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Research article

Potential of trees leaf/ bark to control atmospheric metals in a gas and petrochemical zone

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ABSTRACT

Leaf and bark of trees are tools for assessing the effects of the heavy metals pollution and monitoring the environmental air quality. The aim of this study was to evaluate the presence of Ni, Pb, V, and Co metals in four tree/shrub species (*Conocarpus erectus*, *Nerium oleander*, *Bougainvillea spectabilis willd.*, and *Hibiscus rosa-sinensis*) in the heavily industrial zone of Asaloyeh, Iran. Two industrial zones (sites 1 and 2), two urban areas (sites 3 and 4), and two rural areas (sites 5 and 6) in the Asaloyeh industrial zone and an uncontaminated area as a control were selected. Sampling from leaf and bark of trees was carried out in spring 2016. The metals content in the washed and unwashed leaf and bark was investigated. The results showed that four studied metals in *N. oleander*, *C. erectus*, and *B. spectabilis willd.* in all case sites were significantly higher than that of in the control site ($p < 0.05$). The highest concentration of metals was found in sites 3, 4, and 6; this was due to dispersion of the pollutants from industrial environments by dominant winds. The highest comprehensive bio-concentration index (CBCI) was found in leaf (0.37) and bark (0.12) of *N. oleander*. The maximum metal accumulation index (MAI) in the samples was found in leaf of *N. oleander* (1.58) and in bark of *H. rosa-sinensis* (1.95). The maximum bio-concentration factor (BCF) was seen for cobalt metal in the *N. oleander* leaf (0.89). The nickel concentration in washed-leaf samples of *C. erectus* was measured to be 49.64% of unwashed one. In general, the *N. oleander* and *C. erectus* species were found to have the highest absorption rate from the atmosphere and soil than other studied species, and are very suitable tools for managing air pollution in highly industrialized areas.

1. Introduction

Recently, unorganized industrial activities and rapid development of cities have caused the emission of various pollutants especially heavy metals into the atmosphere (Kafaei et al., 2017). Heavy metals like Pb, Co, Ni, and V are serious concerns for the environment and human life (Alsaleh et al., 2018; Fernández-Calviño et al., 2017). Co, Ni, and V are released to the environment from sources like petrochemical and gas industries and Pb is originated from commercial activities and small industries (Delshab et al., 2017; Naeimi et al., 2018). The emitted heavy metals in the atmosphere then adhere to the particulate matter and dust. These materials finally settle on the ground as well as trees

(Ugolini et al., 2013). The distribution of the heavy metals depends on the site topography, wind velocity, particulate matter diameter, and surface characteristics of the materials on which heavy metals are deposited (Norouzi et al., 2016). For example, specific area, roughness, and epicuticular waxes of leaf and bark of trees influence the particle deposition. Furthermore, the heavy metals deposited on the land may be relocated by wind or runoff and thus again enter to the vegetal tissue through different sources such as soil, water, and air (Bilo et al., 2017). Therefore, it can be concluded that the human health is affected not only by the polluted air but also by the polluted soil or water. Hence, a continuous monitoring of the environment is required.

Biomonitoring is superior to direct analyzing samples due to the use

Abbreviations: CBCI, Comprehensive bio-concentration index; MAI, Maximum metal accumulation index; BCF, Bio-concentration factor; AOM, Air-originated metals; PSEEZ, Pars Special Economic Energy Zone; BS, Background site; EC, Electrical conductivity; ICP-AES, Inductively Coupled Plasma Atomic Emission Spectroscopy

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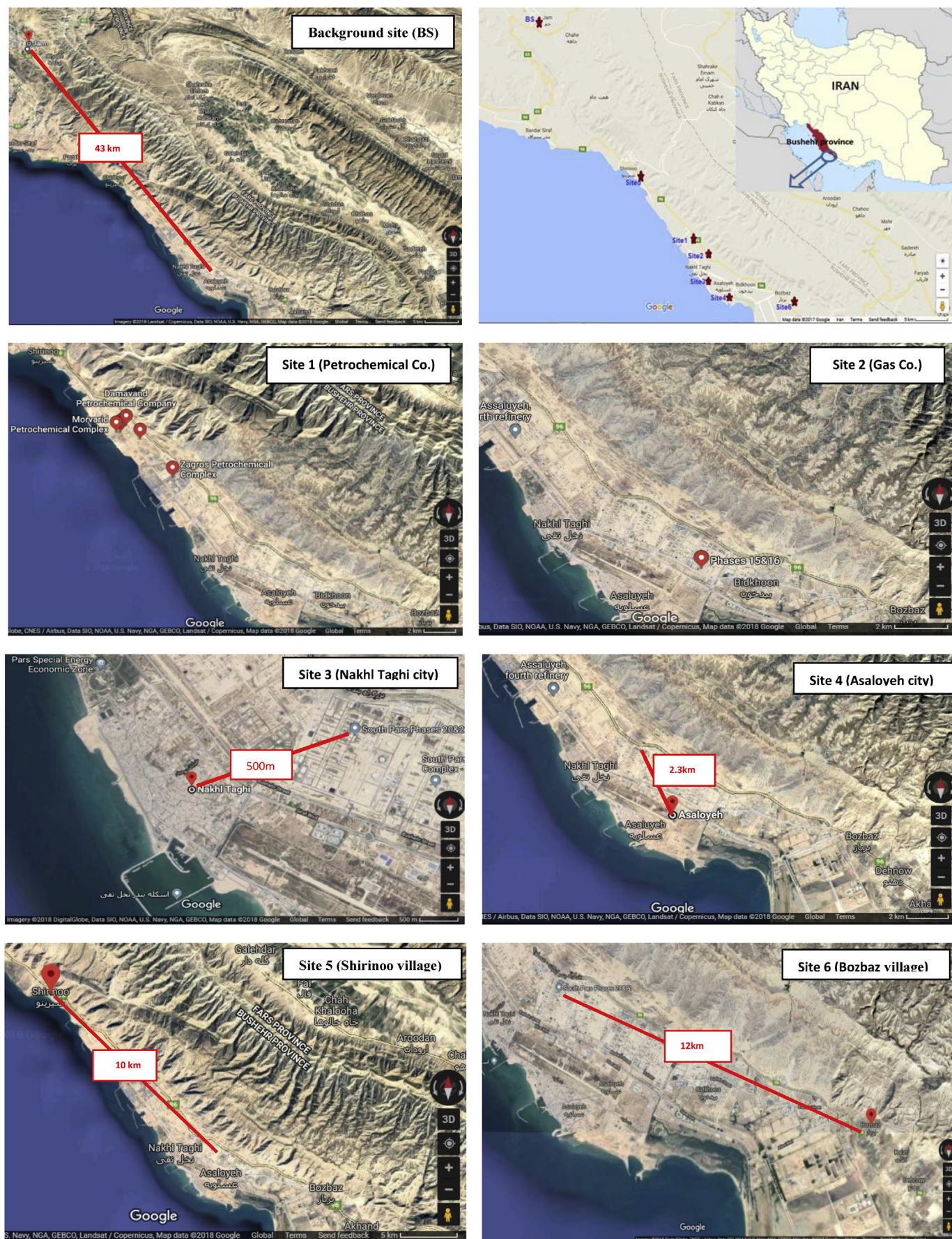


Fig. 1. Map of sampling sites and their distance to the nearest gas or petrochemical company (Image from Google Earth® software).

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