RESEARCHES ON NUTRIENT LOSSES MITIGATION FROM FARMING SLOPPY LAND

Ana Maria DODOCIOIU[1], Romulus MOCANU[1], Marian DOBRE[1]

e-mail: ana_m3310@yahoo.com

Abstract

In order to reduce nutrient losses on farming land with the declination up to 6% from Research Centre for Pastures Preajba, Gorj there have been tried two methods: the applying of organic – mineral fertilizers and buffer strips with pasture herbs. The applying of organic – mineral fertilizer L120 which was obtained from lignite coal has determined the diminishing of phosphorus losses. This way, on the sown pasture, the phosphorus losses have ranged between 0.21 and 0.27 kg/ha when superphosphate fertilizer has been applied and 0.15-0.20 kg/ha when organic – mineral fertilizer, L120 has been given. Buffer strips with 10 m width, along Preajba creek have mitigated the nutrient losses from sloppy adjacent terrains. In this manner, without buffer strips there were lost 0.78 t/ha of soil, 111.2 kg/ha humus, 7.99 kg/ha P and 0.59 kg/ha K. When buffer strips were put in place, the losses were only of 0.286 t/ha soil, 19.5 kg/ha humus, 1.22 kg/ha N and 0.053 kg/ha P.

Key words: organic – mineral fertilizer L120, slope, nutrient losses, buffer strips

Irrational applying of fertilizers can determine polltion phenomenon of surface and ground waters. In order to prevent this phenomenon there have been elaborated by European Community two directives: the Nitrates Directive and Water Frame Directive (Mocanu R. and colab., 2011). The main objective of Nitrates Directive is to reduce water pollution caused or induced by nitrates originating from farming activity.

The Water Frame Directive has to establish a framework for water protection against pollution, wheather surface, ground, transition or coastal waters. This goal assume drastic reduction of nutrient losses from farmingand it will ecologically improve agricultural ecosystems on a long run as well as their sustainability.

Because both nutrient that are mainly lost into the water originate from fertilizers, either chemical or organic, there must be a coomon way between agriculture development and water quality as regard nitrogen and phosphorus (COST 869 Final Report, 2011). At European level there have been elaborated a range of measures (over 80) of mitigation the nutrient losses from farming sloppy land (Chardon W. and colab., 2010, Ulen B., 2005, Shoumans O., 2003). In order to elaborate such measures for sloppy farming land in our country there have been carried out researches in 2009 – 2011 at Research Centre for Pastures (R.C.P.) Preajba, District Gorj.

MATERIAL AND METHOD

The researches have envisaged the reduction of nutrient losses on sloppy soil by two methods: (i) Organic – mineral fertilizer L120 aplication; (ii) buffer strips along Preajba creek.

(i) In order to reduce phosphorus losses from fertilizers through surface runoff there have been, comparativelly, applied superphosphate and the organic – mineral fertilizer L120 made on lignite coal base. This second fertilizer contains humic polimers, ureoacetate aldehidical polimers of sulphuric acid that have been used to activate the coal. In this fertilizer the nitrogen is bonded by ions either as ammonium humates or amidic polimer as well as salt or ammonium sulphate or ammonium phosphate; the phosphorus in this fertilizer is as ammonium phosphate and the potassium is ionitic (Dorneanu A., 2007). In this respect, the nutrients within this fertilizer are bonded under different forms in an organic – mineral matrix that slows and prolongs processes of hydrolisis, ammonification and nitrification of nitrogen compounds, speeding up the retrogradation processes of plant assimilable phosphorus transforming them in superior phosphates of calcium that are unaccesible for plants (Preda C., 2002).

The experiment consisted of special designed plots of 100 s.m. endowed with devices for runoff colection placed at the lower end of the plot. The soil where the experiment took place, at R.C.P. Preajba, is luvosoil. The rate for both phosphorus fertilizer types was P 81 kg/ha. They were applied to three crops: sown pasture, natural pasture and maize, resulting a bifactorial experiment.

(ii) The buffer strips are the most efficient for runoff prevention on slopes. The best results were

[1] University of Craiova, Craiova

given by buffer strips consisting of shrubs (Liu and Zhang, 2008). The optimal width of the buffer strips differ in function of climate, soil type and relief; it ranges between 2 and 50 m (Meier, 2005). At R.C.P. Preajba there have been established buffer strips made of natural pasture along Preajba creek with 10 m width. The predominant species have been: *Agrostis capillaris, Festuca rubra, Cynosurus cristatus, Lollium perenne, Anthoxanthum odoratum* and *Trifolium repens.*

RESULTS AND DISCUSSIONS

(i) As regard the applying of organic – mineral fertilizer L120.

As we have, already, mentioned the organic – mineral fertilizer L 120 has been applied in comparison with superphospate, a well known phosphorus fertilizer at a rate of P 81 kg/ha. The declination of the land was 6%. The quantity of eroded soil and resulting water from the slope has been measured after each rain that could produce runoffs. These quantities were added up for each year of the experiment. There have been made analyses of nutrient content of the resulting suspension. The analyzed nutrient were nitrogen, phosphorus, potassium and humus. For 2009, the results are presented in table 1.

