THE EFFECTS OF STRIP CROPPING SYSTEM, GRASS BUFFERS STRIPS AND SLOPE POSITION ON SOME PHYSICO-CHEMICAL PROPERTIES AT CAMBIC CHERNOZEM FROM IASI COUNTY

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Abstract

The research was carried out on the sloping land from the Agricultural Research Station of Podu- Iloaiei, Iasi (47°12´ N latitude, 27°16´ E longitude) and the Experimental Farm of the University of Agricultural Sciences and Veterinary Medicine, Ezareni (47°07´ N latitude, 27°30´ E longitude) on a cambic chernozem (SRTS-2003).
The parameters analyzed were soil texture, bulk density, aggregate stability (physical characteristics) as well as soil pH, SOM, basic cations (Ca, Mg, K), N and P (chemical characteristics). The climatic conditions in the Moldavian Plain were characterized by annual mean temperature of 9.6oC and a mean rainfall amount, on 50 years, of 553.5 mm, of which 141.5 mm during September-December and 412.0 mm during January-August. At the beginning of the sampling, the study of the researched area was carried out and the GPS was used to identify the geographic location and the coordinate system in the researched areas. Data on soil properties were recorded on thematic maps, scale 1: 2000 and processed using the AutoCAD software. The results obtained on soil erosion indicate that from the total amount of precipitation recorded – 549.8 mm, 338.5 mm (61.6%) generated leaks that varied between 8.2 mm at perennial grasses in the second year of vegetation and 33.4- 35.9 mm at maize and sun flower crops. The annual soil losses due to erosion raged between 0.193 t/ha at perennial grasses in the second year of vegetation and 7.657-8.328 t/ha at maize and sunflower. The percent of hydrostable aggregates ranged between 65.5% at non-eroded soil from the base of the slope and 35.7 at highly eroded soil. Soil erosion caused a reduction in the percentage of aggregate by 14.5% to slightly eroded soil and 37.7% in the strongly eroded soil. The percentage of water stable aggregates was comprised between 73.5% in non-eroded soil, at the bottom of slope land and 45.7% at the highly eroded soil. Erosion influences soil fertility by removing along with the eroded soil, high amounts of mineral elements: 15.02 – 16.36 kg/ha nitrogen, 1.05 – 1.2 kg/ha phosphorus and 1.84 – 2.08 kg/ha potassium, in maize and sunflower crops. The crop structure, which determined the diminution in mean soil losses by erosion until 2.2 t/ha included 20 % straw cereals, 20% annual legumes, 20% row crops and 40 % perennial grasses and legumes. On land with a slope of 16%, lowering the percentage of weeding plants from 60% to 20% has reduced the amount of eroded soil by 47.1% (1.966 t/ha/y).
At Ezareni, on the land with a 12% overall slope, given the agro-terraced process that appeared in time due to soil erosion and tillage, the slope of cultivated stripes decreased, depending on the slope of the land, to 7.40-10.78% and the slope of the taluses increased from 12.78 to 26.18%. At Podu-Iloaiei, on the land with a general slope of 13%, through the agro-terracing process, the slope of cultivated stripes decreased at 7.25 la 11.08 and the slope of the taluses increased from 17.66 to 88.28%.

Key words: slope land, cropping system, soil aggregate stability, organic carbon, grass strips

The assessment and knowledge of soil erosion and land degradation are the main starting points for establishing and implementing conservative farming measures.

One of the most important objectives of sustainable development is to protect soil against various forms of degradation and, above all, against erosion caused by water and wind.

The annual soil erosion values determined between 2011 and 2012 show that the highest value of soil erosion (3.53 t/ha/year) was recorded in South America, followed by Africa with 3.51 t/ha/year and Asia with 3.47 t/ha/year. In North America, Europe and Oceania, soil erosion values were much lower, respectively, of 2.23, 0.92 and 0.9 t/ha/year.

In the EU 28, due to the severe erosion of the surface of 12 million hectares (about 7.2% of the total), where about 0.43% of crop productivity is lost, the annual cost was estimated at around 1.25 billion Euros (Panagos P. *et al*, 2018).

The Organization for Economic Cooperation and Development (OECD) considers that tolerable soil losses by erosion are up to 6 t/ha/year and

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Bazzoffi (2018) considers that, in order to ensure minimum environmental requirements and to continue agricultural activity, the value the tolerable soil losses should not exceed 3 t/ha/year.

