FERTILITY REGENERATION POSSIBILITIES OF SOILS AFFECTED BY EROSION

POSIBILITĂȚI DE REGENERARE A FERTILITĂȚII SOLURILOR AFECTATE DE EROZIUNE

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Abstract. *Hydro erosion is the main threat for the soils placed on slopes. As a result, the most fertile surface stratum is washed by torrential precipitations. The erosion processes in the Republic of Moldova are found on about 1.5 million hectares (60 % of the agricultural territories). Annual losses of fertile soil constitute 26 million tons (19 t/ha). 700,000 tons of humus, 50,000 tons of nitrogen, 34, 000 tons of phosphorus, and 597,000 tons of potassium are lost together with the soil. This fact leads to the reduction of agricultural cultures harvest by 30-70 % compared to un-eroded soils. Regeneration of arable soil fertility affected by erosion is possible through rational use of organic fertilizers. The present paper attempts at pointing out these possibilities.*

Rezumat. *Principalul pericol al solurilor amplasate în pantă este eroziunea hidrică în rezultatul căreia se spală stratul superficial de sol, cel mai fertil, sub acțiunea precipitațiilor torențiale. În Republica Moldova procesele de eroziune se manifestă pe circa 1,5 milioane hectare (60% din teritoriile agricole). Pierderile anuale de sol fertil constituie 26 milioane tone (19 t/ha). Cu această masă de sol se spală: humus – 700 mii tone, azot – 50 mii tone, fosfor – 34 mii tone, potasiu – 597 mii tone, ceea ce conduce la reducerea recoltelor culturilor agricole cu 30-70%, în comparație cu solurile neerodate. Regenerarea fertilității solurilor arabile afectate de eroziune este posibilă prin valorificarea rațională a îngrășămintelor organice. Prezenta lucrare încearcă să evidențieze aceste posibilități.*

Out of the natural processes dangerous to human society, soil erosion is the most complex one what regards the way of developing, the spreading areas and the caused dangers. Annual soil losses disfavor the conservation of nutritive elements and precipitation water retention, thus worsening soil fertility of slope terrains [1].

MATERIALS AND METHODS

The research and the observations were made in the period 1996-2006 at the Pedology and Erosion Experimental Station of „Nicolae Dimo" Institute of Pedology and Agro-Chemistry situated in the village Lebedenco, Cahul district, Republic of Moldova. The experimental field is a 5-7^0 slope inclined to North-East (figure 1).

The soil consists of common moderately eroded chernosem of a clay texture containing 2.07-2.54% of humus and 7.5-7.8 weak alkaline reaction.

Three fertilization systems have been studied: organic, mineral and mixed. The scheme of the experience and the cultivated cultures are presented in Table No. 4. The variants 4, 5, 7, 8 and 9 have the function of determining the optimal doze and the periodicity of manure application. Two annual dozes are tested (12.5 and 25 t/ha). The first is evaluated as optimal doze for the maintenance of humus; the second one is planned as a doze of fertility increase.

Fig.1 – Experimental field planted with alfalfa

The washed off (deluvial) soils formed as a result of erosion constitute an important reserve for the restoration of the eroded soils. The composting with components rich in nutritive elements constitutes the most efficient way of their being used [2]. For this purpose a sample of compost was also investigated [variant 9].

The straw is a very important source of organic matter for the soil and can be used as an organic fertilizer without preliminary composting or transformation into artificial litter [3]. The straw, to which nitrogen fertilizers were added (variant 2), was incorporated in soil in order to reduce the C:N proportion after which the parcels were disked and ploughed. Each year in spring, soil samples are collected for laboratory tests from places indicated on the plot. The surface of the plot is of 6 m x 40 m= 240 m^2

RESULTS AND DISCUSSIONS

In order to know the nitrogen, phosphorus, and potassium content which is introduced in the soil at fertilization, we analyzed the used organic fertilizers (Table 1).

Table 1

Analysis of organic fertilizers used in the experience, % of humid mass

No. crt.	Specification	N	P_20_5	K_20
1	Manure	0,53	0,32	1,31
2	Compost	0,29	0,24	1,45
3	Straw	0,62	0,14	1,28

As a result of the chemical analyses we concluded that the fertilizers contributed to the increase of humus in common chernosem moderately eroded by 0.26-0.47% compared to the initial content (Table 2). Simultaneously with the increase of humus under the influence of the applied fertilizers, the content of the mobile forms of the nutritive elements also increased. In the ploughed layer of the fertilized variants the increase of mobile phosphorus and changeable potassium is of about 1.39-2.10 and 4.2-31.9 mg/100 g of soil respectively compared to the initial content.

