

## BIOLOGICAL WAYS OF STRUGGLE AGAINST WATER EROSION ON ARABLE SLOPES OF THE CENTRAL RUSSIA

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### *Abstract*

*In article are proved a choice of ways of struggle against water erosion of arable slopes on the basis of harnessing the potential of bio-based agrocenosis. Efficiency of use long-term lupine in quality green manure and phyto-ameliorant on eroded soddy-podzolic sandy soils of the Vladimir area is shown.*

*Key words:* arable slopes, a water soil erosion, green manure, long-term lupine

### INTRODUCTION

Strengthening of water erosion is caused excessive of plowed agricultural lands and slopes. About 60 % of the fields have been involved in Russia in the end of last century in an arable land, and in world agriculture only 29%. Insufficiently differentiated on elements of a relief structure of areas under crops, a ploughed land along slopes, long vulnerability of soil agricultural crops in the absence of crops in the spring, in the autumn and in pure steams, loss humus as a result of destruction and washout of an arable layer and an alluvium melkozem, consolidation arable and cultivator horizons running systems of cars - all it promotes progressing and ecologically dangerous development of water erosion and demands immediate measures [1].

The most widespread kind of degradation of soils in the world is water erosion. Formation of a superficial drain begins at biases 0.5-1 °. Such soils on arable lands of the Russian Federation were about 32 million in hectares or 27 %. On arable slopes more than 1 ° - 45.5% of an arable land, 34.0% of natural haymakings and 49.4 % of pastures earlier have been placed. Thus, the superficial drain causing erosion and accelerated degradation of an arable land, had been captured 72.5 %, and in the Vladimir area - more than 50 % of an arable land [2].

Now the ploughed land along slopes and small ploughing was extended. The structure of areas under crops is insufficiently differentiated on elements of a relief. As a result of the strengthened mineralization, wash out nurturing soil and oozy fraction decreases soil humus, there is a consolidation arable and subsoil horizons running systems of cars that causes progressing and ecologically dangerous development of water erosion.

According to the minimum law, the fertility and a production efficiency is defined by not so much average indexes of properties of soils, level the agricultural technicians, brought fertilizers, etc., how many the factor which is in a minimum. Such factors on a slope are the moisture and separate biogenic elements more often.

At repeated reduction of application of organic and mineral fertilizers in the agricultural enterprises root, stubble remains the rests the role of bioresources has sharply increased in reproduction of organic substance and food elements in arable soils, and also in balancing them in agrotechnological circulation. Quantity stubble remains depends on structure of specific structure of cultures of a crop rotation, soil-climatic and weather conditions, level soils, a lay of land, an exposition and degree loss soils of a slope, a complex agricultural technicians in system of agriculture and

finally from size of a biological and economic crop of cultivated cultures.

In connection with sharp deficiency of manure and composts (according to the Ministry of Agriculture the Russian Federation is fertilized now by them no more than 7.5% of crops in the agricultural enterprises) and the terminations of use of peat on fertilizer gets increasing value mobilization of vegetative resources directly on a place of their manufacture. Their use, especially at copy-reclamation agriculture, can compensate unproductive irrevocable losses humus and food elements on the arable slopes subject to water erosion. Traditional fertilizers should be applied first of all on the best, instead of eroded the earths. Especially it concerns applications liquid dung on slopes: it can be used only at presence of techniques for intrazonal soils entering to prevent washout of liquid fraction.

## MATERIALS AND METHODS

On eroded slopes a recouplement of organic and mineral fertilizers much more low, than on plakors and slopes to 1.0-1.5° [3]. Besides, vegetative bioresources as a source of organic substance and cindery elements of a food many times more cheaply also have advantages before traditional fertilizers:

- possibility of realization of vegetative bioresources (long-term grasses, straw, green manure, etc.) are practically inexhaustible, as they annually are reproduced and are insufficiently used now;
- vegetative bioresources, especially with the assistance of bean cultures, allow to involve in agrobio-technogenic circulation of substances biological nitrogen at the expense of a plant-owner, tubercle bacteria and endotrophic mycoriza of roots in quantities to 200-400 kg of hectares, and also remote elements of a food from a soil profile;
- possibility of system fertilizer of remote fields and together with it of operative use of intermediate culture green manure on country and farmer sites on which receive more than 90 % of a potatoes and 80 % of vegetables of the country is provided;

- more than 90 % of the crop (a biomass of green manure) it is formed at the expense of photosynthetic activity of agrocenozes at its annual reproduction. Thus there are ample opportunities of increase in a vegetative biomass of fertilizer on years and crop rotation;

- debris of plant and green manure are ecologically safe fertilizers and their use, at the organization of effective advertising, will allow to compete to the imported foodstuffs successfully.

Forage crops are not only a source of manufacture of forages, but also preservations of fertility of soil, especially slopes, and also ecological stability of environment form a basis biologization of agriculture. Thus humus losses at cultivation of forage crops at the expense of receipt of the vegetative rests (reddish, roots) are compensated to 49 %, and the general deficiency humus decreases to 640 kg/hectares of an arable land [3].

## RESULTS AND DISCUSSIONS

According to VNIIOU research results, the green lupine biomass is more favorable for using, first of all, on forage, instead of on fertilizer. However presence in the Russian Federation more than 0.8 hectares of an arable land per capita against 0.2 hectares in world agriculture creates possibility of maneuvering by the area, and also uses low the earths under green manure steams [4].

Also on slopes it is expedient to sow long-term legume-cereal grass mixtures.

