УДК 631.289

EROSIVE-HYDROLOGICAL EFFICIENCY OF HYDRO-TECHNICAL FACILITIES

R.M. Bordun, research associate

Institute of Agriculture of the North-East of NAAS

In the article the hydrological and soil protection effectiveness of anti-erosion regular measures in the chain of soil-protecting crop rotation winter wheat - buckwheat - barley with sowing sainfoin – sainfoin is examined. The regular measures create a frame for soil protecting system of agriculture delaying the maximum liquid flow on a slope, provide better filtering of precipitation and contribute to a further moisture accumulation in soil.

Key words: Soil erosion, earth embankment, flow, moisture.

In Ukraine the agricultural lands account 42.6 million hectares, 12.6 million hectares of which are subjected to erosion processes and it reaches 29.6%. Intensive use of soil, especially black soil is accompanied by a decrease in humus stocks, the deterioration of water-physical, physical-chemical and biological properties of soil that negatively affects the crop productivity. Even in moderate erosion landscapes with 3% slope humus is lost 2-3 times more than in the plain [6]. However, the yield of crops on eroded lands is lower by 20-60% compared to non-eroded lands. One of the solutions of this problem is the development and implementation of soil protecting highly efficient agricultural systems in conditions of active demonstration of water erosion [3, 5].

Researches of Academician A.N. Kashtanov showed that contour - reclamation organization of the territory is the most effective against erosion, which includes the applying of regular measures and these measures in combination with agro-physical and agrochemical activities contribute to the restoration process of soil formation and on this basis provide obtaining of high and sustainable harvests [4]. At insufficient moisture hydro-technical facilities that

retain the maximum liquid flow on a slope provide better filtering of precipitation by soil and increase its moisture.

The purpose of the study was to investigate the hydrological and soil protection effectiveness of anti-erosion regular measures.

Materials and investigation method. The researches were conducted during 2001-2014 in agricultural landscape with contour-reclamation organization of the land tenure territory in the State Enterprise Research Institute of Agriculture of the North-East of NAAS in Sumy district, Sumy region.

The investigations on determination of the effectiveness of the CMH elements were held in the place of ravine with length of 600 meters, an area of 1.5 ha and water gathering area of 47 hectares. Earth embankments with total length of 580 m with wet slope 1: 10, dry slope 1: 2 has been built. In order to retain the flow of water through earth embankments and their destruction spillways are provided. The lower ditch is built on a full intercept of superficial runoff of 10% supply.

Researches on earth embankments were held in the chain of soil protection crop rotation "winter wheat - buckwheat – barley with sowing sainfoin - sainfoin."

Soil of the research area is a typical humus coarse-dust - middle clay black soil of low degree rinsing.

Investigations of the main indicators of soil fertility were performed by conventional methods. Defining of agrochemical indices of soil were held in agrochemical laboratory of the Institute of Agriculture of the North-East of NAAS. The research results were treated by the statistical method of B.A. Dospyehov [2].

Survey results. Water erosion of soils developed mainly under the influence of snowmelt flow and drainage water from the slopes. Flow depends on many factors including the infiltration properties of the soil and infiltration properties depend on genetic type. Regardless of the type of soil together with increasing degree of its erodibility the maximum hygroscopic moisture content and soil density dramatically increase; total and capillary porosity, field moisture capacity, flexibility, moisture productivity reserves and volume of water-resistant

aggregates reduce. The density of the soil is an important indicator of its fertility and the progress of chemical and biological processes in soil, growth and development of plants significantly depend on it [1].

According to our researches the top soil layer of terraced slopes is characterized by optimal parameters of the density. In 0-10 cm of soil layer the density ranged from 1.18 to 1.24 g / cm3, whereas in the lower soil layers the density increased to 1.43 g / cm3.

The highest soil density was in layer of 30-40 cm and ranged from 1, 38-1, 43 g / cm3 regardless of the slope element during the cultivation of all the crops of soil-protective grain-grass crop rotation.

