POLLUTION OF ERODED SOIL BY EXCESS AND DEFICIENCY OF COPPER

POLUAREA SOLURILOR ERODATE PRIN EXCES ŞI CARENŢĂ DE CUPRU

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Abstract. *In the paper are presented the data concerning to plant pollution by copper excess and deficiency on the Grey Forest eroded soils and diluvial soils with different agricultural utilization. The pollution by copper excess takes place in the vineyards on the eroded soils. Pollution by copper deficiency has founded to alfalfa and grass vegetation on the diluvial soils. The report Fe:Cu is useful as a diagnostically factor in the determination the copper level pollution of soils and plants on the eroded soils.*
Key words: copper, excess, deficiency, plants, soils, erosion

Rezumat. *In lucrare sunt prezentate datele referitoare la poluarea plantelor prin exces şi carenţă de cupru, pe solurile cenuşii de pădure erodate şi deluviale, cu diferită utilizare agricolă. Poluarea produsă de cupru prin exces are loc în solurile erodate plantate cu viţă de vie. Poluarea de cupru prin carenţă s-a depistat la lucernă şi vegetaţia ierboasă pe solurile deluviale. Raportul Fe:Cu poate fi folosit ca indice diagnostic in determinarea nivelul poluării cu cupru a plantelor pe solurile erodate.*
Cuvinte cheie: cupru, exces, carenţă, plante, sol, eroziune

INTRODUCTION

The soil contains a large amounts elements received by agricultural chemicals' of various types and levels of toxicity. Because of erosion, these substances easily put in motion in that case are very difficult to determine and to implement effective economic measures to combat soil erosion. The problem is distribution of chemicals between soil components, chemical forms that migrate in the erosion processes and pollution degree of plant and soil eroded and accumulated. Thus, erosion is represented not only a process of soil degradation, but also as a type of pollution through excess or deficiencies of nutrients. Macro- and microelements fulfill different functions in plant metabolism, lack or excess of one of these elements cause symptoms of "illness" deficiency of the type greensickness physiological function (Kabata-Pendias A., Pendias X., 1989).

MATERIAL AND METHOD

Research objects were Grey Forest soils of the southeast part of Forest reservation "Codri" from Republic of Moldova. The territory has undergone an erosion relief and landslides. Despite these, intensive agriculture developed the prevalence of

viticulture. The pollution of copper carry out on the three different agricultural uses (chains): arable, vineyard - 27 years, fallow land (used under grape vine 6-7 years, then left unprocessed for 20 years caused of erosion, this time covered with natural vegetation). All three chains are representing in the exhibition southwest slope, the inclination of 2-10º, length of 800 - 1000 m. The soil cover is represented by none eroded, weakly eroded, moderately eroded, strongly eroded soils, cumulative soil (at the foot of slopes and meadows). The content of copper was investigates in vines: (leaves, rods (osier), clusters, and grains), growing natural grass, winter barley and alfalfa (whole plant). The soil content of copper was determined by the classical method disaggregate with hydrofluoric acid in combination with sulfuric acid. The plant content of copper in has resulted in hydrochloride solution obtained after dissolution of ash from the incineration plant at 450ºC for 4 hours. Determination was performs by atomic absorption spectra-photometer method.

RESULTS AND DISCUSSIONS

The concentration of copper in plants correlated with the soil mostly in the toxic content. These concentrations is maintained during the first 16 cm of soil, not harmful to the vine root system developed mostly less than 40 cm. Movement of copper in different parts of the vine plants plays an important role in its use. The largest amount of copper accumulated by leaves; in them is contained 3016 mg Cu/kg on the soil with whole profile (non eroded) up to 1560 mg Cu/kg in the strongly eroded soil (table 1).

Table 1

Content of total Cu in plants ash of Grey Forest soils, mg / kg

Chains	Plants	None eroded	Weakly eroded	Moderately eroded	Strongly eroded	Diluvial
Vine-yard	leaf	3016	2750	2200	1560	-
	rod	117	200	233	275	-
	clusters	127	109	107	97	-
	grain	34	50	50	67	
	Alfalfa	-	-	-	-	20
Fallow	Grass	44	34	26	17	20
	Alfalfa	-	-	-	-	34
Arable	Barley	21	17	13	10	-
	Alfalfa	-	-	-	-	14

