Scientific Papers. Series A. Agronomy, Vol. LV-2012
ISSN Online 2285-5793; ISSN-L 2285-5785

AMELIORATION EFFECT OF ALFALFA CULTURE IN THE MINI-TILL AGRICULTURE SYSTEM

Maria MOTELICA

State University of Moldova, MD 2014, str. Alexei Mateevich 60, Chisinau, Republic of Moldova, LCŞ "Procese pedogenetice"

Corresponding author e-mail: procesepedogenetice@yahoo.com

Abstract

Multiannual research contributed at identifying three types of biotechnology based on the principles of ecological agriculture: a) based on the direct impact of crops in the soil organization of structural-functional indices. b) based on influence of agro-ameliorative cultures on the operating regimes of soils (resource-reproductive). c) based on crop cultivation as energy (energy- reproductive). Research has shown that differentiated beans crop cultivation to remedy the degraded soils can display enlarged physical factors of fertility. Optimizations of those guarantee the improvement of hydrothermal, air-hydric and oxidation-reduction regimes with future optimization of nutrition and bio-production regimes.

Key words: *biotechnology, ecological agriculture, crop rotation, alfalfa, mini-till.*

INTRODUCTION

Currently along with the traditional applied technology in agriculture more frequently it is called to use alternative technologies focused on minimizing agro-ecological diversification tillage and practicing crop rotation and organic fertilization based on soil organic matter incorporation. The three types of bio-remediation and restoration of degraded lands: a) based on the direct impact of crops in the soil organization of structural-functional indices. b) based on influence of agro-ameliorative cultures on the operating regimes of soils (resource-reproductive). c) based on crop cultivation as energy resources (energy-resource-productive). In what follows, we refer to evolution and dynamics of the operating parameters of chernozems models in such as technology [1].

MATERIAL AND METHOD

Conceptual foundations of regional models, such as technologies have been used since 1992 in the Scientific Research Laboratory "Pedogenetic Processes" under the leadership of Dr. Gh. Jigau and it have to be mentioned the investigated results were generalized in several publications. Future researches have helped the improvement over time and develop conceptual models of four conservative agricultural technologies and to adapt their principles to the concrete conditions and composition of landscape [1, 2, 3].

RESULTS AND DISCUSSIONS

Evolution of organizational structural-functional indices in the crops technologies have the direct impact on cultivated plants and respectively indices of structural-functional organization of the soil. The concept of such as technology is based on the crop rotation cultivation of alfalfa or other perennial capable grasses, via their root systems, to ensure the organization stability structural-functional indices in the soil. The data in Table 1 shows that under such a crop rotation is establishing a steady reproduction of physical factors of fertility, in particular, structure, bulk density and pore space.

From the table we find that despite the enormous variability of climate conditions during the years 2006 - 2012 the dynamics physical characteristics remains within the optimal range.

Table 1. Dynamic indices of structural organization of the arable layer in the typical chernozem moderate humiferous in terms of remediation technologies (SRL Agrosfera BM. Mean values 2006- 2012)