The impact of hydraulic constructions on moisture accumulation is very significant; especially this measure is effective in winter, because the earth embankments during snowfall perform another important function - snow retention that provide the creation of additional moisture reserves in the soil which is particularly important in winter with little snow.

Researches which were conducted during 2001-2014 showed that the snow distribution on slope elements is occasional.

The height of snow cover is closely connected with the element of the earth embankment, so the most powerful layer of snow is observed in the zone of ponds (the average height is 51 cm), while in the middle of terrace the snow thickness is less 2.5 times.

The process of snow melting is uneven due to different snow thickness on the slope elements. Snow melting is the fastest on inter-terraced space and on its top but in the zone of ponds full snow melting occurs in 3-5 days.

Anti-erosion hydro-technical facilities on the slopes are an integral part of the package of measures on rational use and regulation of rainwater and snowmelt runoff. Moisture reserves in soil after the spring snowmelt are directly proportional to the amount of water in the snow cover on different elements of the slope. These reserves are primarily determined by the width of zones of snow additional

accumulation, the snow cover, snow density and distance between the earth embankments.

Our survey results showed that the largest snow reserves 57.9% of the distribution on the slope elements are formed in a pond. Slightly smaller they are on the top of inter-terraced space - 36.8% and in the middle of the inter-terraced space snow reserves are 5.3%.

It was established by our investigations that in artificially created agricultural landscapes with earth embankments in winter additional snow accumulation occurred due to specific relievo of the area.

Conducted researches have shown that after the spring snowmelt the distribution of moisture in the soil profile within embankments is uneven.

On soil moisture in the ponds affect greater power of snow cover which causes an increase of soil moisture in this area. In addition, within earth embankments during the spring snowmelt little superficial water flow occurs, which contributes to further increase of the moisture volume in the area of a pond.

In the zone of the top of an inter-terraced space moisture in the lower layers of soil approaches to moisture indicators in a pond. Relative moisture reduction deals with the less amount of snow that covers this area during the winter period. Thus, the amount of moisture in 0-100 cm soil layer of terraced top is higher by 8% compared with the midpoint of inter-terraced space, while in a pond - by 16.5%.

According to our observations in a pond area stagnant water is observed, especially, near the borders of earth embankments due to their specific configuration. Thus, in saucers areas during research years water infiltration into the soil occurs within 3-7 days and it had not negative effect on the growth and development of winter wheat and sainfoin.

Observations showed that earth embankments create conditions for the regulation of microclimate in the area of anti-erosion embankment and it has a positive effect on soil moisture conservation. Increased moisture in the topsoil

layer (0-20 cm) is associated with a lower rate of evaporation as a result of special relief.

Conclusions. Analyzing the abovementioned materials it should be noted that regular measures create a frame for the soil protecting system of agronomy retaining the maximum of liquid flow on a slope, provide better filtering of atmospheric precipitation by soil and contribute to further moisture accumulation in the soil that will help to preserve soil fertility and productivity of crop rotation.

References

1. Вергунов В. А. Природоохоронне адаптивно-ландшафтне меліоративне землеробство в басейнах малих річок Лісостепу України / В. А. Вергунов. – К.: Аграрна наука, 2006. – 432с.
2. Доспехов Б. А. Методика полевого опыта / Б. А. Доспехов. – М.: Колос, 1985. – 416 с.
3. Камінський В. Ф. Сучасні системи землеробства і технології вирощування сільськогосподарських культур / В. Ф. Камінський, В. Ф. Сайко, Шевченко І.П. / Під ред. В. Ф. Камінського. – К.: ВП «Едельвейс», 2012. – 196 с.
4. Каштанов А. И. Факторы окружающей среды: и их роль в земледелии/ А. И. Каштанов // Междунар. агропром. журн. – 1991. – №3. – С.61–65.
5. Тараріко Ю.О. Формування сталих агроекосистем: теорія і практика / Ю. О. Тараріко. – К.: Аграрна наука, 2005. – 508 с.
6. Третяк А. М. Земельні ресурси України та їх використання / А. М. Третяк, Д. І. Бамбіндра. – К.:ТОВ «ЦРЗУ», 2008. – 143.