Rods and clusters containing, respectively: 117-275 and 127-97 mg Cu/kg. The small amount of copper has found in grapes: from 34 mg/kg on none eroded soil to 67 mg/kg on highly eroded soil. The concentration of copper in grapes increases with degree of erosion, exceeding the maximum allowable fruit - 10 mg/kg [Leah Tamara, 1995] of 3,7 times. Copper has a lower immobility in plants, in comparison with other elements. Therefore, a large part of the plant to remain with their dying, and only small concentrations can move to the young parts of the plant. The most important practical application of the data above

relates to the problem of excess and deficiency microelements in agricultural crops. The copper insufficiency influence physiological processes, on plant productivity (Răuţă C., Cârstea S., 1983). Although the phenomenon of copper deficiency is widespread and known, his diagnosis and correction methods require further research. For different plant species, the concentration of copper deficiency that is determined is very different. However, generalized data show that a concentration below 2 mg Cu/kg is unfavorable for most plants (Leah Tamara, 2005).

Copper concentrations in eroded soils have a lasting effect. Even 20 years after application of preparations containing copper in concentrations of grass vegetation on the fallow chain are quite large, from 44 mg/kg on whole soil profile to 17 mg/kg on highly eroded soil. The concentration in barley plants is almost 2 times lower than in natural grass vegetation. Stability of high concentrations (excess) of Cu in plants and their ability to accumulate the maximum levels can lead to some undesirable phenomena, damaging the environment. The high concentration of copper in leaves has caused by absorption that takes place during watering the vine plants with copper sulphate solution. Long-fallow eroded soils has stimulated the process of soil genesis, improved some physical-chemical properties, and increased the amount of humus by 2 times compared with eroded soils of neighboring chains.

To provide insufficiency and excess has calculated with the ratio of Fe and Cu in the plants on eroded and diluvial soils (table 2).

Table 2

The ratio of Fe and Cu in plants on the Grey Forest soils

Chains	Plants	None eroded	Weakly eroded	Moderately eroded	Strongly eroded	Diluvial
Vine-yard	leaf	0,25	0,24	0,28	0,36	-
	rod	1,16	1,38	1,51	1,92	-
	clusters	3,33	1,44	0,97	0,73	-
	grain	2,79	2,40	2,22	2,09	-
	Alfalfa	-	-	-	-	95,0
Fallow	Grass	5,0	8,3	16,9	3,2	87,5
	Alfalfa	-	-	-	-	38,2
Arable	Barley	10,5	13,5	19,0	27,5	-
	Alfalfa	-	-	-	-	78,6

Research has shown that the plants on eroded soils ratio of Fe and Cu is lower than in plants on diluvial soil. The lowest values were obtained in vines leaves (0,25-0,36), where he is in high enough concentrations. In a rods, clusters, grapes this ratio varies between 3,33-0,73. The highest values of this report has obtained for alfalfa (95) on diluvial soil, here has found in low concentrations. The grass and barley vegetation ratio is increased (5,0-3,2) while increasing erosion. This report Fe:Cu in the plants on eroded soils is changing and depending

on the degree of erosion. In light of this report has made up gradation of copper excess and deficiencies in the plants (table 3).

Table 3

Gradation of copper excess and deficiency for plant as the ratio of Fe and Cu

Gradation	Level	Fe : Cu	Copper accumulation in plants
Excess	strong	0,1-1,0	Leaves (all eroded soils) Clusters (moderately and strongly eroded soils)
	moderate	1-5	Rods and grapes (all eroded soils)
	low	5-10	Grass (none eroded, weakly eroded soils)
Deficiency	low	10-20	Grass (moderately eroded soils) Barley (none eroded, weakly, moderately eroded soils)
	moderate	20-30	Barley (highly eroded soils)
	strong	>30	Lucerne and grass vegetation (diluvial soils)

According to the graduations, excess or toxicity of copper is strong on all eroded soils with vines (0,1-1,0) and strong deficiency of copper - on diluvial soil (>30) in alfalfa and grass vegetation. Absoluteness set of indices ratio of Fe and Cu in plants on eroded and accumulated soils quite clearly manifested. This report and the reports of micronutrients content in plants on the eroded soils can serve as a diagnostic factor for assessing ecological conditions of plant development.

CONCLUSIONS

1. The excess of copper occurs in the vines (leaves, clusters) on eroded soils; the copper deficiency in the alfalfa and grass vegetation on diluvial soils, on weakly and non-eroded, not detected excess or deficiency of copper in plants.

2. The perspective index provides diagnostic failure and copper toxicity to plants on eroded soils is the ratio of Fe: Cu. Plant pollution by copper excess and deficiency on Grey Forest soils occurs depending on the degree of soil erosion and agricultural uses.

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