Period	Depth cm	Apparent density g/cm³	Humidity % g/g	Porosity %	The range of useful water %
Field 1. Sunflower					
25.03	0 – 10	1.03	25.44	60.15	18.49
	10 – 20	1.13	26. 38	57.60	17.97
	20 – 30	1.19	28.70	55.85	17.80
30.06	0 – 10	1.11	17.46	58.11	18.20
	10 – 20	1.17	19.75	56.69	18.04
	20 – 30	1.19	20.78	56.23	17.96
28.09	0 – 10	1.14	18.71	58.42	18.20
	10 – 20	1.19	18.63	58. 32	17.96
	20 – 30	1.24	22.47	55.58	17.80
Field 2. Autumn wheat					
25.03	0 – 10	1.06	26.18	61.43	18.40
	10 – 20	1.18	28.00	56. 32	17.96
	20 – 30	1.21	29.06	54. 33	17.51
30.06	0 – 10	1.13	19. 38	58.94	18.25
	10 – 20	1.26	19.96	53.12	17.24
	20 – 30	1.28	19.64	51.69	17.80
28.09	0 – 10	1.12	23.28	59.52	18. 33
	10 – 20	1.16	26.22	58.49	18.25
	20 – 30	1.26	29.71	52.43	17.01
Field 3. Corn					
25.03	0 – 10	1.10	26.01	58.87	18. 30
	10 – 20	1.14	28.02	57.98	18.04
	20 – 30	1.22	29.73	55.27	17.60
30.06	0 – 10	1.09	18.78	60.08	18.43
	10 – 20	1.16	23.58	57.60	17.97
	20 – 30	1.27	23.66	52.80	17.92
28.09	0 – 10	1.26	16.96	52. 34	17.01
	10 – 20	1.32	20.22	50.19	16. 31
	20 – 30	1.33	22.75	49.81	16.19
Field4. Sugar Beet					
25.03	0 – 10	1.13	25.26	58.41	18.20
	10 – 20	1.18	26.99	55.74	17.75
	20 – 30	1.21	27.73	55. 39	17.78
30.06	0 – 10	1.26	23.81	52. 34	17.01
	10 – 20	1.27	24.47	52.80	16.92
	20 – 30	1.34	25.57	50.91	16. 31
28.09	0 – 10	1.17	20.81	55.91	17.80
	10 – 20	1.24	22. 30	54.73	17.51
	20 – 30	1.37	26. 33	50. 30	16.61
Field 5. Alfalfa					
25.03	0 – 10	1.13	26.52	58.11	18.20
	10 – 20	1.19	26.99	55.74	17.75
	20 – 30	1.19	27.73	55.90	17.78
30.06	0 – 10	1.26	23.18	52. 34	17.01
	10 – 20	1.27	24.47	52.80	16.92
	20 – 30	1. 35	25.57	50.19	16. 31

28.09	0 – 10	1.19	20.81	55.58	17.80
	10 – 20	1.21	21. 30	54.73	17.51
	20 – 30	1. 37	26. 33	49. 30	16.61

Conforming to the data obtained the benefits of this system is:

- to secure energy for system reproduction of organic matter in the soil;
- encouraging natural processes of formation and reproduction of soil structure;
- optimization of agro and hydro properties by creating a favorable work performance seedbed preparation, sowing, plant growth and development;
- reducing the call for fertilizers and irrigation.

Evolution of organization of structural-functional indices within resource-productive technologies

The concept of such as technology involves the cultivation of crops in order to decrease the negative impact of intrinsic factors and time optimization of surroundings while pedogenesis and promote reproductive processes and tipogenetical elementary processes.

In order to evaluate a biotechnology model of the first type for monitoring the progress of structural organization indices in the typical chernozem the time depending on the length of alfaalfa cultivation.

The data from the Table 2 show that alfaalfa root system through fasciculation in time lead to the improvement of indices of structural organization of soil.

Table 2. Alfalfa function in the reproduction of the soil physical properties

Depth of sampling, cm	**Apparent density, g/cm3**	**Total porosity %**	**The aggregate composition.%**			
			Rough %	**Grainy %**	**Cloggy %**	**Powdery %**
Alfalfa 1 year						
0 – 10	1.12	56.0	5	60	25	10
15 – 20	1. 38	45.0	15	55	25	5
20 – 25	1.22	52.0	10	70	20	-
25 – 30	1. 33	47.0	15	55	30	-
40 – 50	1. 36	47.0	15	50	35	-
50 – 60	1.40	45.0	20	40	40	-
70 – 80	1.42	45.0	20	30	50	-
Alfalfa 2 years						
0 – 10	1.08	57.0	-	70	20	10
15 – 20	1. 33	47.0	10	60	30	-
20 – 25	1.21	52.0	5	70	25	-
25 – 30	1.26	50.0	5	65	30	-
40 – 50	1. 30	49.0	15	60	25	-
50 – 60	1. 38	46.0	20	45	35	-
70 – 80	1.41	45.0	10	40	50	-
Alfalfa 3 years						
0 – 10	1.08	57.0	-	80	20	-
15 – 20	1.26	50.0	-	80	20	-
20 – 25	1.20	53.0	-	80	20	-
25 – 30	1.23	50.0	-	70	30	-
40 – 50	1.27	50.0	-	70	30	-
50 – 60	1. 36	47.0	5	45	50	
70 – 80	1.42	45.0	5	35	60	
Alfalfa 4 years						

0 – 10	1.09	57.0	5	65	30	-
15 – 20	1.26	50.0	5	65	30	-
20 – 25	1.22	52.0	5	75	20	-
25 – 30	1.23	50.0	5	75	20	-
40 – 50	1.29	49.0	10	60	30	-
50 – 60	1. 38	46.0	10	50	40	-
70 – 80	1.43	45.0	20	45	35	-

From the table we see that after the first year of cultivation of alfalfa, the soil horizon agrogen do not suffer hardly any changes, it is layered in several substrates with very variable indices of structural organization. After 2nd year of cultivation, this is more attenuated, and after year 3 becomes distinguishing features of chernozem natural profile. After year 5 of growing the settlement indices remain practically unchanged and even aggregate composition suffers negative changes evidenced by increasing the content of aggregates >10 mm and reducing the aggregate agronomic value.