Average soil losses through erosion, recorded in Romania (2.84 t/ha/year), United Kingdom (2.38 t/ha/year), Portugal (2.31 t/ha/year) and France (2.25 t/ha/year), are about, three times higher than the EU-28 average tolerable losses, considered by most experts of 0.3 to 1.4 t/ha/year.

The results on water runoff and soil losses in different crops from the hydrographic basin of Podu-Iloaiei, Iasi County have shown that in the last sixteen years, of the total amount of 558.4 mm rainfall, 356.8 mm (63.9%) produced water runoff, which was between 8.2 mm in perennial grasses, in the second year of vegetation, and 35.4 - 38.6 mm, in maize and sunflower crops. The annual soil losses due to erosion, recorded at the same period, were between 0.189 t/ha/year in perennial grasses, and 7.428 - 8.245 t/ha/year in maize and sunflower crops.

According to future land use forecasts, RUSLE2015 estimates that the amount of soil loss through water erosion will decrease slightly by 2050 due to the increase in forest areas, but this reduction will be annihilated by the growing demand for arable land for food and fuel. So reducing soil erosion can be achieved by applying more sustainable land management practices.

MATERIAL AND METHOD

The research was carried out on the sloping land at the Agricultural Research Station of Podu-Iloaiei (47°12´ N latitude, 27°16´ E longitude) and the Experimental Farm of the University of Agricultural Sciences and Veterinary Medicine of Iasi (47°07´ N latitude, 27°30´ E longitude) on a cambic chernozem (SRTS-2003).

The experimental design consisted of two plots equipped with anti-erosion works, with a slope of 12% (Ezareni) and 14% (Podu-Iloaiei) each with a width of 260 meters and a length of about 680 meters (*figure 1;2;3*).

The crops on each experimental plot were grown in a crop rotation: pea - winter wheat-maize - sunflower.

The parameters analyzed were soil texture, bulk density, aggregate stability (physical characteristics) as well as soil pH, SOM, basic cations (Ca, Mg, K), N and P (chemical characteristics).

At the beginning of the sampling, the study of the researched area was carried out and the GPS was used to identify the geographic location and the coordinate system in the studied areas. The data obtained on soil properties were recorded on thematic maps drawn up at the scale of 1: 2000.

The content of total nitrogen, nitrates, phosphorus and potassium was determined on soil and water samples, lost by erosion, in different crops, thus establishing the losses of nutritive elements on the area of the watershed where experiments are placed.

Chemical analyses were done according to the following methods: pH – potentiometrically, with combined electrode of glass in watery suspension, at the ratio between soil and water of /2.5; humus – by wet oxidation, according to Walkely-Black Method, modified by Gogoaşă; total nitrogen by Kjeldahl Method, with disintegration with H_2SO_4 at 3500 C, catalyst potassium sulphate and copper sulphate; mobile phosphorus – by extraction, in solution of ammonia lactate acetate (PAL); mobile potassium – by extraction in solution of ammonia lactate acetate (P-AL), according to Egner-Riehm-Domingo Method.

The calculations of total organic carbon and nutrient losses (N, P_2O_5, K_2O) were obtained by multiplying the content of each property from sediments with the amount of sediment production after each erosion event.

The level of variation in OM, pH, Ca, AP, K, Na, Mg, and TN, in the three positions that are upper, mean and lower slope, was performed with variance analysis.

RESULTS AND DISCUSSIONS

Many research carried out in different countries paid special attention to the technological elements that determine the improvement of the physical, chemical and biological properties of the soil in a shorter time and with lower costs (Adhikari B. *et al*, 2011; Ailincăi C. *et al*, 2011, 2015; Bucur D. *et al*, 2011; Dârja M., 2000; Dumitrescu N., 1999; Ioniță I., 2000; Jităreanu G. *et al*, 2007, 2015; Lal R. *et al*, 2011; Popa A., 1984; Rusu T., 2006).

The climatic conditions in the Moldavian Plain are characterized by an annual mean temperature of 9.6ºC and a mean rainfall amount, on 50 years, of 553.5 mm, of which 141.5 mm during September-December and 412.0 mm during January-August.

The Ezareni Farm is part of the Didactic Station of the University of Agricultural Sciences and Veterinary Medicine of Iasi and it is located 2 km away from the city of Iasi, in the southwest of the Moldavian Plain, known as the "Lower Jijia and Bahlui Plain".

