

Researches on Lead Content in Soil and *Zea mays* L. Grains

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Abstract Lead (Pb) is the most common heavy metal contaminant in the environment. Pb is available to plants from soil and aerosol sources. The goal of this paper is a study on lead content in soil and its accumulation in corn (*Zea mays* L.) grains, in a Romanian polluted area. Lead accumulates in soil, especially in soil with high organic contents, where it remains for a long time, hundreds and thousand of years. The lead permissible limit in plants recommended by WHO (World Health Organization) is 2 mg/kg. The area studied is Tarnaveni (Mures County, Romania) and nearby locations. Soil and maize samples were collected from seven familiarly farms. The minerals determination was made by Flame atomic absorption spectroscopy (FAAS). In soil, Pb ranged from 19.37 ppm to 43.004 ppm for 0-20 cm depth and from 20.41 to 37.62 ppm for 20-40 cm depth. The lead soil contents are exceeding 20 ppm (the Normal contents in soil, for Romania) but do not exceed 100 ppm (the Alert threshold values for Romania). Regarding the lead content (mgKg⁻¹ dry weight) in maize grains, the values are between 0.252 and 1.176 ppm. In all the collected maize samples lead contents was recorded below the maximum permissible limit for plants recommended by WHO (2 mg/kg). Maize grains lead content is slightly influenced by the lead soil values.

Key words

soil, maize, pH, lead, atomic, absorption

Maize (*Zea mays* L.) is an edible flowering plant in the Gramineae family and is a warm-season crop that is easily grown during the spring and summer. Maize is, after wheat and rice, the most important cereal grain in the world, providing nutrients for humans and animals and serving as a basic raw material for the production of starch, oil and protein, alcoholic beverages, food sweeteners and fuel. It is known that Pb is accumulated in the maize roots [7, 2].

Lead (Pb) is the most common heavy metal contaminant in the environment. Pb is available to plants from soil and aerosol sources.

Lead is a highly poisonous metal (whether inhaled or swallowed), affecting almost every organ and system in the body. The component limit of lead (1.0 µg/g) is a test benchmark for pharmaceuticals, representing the maximum daily intake an individual should have. Even at this level, a prolonged intake can be hazardous to human beings [6].

Pb accumulates in soil, especially in soil with high organic contents, where it remains for a long time, hundreds and thousand of years. Numerous data

regarding the distribution of lead in soil and plants is available in the research field. Key corn parameters are the precipitation of lead as Pb-phosphate in roots (only Pb not precipitated is available for translocation to the shoots) and effective root mass [1,3,4,5].

According to the U.S. Environmental Protection Agency, lead from soils may take places of other metals within organic matter, particularly plants. Contamination of soils and plants, in turn, affects microorganisms and animals [14].

The lead permissible limit in plants recommended by WHO is 2 mg/kg [12].

Material and Methods

The area studied is Tarnaveni (Mures County, Romania) and nearby areas. Soil and maize samples were collected from seven familiarly farms. The locations geographical coordinates are mentioned in Table 1.

Table 1

Prelevations points	Latitude (North)	Longitude (East)	Altitude
PP 1	46°33'03.6"	24°27'25.3"	372
PP 2	46°31'75.1"	24°27'25.7"	277
PP 3	46°32'09.3"	24°27'63.2"	280
PP 4	46°31'24.3"	24°28'11.1"	286
PP 5	46°31'11.9"	24°25'94.8"	298
PP 6	46°31'21.2"	24°23'37.3"	273
PP 7	46°28'35.3"	24°20'46.37"	319

We collected soil (0-20 cm and 0-40 cm depth) and maize samples from each prelevation points (PP).

The minerals determination was made by Flame atomic absorption spectroscopy (FAAS).

After we have calcined the samples we made the solubilisation of the inorganic matter in nitric acid (HNO₃) 0.5 N up to 50 ml. The solutions obtained were used for FAAS determinations. We measured the absorbance in the air-acetylene flame [1].

Determination of pH has been realised in watery suspension in report with the soil:water of 1:2.5.

Results and Discussions

In Table 2 are presented, for Pb, the Normal contents in soil, the Alert threshold values for Romania and the Intervention threshold values for Romania [9].

Table 2

NC*	ATV**	ITV***
20	50	100

* Normal contents in soil, for Romania; **Alert threshold values for Romania; ***Intervention threshold values for Romania [8].

In the studied area, the soil pH registered values from 6.56 to 8.68 for 0-20 cm depth and from 6.58 to 8.73 for 20-40 cm depth.

