

MICROBIAL CHARACTERIZATION OF ABANDONED MINING AREA OF SIDI KAMBER NORTH-EAST OF ALGERIA

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The ecological importance of soil bacteria is not limited to their number or biomass, although these parameters contribute greatly. Indeed, their main asset lies in their great genetic and functional diversity. In this study carried out in the abandoned mine, located in Sidi Kamber (Oum Toub, Skikda, North-Est of Algeria) our objectives was to determine: a) contamination levels of this area by heavy metals b) heavy metal impact on bacterial communities and diversity c) possible risk on the ecological integrity of this area. Soil samples from three zones (Zone A upstream, Zone B at the center of the mine and Zone C downstream) were collected from the top layer (0–20 cm) of mining area. These samples were air-dried at room temperature and sieved through 2 mm mesh before further analysis according to standard methods. Soil pH was measured in a sample suspended in double-distilled water (at a sample: water ratio 1:2.5) with a pH meter, organic matter (OM%) and carbon content (C%) were determined using Walkey-Black method. Total nitrogen (TN) was measured using the Kjeldahl method, available phosphorus (P) was determined by Olsen method and cation exchange capacity (CEC) by titration method with H₂SO₄ For contents of the heavy metals Lead (Pb), Copper (Cu), Zinc (Zn), Cadmium (Cd) and Nickel (Ni) 1 g of soil was digested with aqua regia method then filtered and diluted with de-ionized water. Heavy metals concentration (Pb, Cu, Cd, Zn and Ni) were determined by ICP-MS. Bacterial load (bacterial biomass) was estimated using plates counting methods. Individual distinct colonies were identified by their morphological and biochemical characteristics. Edaphic parameters of soils samples show that; the overall area was characterized by an acid pH, rates of OM%, C% were relatively low and TN contents were relatively high, resulting a low C/N ratio. The CEC was uniformly high, the content of available P was low. A Comparison of these edaphic parameters of the three sampling zones showed no significant variation for the pH values. However, zone A is characterized by the lowest values of C%, TN, OM%, CEC, C/N and the highest content of available P. Generally heavy metals contents were highest in zones B and C. The overall area was severely polluted with Cu, Cd, Pb, Ni and Zn, with a total concentration far exceeding international standard (CCME 2007; VROM, 2009; Baiz, 2000; Afnor, 1994). Heavy metal concentrations have shown significant variation between zones. According to bacteria biomass, we can classify the sites into two groups: group I includes zone B,C with a highest concentration of heavy metals and least load of bacteria and group II includes zone A and with a low concentration of heavy metals and high amount of bacteria. Zone A show the highest value of bacterial diversity with a high index of Shannon-Weaver, followed by Zone B and C respectively. The PCA analysis for soil characteristics indicates that organic matter and CEC positively affect the distribution of metallic trace elements in soil and also allowed us a clear separation of the studied zones. High levels of heavy metals have a negative impact on bacterial communities. Nonetheless, soil microorganisms have developed highly efficient systems for metal detoxification. Heavy metal contamination provides a strong pressure that selects for the recruitment of multiple resistance phenotypes that encode resistance to the predominant metals in the site.

Key words: Heavy metals, Mining Area, Sidi Kamber and Bacterial Diversity