Important special attention to give to cultivation green manure, high which transportability of seeds and cheapness of delivery to remote fields provides economy at the expense of decrease in expenses for Petroleum Products and transport. Possibility of system fertilizer of remote fields, and also an effective utilization of intermediate cultures on homestead, country and farmer sites where it is made about 80 % of all volume of a potato and vegetables is thus reached [5]. It is necessary to consider, that

the vegetative rests and green manure are ecologically pure fertilizers.

The landscape approach to working out of optimum structure of areas under crops assumes fuller use of bioclimatic resources of an agrolandscape by cultural plants, on the one hand, and realization medium resoiling features of cultivated plants, with another. Area differentiation on slope elements, fertility of soil, its loss and to a ploughed land direction should be fixed by system (skeleton) of protective afforestations and copy-reclamation agriculture placing of crops on field horizontals.

In VNIIOU on a slope of a southwest exposition 3.0-3.5° carried out researches on working out agro- phyto- land reclamations receptions of increase of fertility slope soddy-podzolic sandy soils on the basis of use long-term lupine in landscape agriculture. Simultaneously within four years carried out researches on studying of influence of elements of an agricultural landscape on efficiency agrocenosis and fertility of soddy-podzolic soils.

As a result of researches it is established, that relief elements influence efficiency of cultures of a crop rotation more strongly, than anthropogenous actions in agriculture system - agrotechnical, resistance erodible and agrochemical. Distinctions on productivity of grain crops on relief elements in adverse years on humidifying reached six - fold size. In the best parts of a slope efficiency of soils decreased in 1.6-1.8 times in comparison with a watershed and a flat top part of a slope.

For streamlining of directions of a ploughed land and differentiated use of fertility of soils of elements of slopes high agroecological efficiency of copy-reclamation agriculture placing of crops in a combination to application green manure - long-term lupine on fertilizer is revealed. Positive influence of this complex on efficiency of cultures, indicators of soil fertility, agrophysical properties of soil, stocks of productive moisture in vegetation of plants is thus established.

It is established also, that stocks of productive moisture in soil from May till September were

minimum at a control longitudinal ploughed land and interrow processing at corn cultivation. Productivity of green weight of corn in comparison with the control in crops across a slope authentically increased on 10.4-11.6 %. The increase of a crop of barley at the copy-reclamation agriculture organization of a slope territory reached 0.6-0.9 tones on the hectares, or 15.5-18.1% in relation to the control. The best maintenance with moisture of the crops located on a watershed and the top part of a slope, speaks the absence of a drain raised by the maintenance of clay, and also to relatives bedding the waterproof horizon (Table 1 and 2).

Table 1. Influence of elements of a slope on productivity of grown up cultures, t/ha

Experience variant	Winter wheat (2001)	Barley (2002)	Winter rye (2003)	Corn on a silage (2001-2003)
Placing of crops along a slope				
The control	2.8	1.1	1.6	11.5
Placing of crops across a slope				
Watershed	3.2	2.0	2.5	19.0
Average part of a slope	3.0	1.7	2.6	14.7
The bottom part of the slope	3.0	2.0	2.6	15.8
The least significant difference 05 tons/hectares	0.08	0.3	0.42	3.0

In adverse on deposits years the herbage long-term lupine grew with weed vegetation. Therefore lupine it is necessary to combine with other cultures steadier against a drought and, first of all, with long-term cereal grasses. According to A. N. Kashtanov and V. E. Javtushenko (1997), long-term grasses reduce erosive losses humus and biogenic elements in 2-3 times in comparison with grain crops and in 10 times in comparison with pure steam. Grasses practically stop water erosion and by that create a basis for ecologically safe and biologically balanced system of agriculture on arable slopes. In adaptive crop rotations and outlet fields on eroded slopes it is recommended to sow weathers difficult highly productive and steady against

anomalies grass mixtures, calculated on long use in agriculture.

Table 2. Stocks of a productive moisture in soil, mm

Experience variant	Culture	Layer of earth, cm			
		0-60		0-100	
		May	August	May	August
The control	Winter wheat	42.4	85.8	54.7	100.8
Watershed	- « -	57.5	88.3	116.4	170.9
Average part of a slope	- « -	81.0	84.2	134.0	161.0
The bottom part of a slope	- « -	40.5	87.0	78.4	169.0
The control	Corn on a silage	55.2	58.2	124.6	118.6
Watershed	- « -	60.7	73.7	113.1	134.8
Average part of a slope	- « -	66.0	68.7	126.0	124.0
The bottom part of a slope	- « -	34.0	75.4	130.0	136.1

At formation competitive fodder agrocenosis it is necessary to consider fuller economic-biological features of long-term bean and cereal grasses.

## CONCLUSIONS

Infringement of balance of biogenic elements in agriculture conducts not only to reduction of production and deterioration of its quality, but also to decrease in stability of agricultural landscapes. There upon indemnification of deficiency of nutrients at the expense of maximum use bio resources and mineral and organic fertilizers should be considered as ecologically necessary problem, and «object of regulation of economic-biological circulation of nutrient substances in agriculture and animal industries becomes farmland has in general» [6].

The landscape approach to working out of optimum structure of areas under crops assumes strengthening of differentiation of an arable land for the purpose of fuller use of bioclimatic resources of an agrolandscapes by cultural plants, on the one hand, and realizations features of cultivated kinds of plants, with another.

Area differentiation on slope elements, fertility of soil and to a ploughed land direction is fixed by system (skeleton) of the protective afforestations which participation increases with a steepness of a slope and degree destruction of soils.

Thus it is necessary to consider, that with increase in a corner of a slope relative density long-term legume-cereal grass mixtures should grow.

Grass planting in crop rotations it is necessary not only on slopes, but also on plakors, however the importance of grasses repeatedly increases on slopes where they can and should prevent a soil erosion.

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