GLOBAL WARMING IS FORCING URJENT CHANGES IN FARMING SYSTEMS OF MOLDOVA

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One of the severest droughts was noticed in Moldova in 2007. The yields of winter cereal crops have been determined by the stocks of soil moisture to the optimal terms of their sowing. The yields of winter wheat after early harvested predecessors consisted 4,5-5,14 t/ha, but after late harvested predecessors only 2,5 t/ha.

In order to decrease the negative influence of "green house effect" the whole farming system in drought conditions should be directed both to efficient water management and to carbon sequestration. The data obtained during 45 years in the long-term experiment with different crop rotations in monoculture of corn and winter wheat, in continuous black fallow and meadow proved the real possibilities to influence on soil fertility by influencing carbon sequestration. The best system for management of soil organic matter allows to increase carbon sequestration and to improve soil fertility.

***Keywords**: crop rotation, wheat, alfalfa, soil moisture.*

The severest drought during the last 60 years noticed in 2007 in Moldova has proved the idea that farming systems of Moldova have to be adapted to local climatic conditions. Republic of Moldova is located in steppe conditions where soil moisture is one of the main limiting factors in obtaining higher level of yields for majority of crops. Obviously that without holistic approach, without integrating different components of modern farming systems it would be difficult to achieve sustainability of such systems. Among such components the following can be mentioned: a system of shelter belts, a system of ponds and water reservoirs, crop rotations, minimalization of soil tillage, optimization of fertilization system by using mineral and organic fertilizers, especially through integration of plant and animal husbanddries in each farm, irrigation, integrated system for pest, desease and weed control, utilization of varieties (hybrids) of crops with high adaptability to local conditions, optimal terms of sowing etc. Such system allows not only to accumulate soil moisture and to be better adapted to more often drought, but also to restore soil fertility, especially soil organic matter, as one of the integrated indexes of soil fertility. Carbon sequestration is one of the best methods in reducing the negative influence of green house effect (1,2). The whole farming system has to be directed to both efficient water management and carbon sequestration. Respecting technologies of growing field crops isn't enough nowadays. We need to speak

about respecting technologies in the frame of crop rotations and the whole farming systems.

This publication is dedicated to the importance of predecessors of winter wheat in the conditions of Balti steppe (northern region of Moldova). In order to change the unfavorable structure of predecessors for winter cereal crops in Moldova (at the moment 93% of winter cereal crops are sown after late harvested crops) we have to reconsider the whole structure of sowing area in order to increase the area under earlier harvested crops for winter cereal crops.

MATERIALS AND METHODS

Researches have been conducted in long-term experiment with 8 different crop rotations in three replications.

The difference between crop rotations has consisted in different level of saturation with row crops (from 40 up to 70%). Simultaneously, crops are grown as permanent crops on fertilized and unfertilized plots. The duration of the experiment is 45 years.

Winter wheat follows different predecessors in crop rotations. In one field winter wheat follows after different early harvested predecessors (spring vetch in mixture with oats for green mass, winter vetch in mixture with winter rye for green mass, alfalfa on the third year after first cutting, peas for grain) and black fallow. On the second field winter wheat is following after corn for sillage. On the third field winter wheat is following after corn for grain.

More details regarding the experimental design can be found in our earlier publications (3).

RESULTS AND DISCUSSIONS

One of the main advantages of early versus late harvested predecessors in the steppe conditions of Moldova consists in their ability to accumulate soil moisture from precipitations before the optimal terms for sowing winter cereal crops (tab. 1).

Table 1

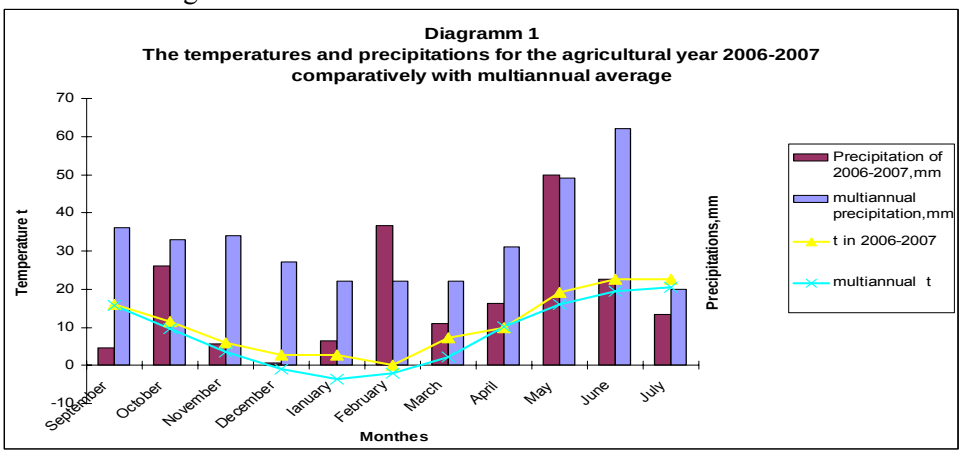
The stocks of soil moisture after different predecessors in 0-20 and 0-100 cm layers of soil to the optimal terms for sowing winter wheat, average for 10 year, in mm

