Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw, Poland 00-773
Tel: +48 226 0 227 03
Email: editorial_office@rsglobal.pl

JOURNAL	World Science
p-ISSN	2413-1032
e-ISSN	2414-6404
PUBLISHER	RS Global Sp. z O.O., Poland

ARTICLE TITLE	MIGRATION OF HEAVY METALS IN THE AGRICULTURAL SOIL PROFILE AROUND THE GANJA-KAZAKH ZONE OF THE REPUBLIC OF AZERBAIJAN
AUTHOR(S)	Maharramova Sevinj Telman gizi
ARTICLE INFO	Maharramova Sevinj Telman gizi. (2022) Migration of Heavy Metals in the Agricultural Soil Profile Around the Ganja-Kazakh Zone of the Republic of Azerbaijan. World Science. 1(73). doi: 10.31435/rsglobal_ws/30012022/7749
DOI	https://doi.org/10.31435/rsglobal_ws/30012022/7749
RECEIVED	16 November 2021
ACCEPTED	10 January 2022
PUBLISHED	14 January 2022
LICENSE	This work is licensed under a **Creative Commons Attribution 4.0 International License.**

MIGRATION OF HEAVY METALS IN THE AGRICULTURAL SOIL PROFILE AROUND THE GANJA-KAZAKH ZONE OF THE REPUBLIC OF AZERBAIJAN

Maharramova Sevinj Telman gizi,
Doctor of Philosophy in Agrarian Sciences, Odlar Yurdu University, Baku, Azerbaijan

DOI: https://doi.org/10.31435/rsglobal_ws/30012022/7749

ARTICLE INFO

Received: 16 November 2021
Accepted: 10 January 2022
Published: 14 January 2022

KEYWORDS

migration, automobile, profile, heavy metal, soil, waste.

ABSTRACT

Depending on the nature and characteristics of the heavy metals that accumulate on the surface of the soil, separated from vehicle waste around the highway, they migrate downwards in the soil profile. The course of this process and the properties of heavy metals have been studied by many researchers. The migration of heavy metals in the soil profile later leads to the contamination of plants, especially agricultural crops, with toxic substances. It enters the food chain around the highway, especially with the more intensive accumulation of lead. It is considered dangerous for animals when the amount of lead in dry fodder plants is 100 mg/kg. Its amount migrates deep into the soil profile for several years and remains in the soil for many years without losing its effect. Until recent years, tetraethyl lead was added to all fuels to increase its combustibility and increase the deformation pressure, which caused the release of 200-400 mg of lead into the atmosphere during the combustion of one liter of gasoline. The study found that the migration of heavy metals in the soil profile depends on its granulometric composition, density, thickness of many organic compounds and pH.

Citation: Maharramova Sevinj Telman gizi. (2022) Migration of Heavy Metals in the Agricultural Soil Profile Around the Ganja-Kazakh Zone of the Republic of Azerbaijan. *World Science.* 1(73). doi: 10.31435/rsglobal_ws/30012022/7749

Introduction. In order to study the migration of heavy metals in the soil profile of the areas around the main zone of the western zone of the Republic of Azerbaijan, 50, 100 and 200 meters of soil sections were placed. At the same time, 3 soil samples were taken to characterize it in depth. The amount of heavy metals (copper, zinc, lead, chromium, cobalt and mercury) present in soil samples was determined by atomic absorption spectrometric method.

The study found that most zinc contamination of the soil is observed in its layers. This regularity is also confirmed by the scientific results of many researchers [8]. The spread of zinc in the soil profile occurs more mobile. Zinc spreads more intensively along the profile, especially in moist soils and as a result of the erosion process. In soils with heavy granulometric composition and soils with more organic content, its migration along the profile is weakened. It is also important to note that zinc has a greater effect on microorganisms when migrating along the soil profile. This effect can be considered more dangerous than copper and cadmium.

In the irrigated gray-brown soils in the study area, the amount of zinc in the middle layer of 20-45 cm 50 meters from the highway is less than in the upper and lower layers, which is due to the high inclination and surface flow in that part. Medium-layer zinc migration was weak due to high surface runoff. In general, in all cases, there is an increase in zinc to a depth of 100 cm, which is similar to the data of many researchers [2].