The measurements conducted in 2018 on strip grass and crop strips in the Podu-Iloaiei and Ezareni basins aimed at assessing the changes on the slope of the agro-terraced land (*figure 1;3*). Reducing the slope of the land by terracing and the existence of taluses with perennial grass determine erosion reduction and the modification of the physico-chemical properties of the soil (*figure 2*).

On the land with a 11.8% overall slope, at Ezareni, through the agro-terracing process generated by erosion and soil tillage, the slope of cultivated stripes decreased, depending on the slope of the land, to 8.22-10.78% and slope of the taluses increased from 12.78 to 26.18% (*table 1)*.

Table 1

The slope of the land (%) at three transects at Ezareni, Iasi watershed

Terrace	**Transect 1**	**Transect 2**	**Transect 3**	**Average**
Te-1	8.22	9.67	9.57	9.15
Te-2	9.04	12.17	12.23	11.15
Te-3	10.71	9.94	8.24	9.63
Te-4	10.78	8.02	10.50	9.77
Te-5	17.03	18.64	15.39	17.02
Taluse	**Transect 1**	**Transect 2**	**Transect 3**	**Average**
Tl-1	17.24	16.46	20.71	18.14
Tl-2	24.57	17.83	17.63	20.01
Tl-3	14.88	15.32	18.62	16.27
Tl-4	19.09	12.88	12.78	14.92
TL-5	22.11	26.18	**24.12**	24.14
Overall slope of the land	**11.51**	**12.00**	**11.90**	**11.80**
LSD 5% = 1.8; LSD 1% = 2.5; LSD 0.1% = 3.7 %				

At Podu-Iloaiei, on the land with a general slope of 13.04%, through the agro-terracing process produced in time due to erosion and soil tillage, the slope of cultivated stripes decreased depending on the slope of the land, to 7.25 - 11.05 and the slope of the taluses increased from 17.66 to 73.5% (*table 2*).

Measurements made after 38 years after the placement of perennial grass strips show that the slope of the platforms decreased by 15.0-44.4% compared to the initial slope of the terrain, by the agro-terracing process, and the slope of the taluses with perennial herbs, increased by 150-463%.

On soils with silt-clayey texture, from Podu-Iloaiei, Iasi, the bulk density of less than 1.36 g / cm^3 is ideal for plant growth, but densities higher than 1.47 limit the growth of roots.

The highest values of bulk density (Te-4 - maize, 1.45 g / cm^3) were recorded on the number four terrace where the erosion is higher and the lowest values were recorded at the lower slope (Te-1 maize, 1.29 g/cm^3) (*table 3*).

The bulk density of the soil was 1.31 g / cm^3 (100%) at the lower slope of the terrace platform and 1.38 g / cm^3 (106%) on the middle slope.

Soil erosion caused a reduction in the percentage of aggregate by 14.0% to slightly eroded soil (upper slope) and 37.7% in the strongly eroded (middle slope) soil (*table 4*).

Table 2

The slope of the land (%) at three transects at the Podu-Iloaiei, Iasi watershed

Terrace	**Transect 1**	**Transect 2**	**Transect 3**	**Average**
Te-1	10.2	7.29	8.26	**8.58**
Te-2	10.46	9.12	9.83	**9.80**
Te-3	11.02	10.39	11.05	**10.82**
Te-4	10.41	10.36	10.39	**10.39**
Te-5	8.79	7.25	9.23	**8.42**
Taluse	**Transect 1**	**Transect 2**	**Transect 3**	**Average**
Tl-1	33.62	32.73	34.12	**33.49**
Tl-2	58.71	73.49	65.34	**65.85**
Tl-3	51.61	49.52	51.34	**50.82**
Tl-4	41.23	46.45	47.62	**45.10**
TL-5	33.47	41.23	35.87	**36.86**
Overall slope of the land	**12.54**	**13.83**	**12.76**	**13.04**
LSD 5% = 2.1; LSD 1% = 2.9; LSD 0.1% = 4.3 %				

