Studying of influence of different steppe plants species biological features on heavy metal accumulation according to long-term monitoring data

Victor Chaplygin, Saglara Mandzhieva, Tatiana Minkina, and Denis Makhinya
Rostov-on-Don, Russian Federation (otshelnic87.ru@mail.ru)

The steppes of the northern Azov Region are extremely favorable for agriculture. Thus, the foremost problem is the cultivation of ecologically safe products under conditions of technogenic pollution. Soil and plant contamination by anthropogenic emissions from industrial enterprises leads to the decreasing of crop quality; therefore, the monitoring investigation of plants and soils acquires special importance. The largest first-class enterprise on this territory, a Novocherkassk Power Plant (NPP); its emissions constitute over 70% of the total emissions in Azov Region. All monitoring plots were established in fallow sites at different distances (from 1 to 20 km) in the direction from the NPP. The effect of technogenic emissions on the input of Pb, Zn, Cd, Cu, Mn, Cr, and Ni into soil and plants from the Poaceae and Asteraceae families based on 17-year monitoring data has been studied. The proportion of loosely bound compounds of heavy metals in the polluted soils is 28–52% of the total content. A close relationship between the HM content in herbaceous plants and the content of their loosely bound compounds in the soil: $r = 0.60$–$0.93(tr > t05)$ was found. The herbaceous plants may be used as bioindicators for main environmental changes. It was found that the high level of anthropogenic load related to atmospheric emissions from the power plant favors the heavy metal (HM) accumulation in herbaceous plants. Contamination with Pb, Cd, Cr, and Ni was revealed in plants growing near the power plant. At the monitoring sites with the highest technogenic load, the content of Pb, Cd, Cr and Ni in the studied plants exceeds the maximum permissible level (MPL) for feed by 1,9-4,2, 2,6-3,7 and 3-6,3 times, respectively (GOST. . . , 1991). Heavy metals arrive at plants from the soil in the form of mobile compounds. Plant family is one of the main factors affecting the HM distribution in the above- and underground parts of plants. Plants from the Poaceae family accumulate less chemical elements in their aboveground parts than the Asteraceae plants.

Ambrosia artemisiifolia and Artemisia austriaca are HM accumulators. For assessing the stability of plants under contamination with HMs, metal accumulation by plants from soil (the bioconcentration factor) and metal phytoavailability from plants above- and underground parts (the acropetal coefficient) were calculated. According to the bioconcentration factor and translocation factor values, Poaceae species are most resistant to technogenic contamination with HMs. The translocation factor highest values were found for Tanacetum vulgare; the lowest bioconcentration factor values were typical for Poa pratensis.