Studies of lead migration in the soil profile show that it is significantly different from zinc. There are many reasons for the downward migration of lead. In particular, the density and compaction of the soil prevents its migration, and as a result, unlike zinc, lead is more concentrated on the soil surface. Researchers note that the inability of lead to migrate below the six layers of crops is due to the very compaction of this layer [9, 2]. In irrigated soils, the amount of lead around the highway can vary greatly depending on depth and distance. However, in many cases, the amount of lead around the highway can be 100 times higher than in the background [10]. It has been found that the decrease in lead to the depth of the soil profile is due to the fact that in many soils it is poor depending on the conditions of formation and the parent rock.

The change and migration of copper in the soils around the highway varies in size. Microorganisms play an important role in the spread and migration of copper. Especially in the lands where grapes are grown, they are observed in very high doses. The main reason for this is the "sky" device used to protect grapes from diseases and pests. Its use for many years has led to the accumulation of copper in the soil. This increases the amount of copper in the surrounding lands of the highway.

Table 1. Profile migration of heavy metals in ordinary gray-brown soils (in mg/kg)

Heavy metals Zinc	Depth, cm	Distance from the asphalt pavement of the highway, in m		
		50	100	200
Lead	0-20 20-45 45-90	17,65 21,36 20,39	16,44 19,91 19,81	13,37 15,97 17,21
Mis	0-20 20-45 45-90	8,36 12,62 3,91	7,10 7,98 3,15	5,16 8,87 0,39
Mercury	0-20 20-45 45-90	58,10 57,87 59,90	43,51 47,12 80,99	36,86 37,87 45,12
Chrome	0-20 20-45 45-90	0,035 0,025 0,035	0,020 0,015 0,020	0,014 0,021 0,020
Cobalt	0-20 20-45 45-90	176,80 207,80 87,65	261,0 242,0 99,61	202,9 98,41 -
Heavy metals	0-20 20-45 45-90	14,17 18,98 14,25	15,11 15,92 11,91	13,33 15,97 12,22

In the ordinary gray-brown soils we studied, there is no continuous pattern of copper profile changes. At a distance of 50 meters from the highway, 58.10 mg/kg was found at the surface, 57.87 mg/kg at 20-45 cm and 59.90 mg/kg at the 45-90 cm layer (Table 2). At a distance of 100 meters, while the top layer was 43.51 mg/kg, the amount in the subsoil was 47.12 mg/kg, and increased by 45-90 cm to 80.99 mg/kg. At a distance of 200 meters, it generally decreased, and increased from the top to the bottom.

The results of laboratory analyzes obtained on dark gray-brown soils are not significantly different from the previous field (Table 2). In this soil, the amount of copper in the top layer of the section at a distance of 50 meters is 57.00 mg/kg, and in the bottom layer of 52.74 and 45-95 cm layer is relatively reduced to 47.96 mg/kg. At a distance of 100 meters, its volume increased to a depth. Similar results were obtained at a distance of 200 meters.

Table 2. Profile migration of heavy metals in dark gray-brown soils (in mg/kg)

Heavy metals	Depth, cm	Distance from the asphalt pavement of the highway, in m		
		50	100	200
Zinc	0-20	21,78	21,58	20,48
	20-45	22,69	22,69	22,00
	45-90	21,67	20,73	10,14
Lead	0-20	20,16	16,17	18,82
	20-45	17,78	11,82	7,91
	45-90	10,06	16,64	8,02
Mis	0-20	53,00	47,11	42,78
	20-45	52,74	50,42	50,89
	45-90	47,96	52,75	52,31
Mercury	0-20	0,050	0,040	0,040
	20-45	0,040	0,045	0,045
	45-90	0,040	0,030	0,045
Chrome	0-20	225,80	104,00	96,75
	20-45	131,80	111,6	90,87
	45-90	97,30	98,74	73,85
Cobalt	0-20	8,88	10,17	8,95
	20-45	14,24	12,18	12,48
	45-90	13,92	11,98	3,18

Many specific changes in copper content are observed in irrigated gray-brown soils (Table 3). It was found to be 58.10 mg/kg in the upper layer at 50 meters, 50.30 mg/kg in the middle layer and 26.75 mg/kg in the lower layer. At a distance of 100 meters, it was 43.51 mg/kg in the upper layer, 57.87 mg/kg in the subsoil and 25.51 mg/kg in the lower layer. In the section laid at a distance of 200 meters, it was determined that it was less in the upper subsoil.