Table 3

Bulk density (g/cm3) on the sloping land of Podu-Iloaiei, Iasi County

Terrace (Te)	**Depth, cm**	**Upper slope**	**Middle slope**	**Lower slope**	**Mean**
Te-1-Maize	0-10	1.31	1.31	1.29	1.30
	10-20	1.33	1.35	1.31	1.33
	20-30	1.35	1.38	1.33	1.35
Mean		**1.33**	**1.35**	**1.31**	**1.33**
Te-2-Wheat	0-10	1.28	1.31	1.26	1.28
	10-20	1.31	1.34	1.29	1.31
	20-30	1.35	1.42	1.32	1.36
Mean		**1.31**	**1.36**	**1.29**	**1.32**
Te-3-Peas	0-10	1.25	1.33	1.21	1.26
	10-20	1.29	1.35	1.27	1.30
	20-30	1.32	1.39	1.29	1.33
Mean		**1.29**	**1.36**	**1.26**	**1.30**
Te-4-Maize	0-10	1.35	1.39	1.31	1.35
	10-20	1.39	1.43	1.34	1.39
	20-30	1.44	1.45	1.40	1.43
Mean		**1.39**	**1.42**	**1.35**	**1.39**
Te-5-Wheat	0-10	1.33	1.37	1.29	1.33
	10-20	1.39	1.42	1.32	1.38
	20-30	1.41	1.44	1.37	1.41
Mean		**1.38**	**1.41**	**1.33**	**1.37**
General mean		**1.34**	**1.38**	**1.31**	**1.34**
LSD 5% = 0.06; LSD 1% = 0.10; LSD 0.1% = 0.17 g/cm^3					

The percentage of water stable aggregates was comprised between 73.5% in non-eroded soil, at the bottom of slope land and 45.7% at the highly eroded soil.

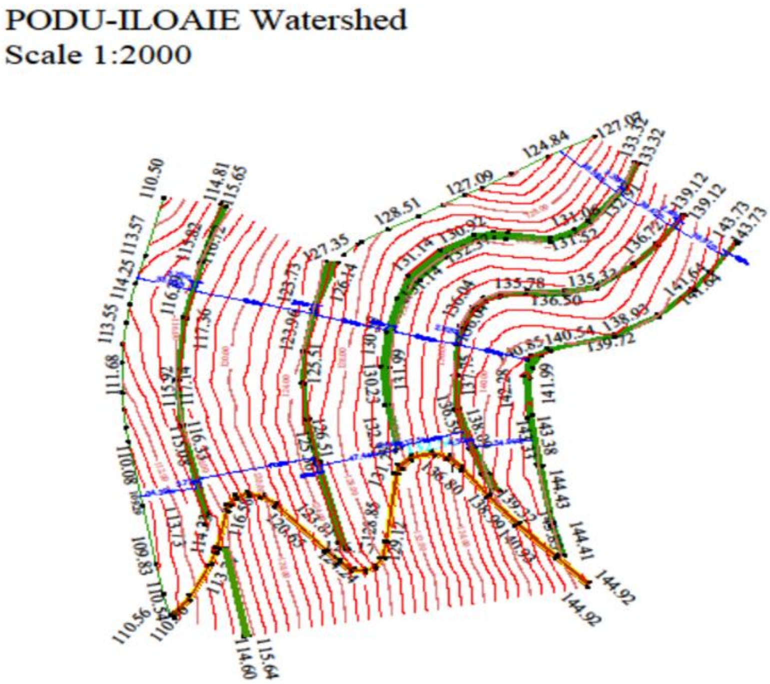

Figure 1 **Strip cropping system and grass buffers strips on 13% slopes at the Podu-Iloaiei Agricultural Research Station**

a **b**

Figure 2 **Terraces and taluses on 16% slopes at the top (a) and at the middle (b) of the slope**

The results on water runoff and soil losses in different crops from the Moldavian Plateau have shown that in the last ten years, of the total amount of 549.8 mm rainfall, 338.5 mm (61.6%) produced water runoff, which was between 8.2 mm in perennial grasses, in the second year of vegetation, and 33.4 – 35.9 mm, in maize and sunflower crops (*table 5*).

Erosion has affected soil fertility by removing along with the eroded soil, high amounts of mineral elements, which reached 15.02 – 16.36 kg/ha nitrogen, 1.05 – 1.2 kg/ha phosphorus and 1.84 – 2.08 kg/ha potassium, in maize and sunflower crops.

