USE OF VETCH FOR GREYZEMS QUALITY REMEDIATION AND INCREASE OF CROP YIELDS

UTILIZAREA MĂZĂRICHII PENTRU RESTABILIREA CALITĂȚII SOLURILOR CENUȘII ȘI MAJORAREA RECOLTELOR

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Abstract. *Strong degradation of agricultural land in the Republic of Moldova imposes soil quality restoration by use of different methods including phytomelioration. In the present research is analyzed use of vetch for greyzems quality improvement and its influence on the next crops from crop rotation. It was established that vetch improved soil structure and increased aggregates stability. As a result of vetch influence soil bulk density and degree of compaction decreased, total porosity values increased. Vetch had a positive effect on the next crops from crop rotation, significantly increasing their harvest.*
Keywords: *vetch, bulk density, porosity, soil structure, yield.*

Rezumat. *Degradarea puternică a terenurilor agricole ale Republicii Moldova impune necesitatea de restabilire a calității solurilor, inclusiv și prin metode fitotehnice. În cercetarea dată se analizează utilizarea măzărichii pentru ameliorarea stării de calitate a griziomurilor și influența acesteia asupra recoltelor culturilor din asolament. S-a stabilit că măzărichea a favorizat îmbunătățirea structurii solului și a majorat hidrostabilitatea agregatelor structurale. De asemenea s-a micșorat densitatea aparentă și gradul de tasare a griziomurilor, au crescut valorile porozității totale. Măzărichea a avut un efect pozitiv și asupra culturilor din asolament, majorând semnificativ recolta acestora.*
Cuvinte cheie: *măzăriche, densitatea aparentă, porozitatea, structura, recolta.*

INTRODUCTION

Sustainable use of soil resources is a crucial issue for Moldova's economy that relies greatly on agriculture. Continued use of conventional agriculture has resulted in strong degradation of physical, chemical and biological properties of soils (Inspectoratul Ecologic de Stat, 2011). In this context it is strictly necessary to use environmentally safe methods of soil restoration and conservation. In the current research it was tested the possibility of using vetch for improvement of soil quality and assessed its influence on yields of field crops. This crop is widely used in world agriculture (Dogan et. al., 2009; Brook and Sieglinde, 2008) and has already proved to be an effective melioration method and excellent predecessor for field crops.

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MATERIAL AND METHOD

The research was conducted at the experimental station of the Institute of Pedology, Agrochemistry and Soil Protection “”Nicolae Dimo” from Ivancea village, Orhei district. The experiment was established on greyzems with medium humus content of 2.32%, pH=6.3-6.5 and moderate content of phosphorus and potassium in the layer of 0-35 cm.

In the fall 2010 the soil was worked with disk harrow and sown with hairy vetch (*Vicia villosa* Roth), Viola variety. In spring 2011 the vetch was introduced into the soil as green manure by disking and the plot was divided into two parts. The first one was sown with common vetch (*Vicia sativa* L.), variety Vilena. At the second one was continued the crop rotation and sown sunflower. In July, common vetch was mown for hay and its crop residues incorporated into the soil by disking. In the autumn after sunflower harvest the two plots were sown with winter wheat that was harvested in June of 2012. In order to determine the influence of vetch on soil properties soil samples were collected before the foundation of the experiment, after each crop of vetch and before the sowing of winter wheat. The methods of analysis approved in Moldova were used for soil and plant analysis.

RESULTS AND DISCUSSION

Weather conditions of autumn 2010 and spring 2011 did not allowed to obtain high yields of hairy vetch that was only 17 t/ha of green mass. Common vetch had more favorable conditions for development and as a result the yield was 20 t/ha of green mass. Chemical composition analysis of vetch revealed low ratio of carbon to nitrogen (Table 1), which favored high yields of the next crops from the crop rotation.

Table 1

Yields and chemical composition of hairy and common vetch

Parameter	Hairy vetch, aboveground part	Hairy vetch, belowground part (0-30 cm)	Common vetch, aboveground part	Common vetch, belowground part (0-30 cm)
Green mass, t/ha	17,0	-	20,0	-
Moisture content, %	79,5	-	70,5	-
Dry mass, %	20,5	-	29,5	-
Dry mass, t/ha	3,5	3,4	6,0	4,1
Carbon, %	37,1	26,6	37,1	26,6
Nitrogen, %	4,21	2,28	4,29	2,13
C:N	9:1	12:1	9:1	12:1
Phosphorus, %	0,66	0,32	0,71	0,32
Potasium, %	2,29	0,43	2,06	0,45
Ash, %	11,6	17,0	9,6	21,1

Basing on the results of plant chemical composition analysis it can be concluded that after incorporation of hairy vetch in soil remained 6.9 t/ha of dry matter (aboveground part plus roots) containing 2203 kg/ha of carbon. Besides in

the soil were returned about 225 kg/ha of nitrogen, 34 kg/ha of phosphorus and 95 kg/ha of potassium. The amount of introduced nitrogen is equivalent to the application of 40 t/ha of qualitative cattle manure with the nitrogen content of 0.56%.