Mercury is a heavy metal that is more prevalent in the soil and has a severe effect on cultivated crops. Mass poisoning occurs when its metallic mercury compounds enter food. One of the main features of mercury is that it accumulates in the upper part of the soil. Mercury can accumulate more in the upper humus-accumulative layer, which has a clayey granulometric composition [10]. Its migration to the lower layers is not felt in the soil profile. In soils with slightly granulometric acidity and relatively weak humus, its migration is relatively accelerated.

In ordinary gray-brown soils, the amount of mercury in the top layer of 0-20 cm of the section dug 50 meters from the asphalt cover was 0.030 mg/kg, 0.020 mg/kg at 20-45 cm and 0.030 mg/kg at 45-90 cm. At a distance of 100 meters, its amount was the same in the upper and lower layers. According to the results of laboratory tests at 200 meters, no significant difference in profile was obtained.

The amount and distribution of mercury in the dark gray-brown soils around the Ganja-Gazakh highway is similar to that in ordinary gray-brown soils. For example, at a distance of 50 meters after the asphalt pavement, its amount was 0.050 mg/kg at 0-20 cm along the profile, and 0.040 mg/kg at 20-45 and 45-90 cm. It was determined that 0.040 mg/kg at a depth of 0-20 cm, 0.045 mg/kg at 20-45 and 0.030 mg/kg at 45-90 cm in the soil excavated at a distance of 100 meters. At 200 meters, it was 0.040 mg/kg in the top 0-20 cm layer, and then 0.045 mg/kg until the end.

As mentioned earlier, the distribution of mercury along the profile of the gray-brown soils irrigated around the highway does not differ significantly from the soils shown earlier (Table 3).

Chromium has a special distribution pattern in the soil profile of heavy metals, which pollute the atmosphere and soil by road transport. According to researchers, the amount of chromium in the soil can be affected by the parent rock, which forms more soil.

Emissions from car engines and during their operation cause chromium contamination of the soil.

Tables 1, 2 and 3 show that the distribution of chromium in the study soils is different. Depth of chromium in ordinary gray-brown soils is 225.80 mg/kg in 0-20 cm at 50 meters, 131.80 mg/kg in 20-45 cm in the subsoil and 97.30 mg/kg at 45-90 cm. kg. At 100 meters, it was 104.00, 111.6 and

98.74 mg/kg, respectively. At 200 meters, all indicators decreased. At 200 meters, it decreased to 96.75 mg/kg in the upper layer, 90.87 mg/kg in the subsoil, and 73.85 mg/kg in 45-90 cm.

Table 3. Profile migration of heavy metals in irrigated gray-brown soils (in mg/kg)

Heavy metals **Zinc**	Depth, cm	Distance from the asphalt pavement of the highway, in m		
		50	100	200
Lead	0-20 20-45 45-90	17,65 15,90 17,20	16,44 21,36 19,26	13,37 19,26 -
Mis	0-20 20-45 45-90	8,36 12,62 9,40	7,98 7,10 11,97	5,16 7,98 -
Mercury	0-20 20-45 45-90	58,10 50,30 26,75	43,51 57,87 25,51	36,85 47,12 25,51
Chrome	0-20 20-45 45-90	0,040 0,020 0,030	0,013 0,043 0,045	0,035 0,043 0,045
Cobalt	0-20 20-45 45-90	261,00 207,80 202,90	176,80 242,00 87,65	261,00 262,00 -
Heavy metals	0-20 20-45 45-90	14,17 18,97 15,31	15,11 15,49 15,08	13,33 15,08 -

The distribution and migration of cobalt in the soil profile differs significantly from the aforementioned heavy metals. Cobalt, like chromium, can enter the soil as a polluting metal from a variety of sources. But it is also important to note that road waste plays a big role in it.

In normal gray-brown soils, the change in profile of cobalt was 50 meters from the asphalt bed, 14.17 mg/kg in the upper layer, 18.98 mg/kg in the middle transition layer, and 14.25 mg/kg in the lower 45-90 cm. In the 100-meter section, it was 15.11 mg/kg at the top, 15.92 mg/kg in the middle layer and 11.91 mg/kg in the bottom layer. At 200 meters, it was 13.33 mg/kg in the upper layer, 15.97 mg/kg in the middle layer and 12.22 mg/kg in the lower layer. Here we can determine the regularity that the amount of cobalt increases from the top layer to the middle layer, and decreases again in the top layer.