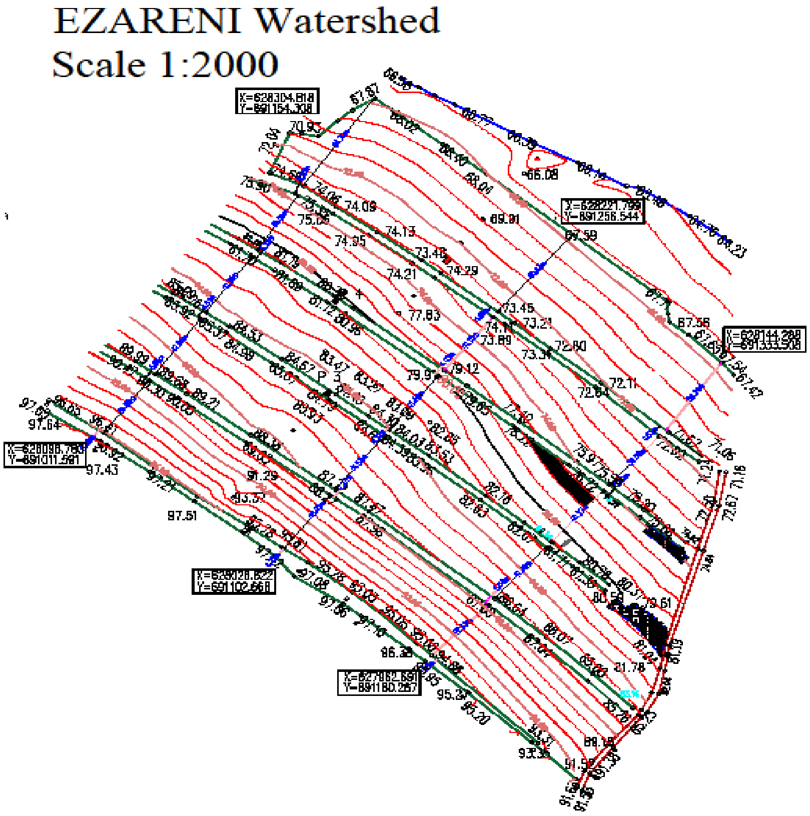

Figura 3 **Strip cropping system and grass buffers strips on 12% slopes at the Ezareni the Experimental Farm of the Agricultural University of Iasi**

On 16% slope lands, the annual mean of nitrogen, phosphorus and potassium leaches due to erosion recorded in the last ten years ranged between 17.91 and 19.63 kg/ha in maize and sunflower (row crops) and between 2.34 and 5.53 kg/ha/year in wheat and pea crops (*table 6*).

The mean annual losses of soil caused by erosion, recorded in the last ten years, in the Moldavian Plain, were of 0.193 t/ha in perennial grasses in the second year of vegetation, 3.620 t/ha in beans, 7.657 t/ha in maize and 8.328 t/ha in sunflower (*table 5*).

At Perieni, after a 12-year agroterracing period, it was found that the slope of the agroterrace platforms decreased by 35-60%, compared to the initial slope of the land, and the slopes of the taluses increased by 41-62% (Popa A., 1984).

Reducing the leakage of nitrogen, phosphorus and potassium from the soil due to erosion helps reducing nutrient deficiency and avoiding eutrophication and pollution of rivers, lakes and oceans.

The maximum N-NO_3 concentrations recorded in erosive water did not exceed 50 mg/L, which is the permissible limit for drinking water, according to the WHO (2011).

In crops of maize and sunflower, in most cases, N-NO_3 concentrations in the water leaked through erosion exceeded 10 mg/l the limit recommended for drinking water by US EPA (1976).

Table 4

The influence of crops and soil erosion on the degree of water stability of aggregates, hydro-stable aggregates > 0.25 (%)

Terrace (T)	Depth, cm	Upper slope	Middle slope	Lower slope	Mean
T-1-Maize	0-10	57.4	53.6	65.3	58.8
	10-20	58.1	54.2	65.7	59.3
	20-30	55.4	51.6	63.7	56.9
Mean		**56.9**	**53.1**	**64.9**	**58.3**
T-2-Wheat	0-10	54.8	46.8	61.8	54.5
	10-20	54.9	47.2	59.2	53.8
	20-30	47.5	43.9	56.3	49.2
Mean		**52.4**	**45.9**	**59.1**	**52.5**
T-3-Pea	0-10	36.4	29.7	41.9	36.0
	10-20	37.2	31.2	42.1	36.8
	20-30	29.7	28.4	32.6	30.2
Mean		**34.4**	**29.7**	**38.8**	**34.4**
T-4-Maize	0-10	35.2	31.4	45.3	37.3
	10-20	35.3	30.9	46.2	37.5
	20-30	29.4	27.3	38.6	31.8
Mean		**33.3**	**29.8**	**43.4**	**35.5**
T-5-Wheat	0-10	40.6	31.1	46.8	39.5
	10-20	39.7	29.8	45.3	38.3
	20-30	34.2	27.4	39.5	33.7
Mean		**38.2**	**29.4**	**43.8**	**37.2**
General mean		**43.1**	**37.6**	**50.0**	**43.6**
LSD 5% = 4.1%; LSD 1% = 5.2%; LSD 0.1% = 7.4%					