Table 1

Phosphorus losses in function of fertilizer type in 2009 at R.C.P. Preajba, Gorj

Treatment	Rainfall/2009	Water runoff m^3/ha	Eroded soil t/ha	Phosphorus loss Kg/ha
Sown pasture Control (not fertilized)	593 mm	650.7	2.98	0.33
Sown pasture N162P81K80		621.3	2.71	0.27
Sown pasture L 120		631.4	2.82	0.20
Corn Control (not fertilized)		733.7	5.58	0.68
Corn N162P81K80		797.8	5.36	0.51
Corn L 120		727.4	5.45	0.33

The phosphorus quantities lost from the soil ranged between 0.22 and 0.33 kg/ha with sown pasture and 0.33-0.68 kg/ha with corn. By using organic – mineral fertilizer L120 the phosphorus losses have been of 0.22 kg/ha with sown pasture and of 0.33 kg/ha with corn crop which means a reduction of almost half of the quantity.

In 2010 there have been recorded a simillar situation *(tab. 2)*. This way, the phosphorus losses are less with organic – mineral fertilizer L 120, of 0.17 kg/ha with sown pasture as compared with 0.25 – 0.34 kg/ha when superphosphate has been applied and of 0.30 kg/ha, in comparison with 0.50-0.62 kg/ha with corn crop.

Table 2

Phosphorus losses in function of fertilizer type in 2010 at R.C.P. Preajba, Gorj

Treatment	Rainfall/2010	Water runoff m^3/ha	Eroded soil t/ha	Phosphorus loss Kg/ha
Sown pasture Control (not fertilized)	536 mm	494.4	2.38	0.30
Sown pasture N162P81K80		427.3	1.96	0.25
Sown pasture L 120		467.8	1.82	0.17
Corn Control (not fertilized)		756.2	5.22	0.62
Corn N162P81K80		787.4	4.94	0.51
Corn L 120		741.1	4.90	0.30

In 2011 there was recorded less rainfall, namely, 454 mm and the quantities of eroded soil and phosphorus that were lost through erosion have been smaller *(tab.3)*. This way, with sown pasture the quantity of runoof water ranged between 438.2 and 456.7 l/ha while with corn crop the quantity of runoff water has been of 668.2 – 691.7 l/ha. The phosphorus losses have followed the same pattern, being influenced by researched crops. This way, with sown pasture the lost quantity varied between 0.15 and 0.25 kg/ha and with corn crop, of 0.26 to 0.46 kg/ha P. With the applying of organic – mineral fertilizer L120 there was lost a smaller quantity of phosphorus, namely,

0.15 kg/ha with the sown pasture and 0.26 kg/ha with the corn crop.

Table 3

Phosphorus losses in function of fertilizer type in 2011 at R.C.P. Preajba, Gorj

Treatment	Rainfall/2011	Water runoff m^3/ha	Eroded soil t/ha	Phosphorus loss Kg/ha
Sown pasture Control (not fertilized)	454 mm	456.7	0.48	0.25
Sown pasture N162P81K80		438.2	0.39	0.21
Sown pasture L 120		440.5	0.42	0.15
Corn Control (not fertilized)		691.7	4.84	0.42
Corn N162P81K80		668.2	4.70	0.46
Corn L 120		677.8	4.58	0.26

(ii) As regard buffer strips results

In 2010 there were determined the soil and nutrient quantities that were lost from sloppy terrain with and without buffer strips established on the shore of Preajba creeck. These results are written in table 4. There can be observed that the establishing of buffer strips greatly reduces both soil and nutrient losses. This way, the eroded soil quantity decreases from 0.78 t/ha to 0.27 t/ha, the humus quantity, from 111.2 to 14.5 kg/ha, the nitrogen from 7.94 to 1.22 kg/ha and the phosphorus one from 0.11 to 0.053 kg/ha.

Table 4

Soil and nutrient losses in function of presence of buffer strips

Specification	Liquid runoff m^3/ha	Eroded soil t/ha	Humus Kg/ha	Nitrogen Kg/ha	Phosphorus Kg/ha	Potassium Kg/ha
Without buffer strips	674.2	0.78	111.2	2.94	0.114	0.59
With buffer strips	326.3	0.27	14.5	1.22	0.053	0.34

CONCLUSIONS

- the applying of organic – mineral fertilizer L 120 on lignite basis has determined the diminishing of phosphorus losses from soil due to bonding this nutrient in an organic – mineral matrix that speed up retrogradation and insolubilization processes; this way, with sown pasture the phosphorus losses have been of 0.21 – 0.27 kg/ha when superphosphate fertilizer was applied and 0.15-0.20 kg/ha with the L 120 organic – mineral fertilizer applying.

- buffer strips consisting of pasture herbs with 10 m width along Preajba creeck have determined the decreasing of lost nutrients and soil quantities in the area of R.C.P. Preajba, District Gorj. With no buffer strips the quantity of soil that was lost through erosion was of 0.78 t/ha, humus = 111.2 kg/ha, P = 2.99 kg/ha and K = 0.59 kg/ha.

Where buffer strips were established the lost quantities have been of only 0.286 t/ha soil, 14.5 kg/ha humus, 1.22 kg/ha N, and 0.053 kg/ha P.

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