UDC 631.51.01

CHALLENGES AND OPPORTUNITIES OF MINIMIZING TILLAGE MOUNTAIN-STEPPE REGIONS OF THE REPUBLIC OF ARMENIA

A. Markosyan, H. Ghazaryan , S.Kroyan

Armenian National Agrarian University Foundation «Scientific Center of Soil sciences, Agrochemistry and Melioration after Hrant Petrosya» Branch, Yerevan-0004, Admiral Isakov 24, Republic of Armenia, markosianalbert@mail.ru

In cropland of Armenia the development of the erosion is largely promoted through traditional moldboard plowing in the Republic. Moldboard plowing is applied everywhere, regardless of the relief terrain, soil and climatic conditions, agricultural techniques, predecessors, etc. As a result of an enhanced development of erosion processes lead in some cases to the accelerated degradation of arable land. Preliminary determination showed that the magnitude of annual soil loss from erosion by moldboard processing system in a mountain-steppe zone of the republic is from 1,5 to 24,0 t/ha or more. The last was the root cause of searching for relevant agronomic measures to protect arable land on the slopes and develop soil treatment methods.

INTRODUCTION

The current development of agriculture in many countries in the anti-erosion tillage is the use of increasing use of energy saving tillage, primarily minimum and zero, which will decrease intensity of the impact and reduce time used on the soil [1, 2]. At its basic, this is the practice of soil protection, which gives a rational effective control of soil erosion and helps to improve soil characteristics and its quality [3-5].

OBJECTIVES AND METHODS

A comparative study of the effectiveness of moldboard, flat-cut, zero and surface processing of eroded mountain soil under field crops was held in Armenia since 1983. Furthermore a study of the efficiency of zero tillage in the conditions of the most common mountain chernozem (Spitak Soil- erosional strong point (SESP)) and chestnut soils (Abovyan and Sisian SESP) was held since 2002. The purpose and objectives of the research was to study and reveal the effect of soil protection technologies of tillage on the dynamics of field moisture, antierosion stability of the soil, weediness and other indicators.

All analysis and calculations were made by the the respective GOST and methods accepted in the scientific institutions. The experimental data were processed by the method of analysis of variance. Meteorological conditions during the growing seasons were mostly typical to the mountain-steppe regions of the country, but sometimes had significant variations of precipitation and temperature conditions.

In the area of mountain chernozems (Spitak SESP) experiments were conducted on the site "Chor Andes." The site is located at an altitude of 1600-1700 meters in the mountain-steppe zone. The area is confined mainly to the southern and northern slopes. The area has a slope of 8-10 °. The soil of pilot area is a moderately low-humus, medium loamy, by carbonate eroded black soil. The content of humus in the upper profile is 4.1 %, the reaction of the soil solution weakly basic, the readily available nitrogen and phosphorus compounds provided the soil is weak, potassium - well. The annual precipitation is 450 - 500 mm.

In the area of dark brown soil experiments were carried out on site at the village of Geghadir (Abovyan SESP), and in nearby areas Sisian (Sisian SESP). Abovyan SESP is located at an altitude of 1660 - 1700 m, it is a separate drainage basin dominated by the slopes of the eastern and western exposure,

with slopes of 10-12 °. Soil tests results from this area is characterized by light texture, a little humus content, relatively rocky and skeletal. The humus content in arable soil layer does not exceed 1,8 %. Precipitation is 400 - 500 mm.

Sisian SESP is located within the heights of 1590 - 1720 m. The area is confined mainly to the southern and northern slopes, the slope of 10 - 12 °. Soil test results from this area is different heavy texture, low carbonate content and humus content. The humus content in arable soil layer reaches 2,7 %. Precipitation is 350 - 400 mm.

RESULTS AND ANALYSIS

Research to identifying the effectiveness of replacing conventional tillage with , flat-cut and zero treatments in order to restore degraded water-physical properties of eroded cropland show that the impact of these techniques largely due to the typical and sub typical properties of soils.

Data research shows that the replacement of conventional moldboard plowing on , flat - cut treatment and using zero tillage produces positive effect on the anti-erosion stability of soils. In the conditions of eroded mountain chernozem soil erosion under winter wheat in , flat - cut and zero treatment was 1,3-2,1 times less than the moldboard plowing. Under the seeding barley soil erosion decreased 1,6-1,7 times. Under seeding grain and legume mixtures produced decreased soil erosion to 1,3-fold (table 1). In the mountain chestnut soils of Sisyan and Abovyan there is a similar pattern. Zero tillage and flat- cut treatment contribute to a significant reduction in soil loss, at the same time reduces the loss of nutrients.