The average concentrations of $P\text{-}PO_4$ in water leaked through erosion ranged from 0.01 to 0.12 mg/l, the highest values recorded in sunflower and maize and the lowest in perennial grasses.

In most rainfall events and in most cultures the concentration exceeded the established limits for eutrophication of surface water from 0.01 mg P/L to 0.05 mg P / L (US EPA, 1976) and was well below the recommended level of 2 mg/L for agricultural water.

Most authors assessed mainly the physical aspects (Lugato E., 2016, Orgiazzi A., 2018) while others assessed the economic effects of erosion processes (Adhikari B., 2011; Bizoza A. R., 2012, Posthumus H., 2015).

Estimating the impact of erosion on society is very difficult because erosion causes quantitative losses, quantified by the value of agricultural products, washed nutrients, product losses and planting materials, costs for repairing damage caused by erosion, on-site and offsite (sedimentation, floods, landslides and eutrophication of water) etc.

To replace the lost phosphorus due to water erosion on agricultural land in the EU, for the amount of eroded soil established after RUSLE2015 and for a price of phosphate diammonium 440 € per tonne, it would take 3 to 17 million euro / year (Orgiazzi A. *et al*, 2018).

Adoption of a suitable crop structure comprising 16.7% winter wheat, 16.7% pea, 16.6% maize and 50% perennial grasses, has reduced soil losses by erosion to 1.873 t/ha/year.

For Romania, on the land area of 1146700 ha, with a severe erosion of more than 11 t/ha/year (10.5% of the agricultural area), the loss of crop productivity was calculated by Panagos, 2018, at 74.058 million Euros.

Table 5

Annual average losses of water, soil and nutritive elements runoff by erosion

Crop	Water runoff, mm	Erosion t/ha/y	N at water runoff, kg/ha	N at eroded soil, kg/ha
Field	58.9	15.33	4.26	21.98
Sunflower	35.9	8.33	4.45	11.91
I st year grasses	20.9	1.89	2.36	2.79
IInd year grasses	8.2	0.193	0.93	0.28
Maize	33.4	7.66	4.14	10.87
Pea	18.4	1.79	2.30	2.68
Wheat	11.2	0.64	1.18	0.93
Bean	28.5	3.62	3.76	5.28
Soya bean	27.2	3.51	3.69	5.13
Rape	15.8	1.40	2.13	2.03

The crop rotation and the degree of coverage of the land by plants play an essential role in influencing the proportion of erosion processes.

From the investigations carried out on erosion, based on direct determinations, we found that the erosion in the Moldavian Plain, in peas-wheat-maize rotation, had a mean value of 2.573 t/ha/year (*table 7*).

These elements are necessary for establishing the crop structure and dimensioning the anti-erosion works, which determine the decrease in soil erosion below the limit corresponding to the natural capacity of annual soil recovery, of 1-3 t/ha/year of eroded soil.

The crop structure, which determined the diminution in mean soil losses by erosion until 2,209 t/ha included 20 % winter wheat, 20% of peas, 20% maize and 40 % perennial grasses and legumes (*Alfalfa* + *Lolium perene*).

On the land with a slope of 16%, lowering the percentage of row plants from 60% to 20% has reduced the amount of eroded soil by 48.9% (2.045 t/ha/year) (*table 7*).

Cambic chernozem in the Podu-Iloaiei watershed has a medium organic carbon content (1.56 – 1.89%), it is well supplied with mobile potassium (246 - 312 ppm) and moderate with mobile phosphorus (36-52 ppm) and nitrogen (0.116 - 0.126%) (*table 8*).