Common vetch was mown for hay and its crop residues (about 25% from the yield) were incorporated into the soil. Also in the soil remained plant roots. Total contribution of dry matter into the soil was 5.6 t/ha with carbon content of 1647 kg/ha. In this case into the soil were returned 152 kg/ha of nitrogen, 24 kg/ha of phosphorus, 49 kg/ha of potassium. The ratio of carbon to nitrogen in vetch composition was also low.

Effect of vetch on soil physical properties was appreciated comparing bulk density, total porosity and degree of compaction of the soil (Table 2).

Table 2

Influence of vetch on greyzems physical properties

Depth of sample collection	Initial soil state	One month later after incorporation of hairy vetch in soil	After harvest of common vetch for hay	Before winter wheat planting
Bulk density, g/cm^3				
0-12	1,36	1,17	1,17	1,22
12-20	1,52	1,46	1,45	1,41
20-34	1,56	1,52	1,50	1,51
34-50	1,62	1,61	1,61	1,61
Total porosity, %				
0-12	48,2	55,0	55,0	53,1
12-20	41,8	43,8	44,2	45,8
20-34	40,2	41,8	42,5	42,1
34-50	39,5	39,5	39,5	39,5
Degree of compaction, %				
0-12	5,8	-5,3	-5,3	-1,6
12-20	18,3	15,7	15,0	12,0
20-34	21,5	18,9	17,4	18,2
34-50	24,2	22,9	22,9	22,9

Influence of vetch roots on soil and additional intake of organic matter led to decrease of bulk density and increase of total porosity in layers 0-12 cm and 12-20 cm. In the next 20-34 cm of soil the influence was weaker. Unfortunately roots almost failed to penetrate the 34-50 cm layer due to its initial very high values of bulk density. The degree of compaction in the upper soil layers decreased proportionally to the bulk density values.

It was established the improvement of soil structure and aggregates hidrostability of greyzems (Fig. 1). An increase of agronomic valuable aggregates content and an improvement of aggregates hidrostability were detected.

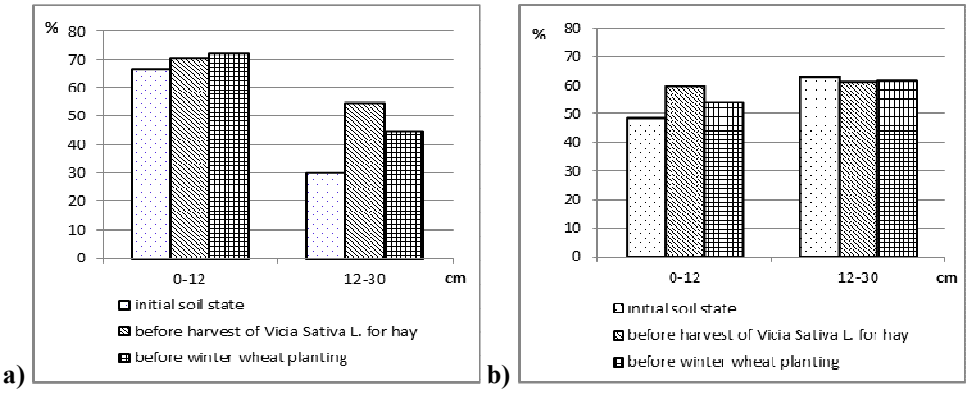

Fig. 1 - Sum of agronomic valuable aggregates (□10-0,25 mm): a) dry sieving; b) wet sieving.

Incorporation of vetch into the soil as green manure had a positive effect on the crops sown after that. Thus the increase of sunflower sown immediately after hairy vetch incorporation was 0.4 t/ha in comparison with the control plot. The harvest of wheat (the next crop in the crop rotation) sown after sunflower increased by 0.8 t/ha. The increase of wheat yield sown after two crops of vetch was 1.7 t/ha.

CONCLUSIONS

1. Contribution to the soil organic matter content due to incorporation of vetch favored restoration of greyzems structure, increasing soil porosity and structural aggregates hidrostability, reduction of bulk density and degree of compaction of the soil.

2. The main changes occurred in the 0-12 and 12-20 cm layers of the soil where plant roots developed and the vetch was incorporated as green manure.

3. The positive effect on field crops yields sown after vetch was achieved. Sunflower yield growth made 20%, winter wheat sown after sunflower - 33%, winter wheat after two crops of vetch - 70% in comparison with the control plot.

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