Stocks of soil moisture, mm in soil layers	Predecessors					
	Black fallow	Alfalfa 3-rd year, after first cutting	Peas for grain	Vetch and oats for green mass	Corn for sillage	Corn for grain
0-20 cm	31,0	30,5	30,5	32,0	23,6	19,5
0-100 cm	152,9	145,0	143,9	153,6	117,6	90,6
The stocks of soil moisture in drought years						
0-20 cm	35,7	28,2	26,0	23,0	2,1	9,8
0-100 cm	164,8	133,0	92,4	80,4	57,3	56,9

The stocks of soil moisture are critical for receiving a good emergence of winter cereal crops in drought conditions after late harvested predecessors. They are determining low level of yields for winter cereal crops in drought conditions.

Such a situation was typical for the agricultural year 2006-2007 with only 43,4 % of precipitation comparatively with the average (multiannual) amount of precipitation.

The temperatures and precipitations for the agricultural year 2006-2007 are shown in the diagram № 1.



Because of shortage of precipitations during the fall – winter-spring periods the stocks of soil moisture have been higher in the spring of 2007 after early harvested predecessors (tab. 2).

Table 2

The stocks of soil moisture after different predecessors in the long-term experiment of the RIFC "Selectia" in the spring of 2007 (13.03.2007), in mm

Soil layers, cm	Predecessors				
	Black fallow	Alfalfa 3-rd year after first cutting	Peas for grain	Vetch and oats for green mass	Corn for sillage
0-100	166,8	181,2	150,5	160,8	113,3
100-200	156,1	176,4	199,2	196,9	125,0
0-200	322,9	357,6	349,7	357,7	238,3

The stocks of soil moisture has affected greatly the yields of winter wheat in 2007 (tab. 3).

The yields of winter wheat after early harvested predecessors has been at least twice higher than yields of winter wheat after late harvested predecessors.

The ability of crops to restore soil fertility depends in great extent from their biology and methods of growing, their share in crop rotations, systems of soil tillage and fertilization in crop rotation etc. It is important to mention that no one from the experimental crop rotations couldn't restore completely the annual losses of soil organic matter.

Table 3

The yields of winter wheat (preliminary data) in 2007 after different predecessors in the long-term experiment of RIFC "Selectia", t/ha

	Variety Capriana	Variety Odessa 51
Early harvested predecessors		
Black fallow	5,14	4,50
Alfalfa, 3-rd year after first cutting	5,04	4,51
Peas for grain	4,50	3,70
Vetch and oats for green mass	4,74	4,49
Corn for sillage		
	Variety Alunis 2,53	2,19
Corn for grain		
	-	2,52

Table 4

The total and annual losses of soil organic matter during 45 years in the long-term experiment with different crop rotations, permanent crops, meadow and black fallow, t/ha and %, 0-20 cm

Indexes		Meadow	Black fallow, fertilized	Permanent crops		Crop rotations, % of row crops			
				Corn for grain	Winter wheat	40 t 30% alfalfa	50 t black follow	60	70
Total losses (from initial stoks)	t/ha	1,2	35,8	25,7	17,4	19,5	34,0	21,6	23,6
	%	0,9	26,4	23,4	14,7	16,8	25,1	18,9	21,1
Annual losses	t/ha	0,05	0,80	0,57	0,39	0,43	0,76	0,48	0,52

The lowest rates of annual losses of soil organic matter was found in crop rotation with 30 % of alfalfa in crop rotation – 0,43 t/ha. The highest rates of annual losses of soil organic matter have been found for crop rotation with black fallow and low rates of animal manure - 0,76 t/ha.

Under the meadow the annual losses of soil organic matter consisted – 0,05 t/ha, but under the black fallow – 0,8 t/ha.

So, carbon sequestration can be influenced by different systems of soil management.

CONCLUSIONS

1. Soil moisture is one of the main limiting factors for steppe agriculture of Moldova. Early harvested predecessors accumulate more soil moisture in the arable layer before optimal terms of sowing winter cereal crops than late harvested predecessors.

2. In 2007, with the most drought conditions during the last 60 years in Moldova, the spring stocks of soil moisture in 0-100 cm layer of soil after early

harvested predecessors of winter wheat consisted 150,5-181,2 mm, but after corn for sillage only 113,3 mm. For the layer 0/200 cm the spring stocks of soil moisture consisted 322,9-357,7 mm and 238,3 mm, respectively.

3. The yields of winter wheat in the drought conditions of 2007 year were at least twice higher after early harvested predecessors than after late harvested predecessors.

4. Carbon sequestration is higher in crop rotation with perennial leguminous crops than in other crop rotations. The annual losses of soil organic matter for crop rotation with perennial leguminous crops consisted 0,43 t/ha.

5. Meadow has the best influence on carbon sequestration, but black fallow the worsens influence.

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