Table 6

Annual average losses of nutritive elements runoff by erosion registered in different crops

Crop	Total N kg/ha	P- AL, kg/ha	K-AL, kg/ha	Total NPK, kg/ha	SOC, kg/ha
Field	26.24	1.76	3.68	31.68	313
Sunflower	16.36	1.19	2.08	19.63	170
I st year grasses	5.15	0.22	0.47	5.84	39
IInd year grasses	1.21	0.02	0.05	1.28	4
Maize	15.01	1.05	1.85	17.91	157
Pea	4.98	0.19	0.36	5.53	37
Wheat	2.11	0.07	0.16	2.34	13
Bean	9.04	0.39	0.72	10.15	74
Soya bean	8.82	0.40	0.76	9.98	72
Rape	4.16	0.16	0.31	4.63	29

The average values of the nutrient content at three transverse profiles on the cambic chernozem on the slope lands at the Podu-Iloaia and Ezareni watersheds, Iasi County, are presented in *table 8.*

Table 7
Average annual water and soil runoff by erosion registered in different crops rotation

Crop rotation	Water runoff, (mm)	Erosion, (t/ha)	Humus, (kg/ha)	NPK, kg/ha	Row plants, (%)
*Mcc	33.4	7.66	157	10.46	100
B-W-M-Sf--W	24.0	4.175	147	10.12	60
W-M	22.3	4.147	146	9.63	50
P-W-M-Sf+G	22.3	3.836	135	8.59	40
B-W-M+ 2G	21.0	3.364	118	8.29	40
Soya-W-M+2G	19.9	3.229	124	6.89	40
P-W-M	18.7	2.573	91	7.15	33
P-WM-Sf+2G	18.9	2.713	96	6.86	33
P-W-M +G	18.5	2.552	90	5.97	25
P-W-M + 2G	16.7	2.209	78	5.79	20
R-W-M + 2G	17.7	2.130	75	5.19	20
P-W-M-+3G	15.4	1.873	66	10.46	16.7

*Mcc = Maize continuous cropping, B-W-M-Sf-W = Beans-wheat-maize- sunflower-wheat rotation, W-M = Wheat-maize rotation, PWM = Peas –wheat-maize, P-W-M-Sf+G = Peas–wheat - maize –sunflower + reserve field, cultivated with legumes and perennial grasses, B-W-M+ 2G = Beans-wheat-maize + 2 reserve field, S-W-M +2G = soybean- wheat-maize + two reserve field, R-W-M + 2G = winter rape-wheat-maize + two reserve field.

The cambic chernozem in the Experimental Farm of the University of Agricultural Sciences and Veterinary Medicine of Iasi has a clay-loam texture, a pH value of 6.8, a humus content of 3.17% (1.84% organic carbon) and a medium nutrient level.

Table 8
Change of the main soil chemical properties on a 14% slope, as influenced by soil erosion

Nutrients	Trans.1	Trans. 2	Trans. 3	Mean	LSD 0,5%
Podu-Iloaiei, Iasi					
SOC, %	1.72	1.56	1.89	1.72	0.01
N t %	0.119	0.116	0.126	0.120	0.001
P-AL, mg/kg	46	36	52	44	3.9
K-AL, mg/kg	267	246	312	275	8.6
Ezareni, Iasi					
SOC, %	1.68	1.85	1.98	1.84	0.01
N t %	0.13	0.17	0.18	0.16	0.001
P-AL, mg/kg	39	51	64	51	4.1
K-AL, mg/kg	276	286	334	298	9.2

CONCLUSIONS

From the results obtained on erosion in different crop rotations, we have found that in 16% slope fields from the Podu-Iloaiei, Iasi watershed, soil losses by erosion diminished below the allowable limit of 2.0 t/ha only in case of 3 or 4 year-crop rotations with two or three reserve fields, cultivated with legumes and perennial grasses, which protect soil.

The introduction of rotations peas - wheat - maize rotation + two outside fields cultivated with perennial grasses, which include in the crop structure 20% maize and plants for the protection against erosion, determined the diminution by 71.2% (5.448 t/ha) in mean annual losses of eroded soil and by 44.7% (4.670 kg/ha) in losses of mineral elements, in comparison with maize continuous cropping.

The crop structure, which determined, between 2006- 2016, the diminution of soil losses by erosion below 2.130 t/ha/year included 20 % straw cereals (winter wheat), 20% winter rape, 20% row crops (maize) and 40 % perennial grasses and legumes (Alfalfa + *Lolium perene*).

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