The Pb contents (mgKg⁻¹ dry matter) in maize (*Zea mays* L.) grains and corresponding soils are presented in Table 3. Each value in the tabel is an average of 3 replicates.

Table 3

Average values mg/kg dry weight (ppm) of total lead contents in maize grains and corresponding soils

Prelevation Point	Soil pH		Pb(ppm) in soil		Maize grains
	0-20 cm	20-40 cm	0-20 cm	20-40 cm	Pb(ppm)
PP1	8.68	8.73	19.370	20.410	0.673
PP2	8.23	8.15	36.972	37.622	1.009
PP3	7.87	7.98	43.004	36.868	0.964
PP4	7.97	7.74	21.918	23.244	0.908
PP5	7.67	7.74	24.960	23.010	0.252
PP6	7.95	8.13	28.132	31.382	0.303
PP7	6.56	6.58	21.580	21.320	1.176

In soil, Pb ranged from 19.37 ppm to 43.004 ppm for 0-20 cm depth and from 20.41 to 37.62 ppm for 20-40 cm depth.

According to Table 2 and Table 3, the lead soil contents are exceeding 20 ppm (the normal contents in soil, for Romania) but do not exceed 100 ppm (the alert threshold values for Romania).

Regarding the lead content (mgKg⁻¹ dry weight) in maize grains, the values are between 0.252 and 1.176 ppm.

In all the collected maize samples lead contents was recorded below the maximum permissible limit for plants recommended by WHO (2 mg/kg)[8].

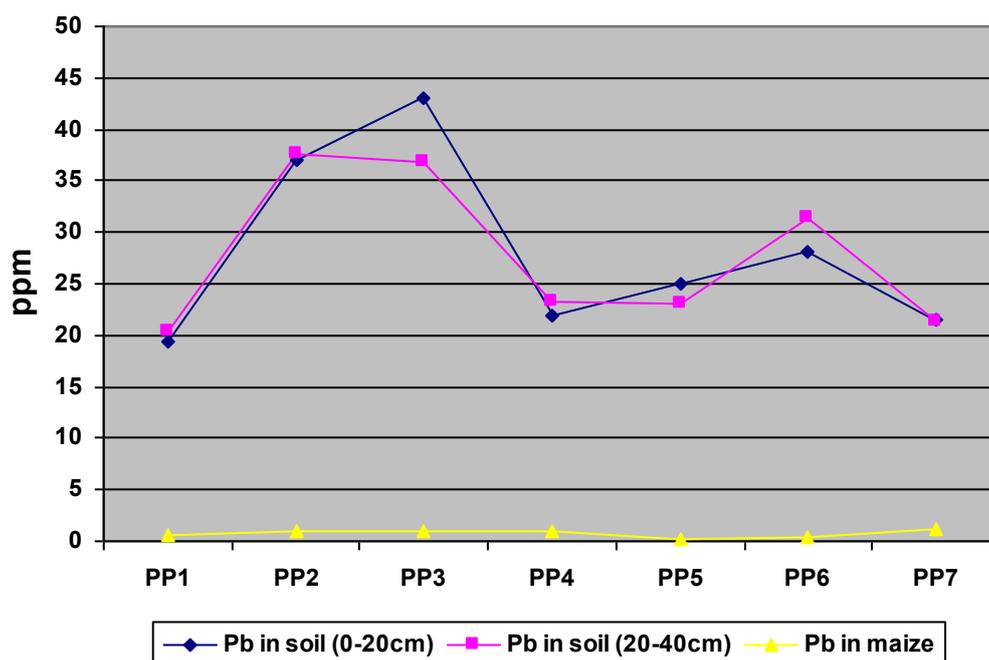


Fig. 1. Graphical representation of Pb contents in maize and corresponding soil
Legend: PP = Prelevation Point

From Figure 1. we observe that maize grains lead content is slightly influenced by the lead soil values.

Conclusions

In soil, Pb ranged from 19.37 ppm to 43.004 ppm for 0-20 cm depth and from 20.41 to 37.62 ppm for 20-40 cm depth.

Our results show that the lead soil contents are exceeding 20 ppm (the normal contents in soil, for Romania) but do not exceed 100 ppm (the alert threshold values for Romania).

In maize grains, lead content registered values between 0.252 to 1.176 ppm (mg/kg dry weight), values who are below the maximum permissible limit recommended by WHO (2 mg/kg).

In conclusion, we can say that maize grains lead content is slightly influenced by the lead soil values. This study allows to obtain informations regarding the lead pollution level in this area.

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