The specified weight is determined by soil consolidation following over-drying of soil. It is therefore appropriate to be cultivated alfalfa improvement for three years. From the Table 3 we see that the effect of alfalfa is of long duration. The data table shows that even sunflower cultivation after three years does not lead to significant deterioration of structural-functional organization indices.

Table 3. Impact of alfalfa on crop rotations pedo-reproductive

Depth of Samples cm	Apparent Density g/cm3	Total Porosity %	Organizational Aggregate.%			
			Rough %	Grainy %	Cloggy %	Powdery %
Grain rotation Pr.1						
0 – 10	1.12	56.0	-	15	15	80
15 – 20	1.56	38.0	70	-	30	-
20 – 25	1.23	51.0	15	60	20	-
25 – 30	1.43	43.0	40	30	30	-
40 – 50	1.40	45.0	-	60	40	-
50 – 60	1. 37	46.0	-	45	55	-
70 – 80	1.27	50.0	-	60	40	-
Rotation of cereal - forage (alfalfa three years) Pr.2						
0 – 10	1.12	56.0	-	80	20	-
15 – 20	1.26	50.0	-	60	40	-
20 – 25	1.23	51.0	-	80	20	-
25 – 30	1.29	49.0	-	70	30	-
40 – 50	1. 39	46.0	15	60	25	-
50 – 60	1. 33	48.0	-	60	40	-
70 – 80	1.42	45.0		50	50	-
Sunflower after alfalfa 3 years Pr.3						
0 – 10	1.08	57.0	10	40	20	30
15 – 20	1.27	50.0	-	80	20	-
20 – 25	1.23	51.0	-	80	20	-
25 – 30	1. 30	49.0	-	70	30	-
40 – 50	1. 37	46.0	-	60	30	-
50 – 60	1. 35	48.0	-	50	50	-
70 – 80	1.40	46.0	-	40	60	-

The second model of reproductive biotechnology of elementary processes is based on cultivation of intermediate surface protects from the sun, thus ensuring stability and hydrothermal regimes air-hydric time.

In order to assess this effect was observed signs of structural-functional organization of land under cultivation of intermediate crops.

The third type of resource-reproductive technologies involves the cultivation of ameliorative cultures that improve the operating complex process by increasing soil organic matter content of fresh soil.

In order to evaluate this model were monitored structural-functional indices in the cultivation and agrochemical faceliei and yellow mustard as green fertilizer (Table 7, 8).

Table 4. The recovery of soil quality indicators under No-Till cultivation of alfalfa

Deph. cm	Grain				Alfalfa				Soy			
	ρ_b g/cm^3	W. %	Aggregate		ρ_b g/cm^3	W. %	Aggregate		ρ_b g/cm^3	W. %	Aggregate	
			Of Rough	Of Grain			Of Rough	Of Grain			Of Rough	Of Grain
0-10	1.27	13.3	-	20	1.09	8.0	40	60	1.23	8.9	40	60
30-40	1.48	15.7	10-20	20-30	1.27	17.4	20	80	1.41	14.4	40	60
50-60	1.59	14.0	20	<10	1.29	20.2	10	90	1.50	13.8	60	30

Table 5. The recovery of soil quality indicators under No-Till the intermediate culture mustard

Deph. cm	Without intermediate crop							With intermediate crop						
	ρ_b g/cm^3	W. %	Aggregate		H %	mg/100g		ρ_b g/cm^3	W. %	Aggregate		H %	mg/100g	
			Of Rough	Of Grain		P_2O_5	K_2O			Of Rough	Of Grain		P_2O_5	K_2O
0-20	1.27	10.41	30	60	3.5	1.3	30.0	1.23	16.2	20	70	3.5	1.30	29
20-35	1.49	14.5	45	55	-			1.41	17.8	10-20	75-80	-	-	
35-60	1.64	13.4	50	45	-			1.47	13.8	40	60	-	-	
75-90	1.52	13.3	40	40				1.46	14.0	30	60			

