Moderate TD density and Cement factory	115866
L5	Moderate TD density with high IA	115000

TD; Traffic density (average car daily), IA; industrial activity

2.2. Statistical Analysis

Data were analyses using SAS statistical package. ANOVA was used to test the effect of the sampling locations, and LSD was used for the mean separation. The generalised linear model (GLM) was used to test for interactions between the species and the sampling locations. The graphs were plotted Sigma Plot 9.0.