A similar pattern is observed in dark gray-brown soils (Tables 1, 2, 3).

Conclusions. As a result of the research, it was determined that the migration of mercury in the soil profile in the surrounding lands of the Ganja-Gazakh highway is almost non-existent. The change and migration of copper in the soils around the highway varies in size. The study found that most zinc contamination of the soil is observed in its deeper layers. There are many reasons for the downward migration of lead. In particular, the density and compaction of the soil prevents its migration, and as a result, unlike zinc, lead is more concentrated on the soil surface. The amount of cobalt increases from the top layer to the middle layer, and decreases again in the top layer. The entry of cobalt into the soil as a polluting metal can come from a variety of sources. But motor vehicle waste plays a big role in it.

The study found that the distribution of chromium in soils varies. Chromium was mainly observed in the upper layers of the soil in these soils. This is the waste generated by car engines and during its operation, which causes chromium contamination of the soil.

REFERENCES

1. Головатый С.Е., Ковалевич З.С., Лукашенко Н.К. Подвижность тяжелых металлов в почвах в зоне воздействия промышленных предприятий. Мат. Международной научно-практической конф. Почвенно-земельные ресурсы: оценка устойчивые использование геоинформационное обеспечение, Минск, Издательский центр, БГУ, 2012, с. 238-242
2. Коргачина К.В., Смачин А.В., Решетина. Оценка техногенного загрязнения городских почв на основе профильного распределения тяжелых металлов и плотности сложения. Почвоведение, 2014, № 8, с. 988-997
3. Плияскина О.В. Ладонин Д.В. Загрязнение городских почв тяжелыми металлами. Почвоведения, 2009, № 7, с. 877-885
4. Oberlander H.E. Roth R. Die Wirkung der schwermentalle Chrom, Nikel, Kupfer, Zink, Cadmium, Quecksilber, und Blei, auf die Aufnahme und Verlagerug von Kalium und Phosphat bei jungen Gerstepflanzen // Z. Pfl. Ernahr, Dung. Boenkunde. 1978. V. 141. S. 263-270.
5. Heavy metals in the environment interface. Ed. H.B. Bradl-Sceince and Technology, 2008, V 6, 269 p.
6. Anderson A.J. Meyer D.R. MayerF/K/ Heavy metal toxicities: levels of nickel? Cobalt and chromium in the soil and plants associated with visual symptoms and variation in growth of an oat crop // Austr. J. Agric. Res. 1973. V. 24. № 4. P. 557-571
7. Soil: Basic Consepts and Future Challenges, Cambridge University Press, 2006. 310 p.
8. Коргачина К.В., Смачин А.В., Решетина. Оценка техногенного загрязнения городских почв на основе профильного распределения тяжелых металлов и плотности сложения. Почвоведение, 2014, № 8, с. 988-997
9. Аржанова В.С. Миграция микроэлементов в почвах (по данным Лизиметрических исследований. Почвоведения 1977, № 7, с. 71-77
10. Добровольский Г.В. Гришина. Охрана почв. Изд-во. Моск. Ун-та, 1985, 224 с.
11. Смагин А.В. Шоба С.А. Макарова О.А. Экологическая оценка почвенных ресурсов и технологии их воспроизводства. Москва. Из-во Моск. ун-та, 2008, 360 с.
12. Rahib Imamguluyev, Elvin Balakishiyev, Nihad Agakishiev, Improving The Mechanism Of Using The Price Factor In The Effective Regulation Of Agricultural Production On The Basis Of Fuzzy Logic, December 2020, International Journal of Innovative Technologies in Economy DOI: 10.31435/rsglobal_ijite/30122020/7325
13. Rahib Imamguluyev, Tural Suleymanli, Niyar Umarova, Evaluation of the Effectiveness of Integration Processes in Production Enterprises Based on the Fuzzy Logic Model, 14th International Conference on Theory and Application of Fuzzy Systems and Soft Computing – ICAFS-2020, DOI: 10.1007/978-3-030-64058-3_17