Table 1 - Antierosion effectiveness of tillage, t / ha (2008-2010 *)

Place	Year	Number of washout	A method of processing								
			Plowing by 20-22 cm			Flat-cut treatment by 20-22 cm			Zero tillage		
			Winter wheat	Spring barley	Grain legume grass mixture	Winter wheat	Spring barley	Grain legume grass mixture	Winter wheat	Spring barley	Grain legume grass mixture
Abovyan	2008	2	4,7	5,2	5,3	2,9	2,6	2,8	2,2	3,1	2,9
	2010	4	12,5	14,1	12,9	8,2	6,8	7,0	6,4	8,3	7,2
Total			17,2	19,3	18,2	11,1	9,4	9,8	8,6	11,4	10,1
Sisian	2008	2	2,4	26	2,2	1,7	2,0	2,0	1,6	1,8	1,6
	2010	4	8,2	9,0	7,9	6,5	6,9	7,5	6,0	7,0	6,5
Total			10,6	11,6	10,1	8,2	8,9	9,5	7,6	8,8	8,1
Spitak	2008	2	2,8	3,4	3,0	2,2	2,2	1,9	1,3	2,3	1,8
	2010	4	9,3	10,5	10,2	7,4	6,3	7,0	4,4	6,1	6,4
Total			12,1	13,9	13,2	9,6	8,5	8,9	5,7	8,4	8,2

*2009 Washout of was not observed

Methods of cultivation have a significant impact on the dynamics of accumulation of soil moisture reserves. Especially noticeable lack of moisture in the fall at the time of sowing of winter crops. If not plow hoeing thanks to mulch of stubble and crop residues available moisture is pulled closer to the surface of the soil and better preserved. So before sowing of winter wheat (average for 2005-2009) a 0.6 m layer of soil moisture in the form of zero tillage increased by 12,0-27,6 mm, respectively making up in the conditions of mountain chernozems Spitak 67,7 mm,, and in the conditions of the mountain brown soils Abovyan and Sisyan 37,1 and 102,1 mm. Flat-cut treatment in this respect is an intermediate position. In the later stages of vegetation effect of tillage on the stockpiling of productive moisture gradually decreases, which is especially noticeable in terms of mountain chestnut soils of Abovyan. In particular, in July compared with May month it decreases in the embodiment moldboard plowing at 34-39 mm, in the embodiment of flat-cut treatment on 28 - 114 mm and in the embodiment of zero processing on 40-87,5 mm (table 2).

As for weed infestation, it should be noted, that each method of tillage, has a definite influence, and on this score so far no common opinion. Our experiments show, that significant influence treatments have had on the nature of the placement of weed seeds in topsoil. Before sowing of winter wheat after flat-cut treatment and zero tillage unlike moldboard plowing most of the weed seeds were concentrated in the upper (0-10 cm) layer. Despite the fact that much of the already germinating weeds were destroyed through mechanical and chemical treatments, in the mountain chernozems weediness of crops of winter wheat before harvesting, against the background of plowing was as follows: - 143 per m^2, against the background of flat - cut treatment was 156 per m^2, against the background of no-tillage without herbicide continuous action amounted to 281 per m^2 and against the background of no-tillage with herbicide continuous action amounted to 135 per m^2. In the area of chestnut soils Abovyan and Sisyan respectively amounted to - 110; 122, 234 and 98 per m^2 and 124, 135, 301 and 116 per/m^2. The same was observed in crops of spring barley (table 3). Replacing plowing flat-cut treatment and no-till without the use of preplant high effective herbicide leads to increased weediness both annual and perennial weeds. In comparison with moldboard plowing at flat - cut treatment and zero tillage average growth of weediness is under sowing of winter wheat was 9,6-117 % under sowing spring barley was 11,1 and 92,9 % and under sowing of sainfoin 6,5- 34,8 %. For zero processing weediness decreases sharply if before sowing (7-10 days) were used against weeds used herbicides continuous action. In this variant compared with the moldboard plowing weediness is reduced by 4,4-7,4 %. Soil conservation tillage without application of herbicides leads to an increase in the number of weed seeds, especially in the upper layer of soil (0-10 cm). With minimizing tillage annual use of highly effective herbicides almost 2-2,6 times reduces the weediness of crops, which expands the range of application of soil protection resource saving systems soil treatment sloping lands for the cultivation of field crops.

Zero tillage is the preferred and by virtue lower costs, saving time and greater soil protection, environmental efficiency. On eroded mountain chernozem and chestnut soils by replacing moldboard plowing to no-till by 9,3 % increases the content of water-stable aggregates, humus content, compared with the control (conventional tillage) increased by 0,2-0,3 %. The averaged increase in yield of winter wheat at zero treatment with herbicide continuous action was respectively 2,0- 2,6 c / ha.

Table 2 - Effect of processing methods on the dynamics of stocks of productive moisture in the 0.6 m soil layer, with the cultures of conservation crop rotation, (mm)