Table 2

Soil Agro-chemical Indicators after the application of fertilizers in the ploughed layer

Variant	Content		
	Humus, %	P_20_5	K_20
		mg/100 g soil	
1	2	3	4
1996, initial content before the application of fertilizers			
Control plot	2.07	1.89	16.8
Straw, 4 t/ha + $N_{60}P_{60}$	2.19	1.75	15.9
$N_{60}P_{60}$	2.28	1.69	16.0
Manure, 50 t/ha after 4 years	2.09	1.93	15.3
Manure, 100 t/ha after 4 years	2.54	1.78	16.7
Manure, 200 t/ha after 8 years	2.17	1.54	16.8
2006, the 10th year of application			
Control	2.15	1.93	18.1
Straw, 4 t/ha + $N_{60}P_{60}$	2.45	3.41	23.4
$N_{60}P_{60}$	2.41	3.08	20.2
Manure, 50 t/ha after 4 years	2.42	4.03	28.5
Manure, 100 t/ha after 4 years	2.98	3.68	31.8
Manure, 200 t/ha after 8 years	2.66	2.71	48.7
Increase compared with the initial content			
Control	0.08	0.04	1.3
Straw, 4 t/ha + $N_{60}P_{60}$	0.26	1.66	7.5
$N_{60}P_{60}$	0.13	1.39	4.2
Manure, 50 t/ha after 4 years	0.47	2.10	13.2
Manure, 100 t/ha after 4 years	0.44	1.90	15.5
Manure, 200 t/ha after 8 years	0.39	1.17	31.9

Due to the organic substances contained in the applied fertilizers the soil physical indicators improved (Table 3). The organic fertilizers contributed to the maintenance of the soil in a better affine condition. As a result, the apparent density was reduced, the soil resistance to penetration dropped. The tendency to increase total porosity is being observed. The influence of fertilizers upon the soil physical characteristics is presented in Table 3.

Table 3

Influence of fertilizers upon the soil physical characteristics in the ploughed layer

Variant	Apparent density g/cm^3	Density g/cm^3	Total porosity, %	Resistance to penetration, kgf/cm^2
Control plot	1.26	2.66	52.6	23.4
$N_{60}P_{60}$	1.24	2.64	53.0	22.8
Manure, 50 t/ha after 4 years	1.22	2.64	53.8	20.1
Manure, 100 t/ha after 4 years	1.18	2.63	55.1	13.3
Manure, 200 t/ha after 8 years	1.16	2.63	55.8	16.8

Improvement of physical and chemical indicators of the common chernosem moderately eroded through the application of fertilizers led to the increase of the yield of the agricultural cultures (Table 4).

Table 4

Soil agrochemical indicators after the application of fertilizers in the ploughed layer

Variant of fertile-zation	Control plot yield and increase on the fertilized variants							
	1999, winter fodder (peas + oat)	2000, au-tumn wheat	2001, corn, seeds	2002, au-tumn bar-ley	2003, corn, seeds	2004, Sun flower	2005, Au-tumn wheat	2006, alfalfa, green fodder
1	4	5	6	7	8	9	10	11
Control plot (with-out ferti-lizers)	56.6	12.4	31.7	14.3	34.2	12.7	14.3	77
Straw, 4 t/ha after 4years + $N_{60}P_{60}$	24.0	2.4	5.2	2.7	7.3	3.1	3.1	25
$N_{60}P_{60}$	8.3	1.3	5.5	2.4	5.2	1.2	2.1	30
Manure, 50 t/ha after 2 years	11.1	5.3	12.8	7.1	15.3	7.4	6.7	95
Manure, 50 t/ha after 4 years	8.6	4.2	10.4	8.2	11.3	6.3	8.6	114

Variant of fertile-zation	Control plot yield and increase on the fertilized variants							
	1999, winter fodder (peas + oat)	2000, au-tumn wheat	2001, corn, seeds	2002, au-tumn bar-ley	2003, corn, seeds	2004, Sun flower	2005, Au-tumn wheat	2006, alfalfa, green fodder
1	4	5	6	7	8	9	10	11
Manure, 50 t/ha after 4 years+ $N_{60}P_{60}$	70.8	6.5	13.3	9.4	12.4	7.1	9.4	121
Manure, 100 t/ha, after 4 years	26.3	8.0	10.8	11.3	10.1	8.2	10.0	119
Manure, 150 t/ha after 6 years	41.4	11.4	11.4	10.4	16.2	9.2	11.7	118
Manure, 200 t/ha after 8 years	48.6	13.7	13.5	12.3	8.3	7.5	10.5	129
Compost, 100 t/ha (manure, 80% + deluvial (washed off) soil, 20%	26.6	11.1	7.2	3.1	5.8	3.9	2.6	85

CONCLUSIONS

- Application of fertilizers, especially of organic ones, constitutes a primordial factor for the improvement of the soils affected by erosion.

- Organic fertilizers on such soils should be applied in the doze limits of 50-100 t/ha, calculated in the equivalent of manure with cover. In case of insufficiency of organic fertilizers resources, a doze of 50 t/ha should be applied in combination with chemical fertilizers $N_{60}P_{60}$.

- As organic fertilizers, manure originated from all kinds of animals, town mud, solid wastes, coming from the processing industry of agricultural products, other organogenic wastes can be used.

- In the case when the organic fertilizers contain an excess of humidity their composting is necessary. Deluvial (washed off) soil, mud, straw etc. can be used as absorbents.

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