Tabel 6. The recovery effect of soil quality indicators under No-Till the intermediate culture of facelia

Deph. cm	Without intermediate crop							With intermediate crop						
	ρ_b g/cm^3	W. %	Aggregate		H %	mg/100g		ρ_b g/cm^3	W. %	Aggregate		H. %	mg/100g	
			Of Rough	Of Grain		P_2O_5	K_2O			Of Rough	Of Grain		P_2O_5	K_2O
0-10	1.14	5.8	20-25	65-70	3.5	1.1	36.8	1.28	9.39	<20	>80	3.5	1.3	40.1
20-30	1.64	12.0	10-20	-	-			1.48	14.0	10-20	80-90	-	-	
45-55	1.50	12.9	20-30	10-15	-			1.48	15.4	15-20	80	-	-	
65-75	1.60	12.8	30	10-15				1.53	15.4	20-25	60			

Tabel 7. Fito-ameliorative cultural influence on soil physical properties (in the years 2006 to 2011) (0- 50 cm)

Crop	**Apparent Density. g/cm^3**	**Density of solid phase. g/cm^3**	**Total Porosity. %**
Incorporation into the soil at the beginning of flowering			
Facelia	1.08	2.52	57.3
Yellow Mustard	1.17	2.59	54.8
Incorporation into the soil mass flowering phase			
Facelia	1.11	2.53	56.1
Yellow Mustard	1.20	2.62	54.5
Incorporation into the soil after flowering			
Facelia	1.14	2.55	55.3
Yellow Mustard	1.20	2.62	53.1

Table 8. The role of fertilizer in crop biotechnology fitoameliorative productive resources (Mean data 2006- 2011) (Layer 0- 50 cm)

Crop	**Accumulation of biomass t/ha**	**The content of nutrients in the soil. kg/ha**			**pH**
		N	**P_2O_5**	**K_2O**	
Incorporation into the soil at the beginning of flowering					
Facelia	25.94	103. 76	77.82	233.46	7.45
Yellow Mustard	28.83	86.49	86.49	288.30	7.45
Incorporation into the soil mass flowering phase					
Facelia	27.89	111.56	83.67	251.01	7.40
Yellow Mustard	31.18	93.54	93.54	311.80	7.40
Incorporation into the soil after flowering phase					
Facelia	27.30	109. 20	81.90	245.70	7.40
Yellow Mustard	29.98	89.94	89.94	299.80	7.40

From the tables presented we find that the incorporation of fresh organic matter in soil helps to improve settlement indices. Also the effect caused by the intensification of activity in the soil biota with refinement of it. Structure, galleries of earworms and other worms etc. While the green table in the soil is incorporated significant amounts of nitrogen. Phosphorus and potassium, which allows us to produce high yields and quality without mineral fertilization practice. In addition, the transportation costs are excluded for fertilizers. thus reducing unit production cost.

CONCLUSIONS

Growing differentiated crop beans to remedy the soils from degraded fields can display enlarged physical factors of fertility. Optimization of those ensures the improvement of hydrothermal, air - hydric and subsequent oxidation-reduction systems with optimization of the regime of nutrition and function of bio-production.

REFERENCES

[1] Георге Жигэу, *Почвенно-функциональные и агрофизические основы внедрения Mini-Till в РМ.// Сельскохозяйственный журнал, Lider-Agro*. Но 4, 2012, с. 14- 20.

[2] Jigău, Gh., Motelica, M., Leşanu, M., Chircu, T.I., Georgescu, E.L., Iticescu, C., 2012. *Indices of the composition of soil structural aggregates in Typical chernozem under various tillage practices.,// Abstracts, Soil as World Heritage, International symposium celebrating the half century of long-term experiments at Balti, Moldova, May, 22- 23.* Ed. Universitatea de Stat „Al. Russo” din Bălţi, , p. 15-16.

[3] Jigău, Gh., Chişlari, E., Motelica, M., Chircu, I., 2011. *Soil physical quality indices under tehnical crop rotation. // Factori şi procese pedogenetice din zona temperată.* Editura Univ. „Al. I. Cuza” – Iaşi, vol 10, p. 135- 140.