Культура	A method of processing	Spitak				Abovyan				Sisian			
		Time limit for determining											
		September	April	May	July	September	April	May	July	September	April	May	July
Winter wheat	Plowing by 20-22 cm	48,6	73,3	69,6	39,2	25,1	102,9	100,6	8,6	74,5	173,4	151,7	79,9
	Flat-cut treatment by 20-22 cm	61,7	81,3	71,8	44,3	27,8	113,7	101,3	14,7	94,4	193,5	178,0	99,6
	Zero tillage	67,7	90,0	85,5	55,8	37,1	126,2	106,8	27,0	102,1	192,1	185,7	102,9
Spring barley	Plowing by 20-22 cm	-	65,2	65,7	42,6	-	58,8	54,9	21,6	-	147,0	125,6	82,1
	Flat-cut treatment by 20-22 cm	-	73,3	64,6	41,3	-	54,6	63,9	35,8	-	170,6	119,8	75,5
	Zero tillage	-	89,2	93,0	68,4	-	61,2	84,6	44,6	-	184,6	154,7	97,2
Grain legume grass mixture	Plowing by 20-22 cm	-	83,2	70,5	39,9	-	124,6	103,7	10,2	-	149,2	126,3	67,1
	Flat-cut treatment by 20-22 cm	-	117,6	100,2	55,9	-	116,1	131,5	17,0	-	178,0	131,5	81,2
	Zero tillage	-	125,7	94,5	51,8	-	128,5	113,0	25,5	-	197,4	134,6	84,8

CONCLUSION

Thus, the results research on minimizing processing mountain chernozem and chestnut soils have shown that the use of energy-saving technologies, possibly with the strict observance of the elements of the system of agriculture. Minimization of soil treatment is advisable to carry out only at the high culture of agriculture (non-compliance with this could lead to a deterioration in the phytosanitary condition of crops and soil), improving its systems with mandatory evaluation and suitability of the soil to minimize.

Table 3 - Weediness of crops under different soil treatment methods (for 2005-2010)

A method of processing	Chernozem , Spitak			Chestnut soil					
				Abovyan			Sisian		
	Winter wheat	Spring barley	Sainfoin	Winter wheat	Spring barley	Sainfoin	Winter wheat	Spring barley	Sainfoin
Plowing by 20-22 cm	143* / 40,1**	184 / 36,2	66 / 14,1	110 / 41,7	130 / 53,1	62 / 13,9	124 / 48,2	57 / 26,6	92 / 37,6
Flat-cut treatment by 20-22 cm	156 / 48,1	198 / 44,0	79 / 16,8	122 / 46,8	136 / 52,1	61 / 13,4	135 / 52,4	69 / 33,5	87 / 35,5
Zero tillage	281 / 72,1	305 / 57,7	97 / 22,4	234 / 81,7	268 / 89,8	85 / 19,2	301 / 89,7	118 / 57,0	111 / 40,1
Zero tillage + herbicide ***	135 / 37,9	182 / 35,5	-	98 / 34,9	114 / 43,6	-	116 / 44,7	57 / 25,7	-

* The numerator is the number of weeds items/m^2

** The denominator of the mass of weeds g / m^2

*** 10 days before sowing used herbicide glyphosate

REFERENCES

1. Ghazaryan H., Markosyan A. Current status of use sloping lands and humus losses mountain chestnut soils Republic of Armenia //Collection of scientific. Articles of the International scientific-practical. Perm. 2010. Part 1. P. 68-71.

2. Ghazaryan H., Logyan D., Markosyan A. The effectivity of the soil protective cultivation of slope soils of the Republic of Armenia //Agroscience scientific journal, 1-2, Yerevan. 2008. P. 46-48.

3. Babayan, L., Hakobjanyan L. The effectiveness of treatment methods mountain brown soil under crops //Proceedings of the Institute of Soil Science and Agricultural Chemistry, vol. 24, Yerevan. 1989. P. 79-84.

4. Markosyan A. Influence of different methods of cultivation of medium eroded chestnut soils on its humus condition //Materials II -th international scientific and practical conference. 8-10 june 2010, volume 5, Ulyanovsk. 2010. P 94-100.

5. Markosyan A. The influence of minimize of tillage on agrophysical indicators of soil fertility mountain-steppe zone of RA //Collection of scientific. Articles of the International scientific-practical. Perm. 2010. Part 2. P.120-125.

ТҮЙІН

Арменияның жыртылатын жерлерінде эрозиялық жағдайлардың дамуына республикадағы жергілікті жердің жер бедеріне, топырақ – климаттық жағдайларына, егілетін дақылдардың агротехникасына байланыссыз қолданылатын дәстүрлі аудара жырту Арменияның жыртылатын жерлерінде эрозиялық жағдайлардың дамуына жағдай жасайды.

Соның нәтижесінде эрозия үрдісінің күшті дамуы байқалады (таулы далалы аймақта жыл сайынғы топырақтың шайылуы 1,5 т/га –дан 24,0 т/га және одан астамды құрайды) мұның өзі беткейлердегі егістіктерді қорғаудың тиісті агротехникалық шараларын іздестіру және ең алдымен топырақты өңдеудің негізгі жолдарын іздестірудің себебі болып табылады.

РЕЗЮМЕ

На пахотных землях Армении развитию эрозионной ситуации в большей степени способствует и то, что традиционная отвальная вспашка в республике применяется повсеместно независимо от рельефа местности, почвенно-климатических условий, агротехники возделываемых культур, предшественников и т.д.. В результате наблюдается усиленное развитие эрозионных процессов (в горностепной зоне ежегодный смыв составляет от 1,5 до 24,0 т/га и более), что и явилось первопричиной поиска соответствующих агротехнических мер защиты пашен на склонах и, в первую очередь, приемов основной обработки почвы.