METHOD AND EQUIPMENT TO PROTECT SLOPING LAND AGAINST SOIL EROSION

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Water and soil resources, which are limited and subjected to a continuous process of degradation under the influence of natural factors or inappropriate human interventions, cannot be managed efficiently sustainable management is carried out, through techniques meant to prevent and diminish this process.

Estimation, exploitation, protection and improvement of natural resources has an essential contribution in improving safety and security of agricultural and food production.

For sustainable agriculture, protecting agricultural sloping land (which in Romania represents 49% of the total area under crop) against soil erosion and enhancing the value of rainfall water conduce to preservation of fertility features of soil, thus resulting in significant growth of production.

On this type of land the phenomenon of soil erosion damages seriously the fertility potential because of alluvial drainage.

As working method we propose execution of partitioned furrows, tracing the general direction of the level curve, of preset length of the canal reach, related to the gradient value and the steady infiltration speed of the respective textural category, which are an artificial obstacle against excess water from downfalls, thus making a significant contribution to mitigation of soil erosion and rendering this water available for nutrition needs of plants.

To this effect, we designed and developed a specialized machine, equipped with a partitioning device with mechanical control, which will allow execution of preset lengths of the canal reach; we also developed an appropriate working technology.

Key words: *soil, erosion, partitioned furrows*

On farming sloping lands, soil erosion affects highly the fertility potential by alluvionary effluence, as influenced by rainfall.

The usage degree of water from rainfalls is low, in soil being kept only water infiltrated from rainfall.

Soil erosion with its variable size in time, according to natural conditions, is a part of natural hazards.

The specific remedies for natural hazards may be non-structural, aiming at the implementation of anti-erosion systems, corresponding to the establishment of crop structure and rotation, as well as works and measures of land improvement.

The introduction of a corresponding technique on sloping lands is conditioned by used **anti-erosion system** and **crop structures**.

MATERIAL AND METHOD

This scientific paper treated some aspects on the development of the concept of anti-erosion system with the notion of **divided furrow.**

The anti-erosion system aims at carrying out all the works on the general direction of level curves, with maximum anti-erosion efficiency on fields with lower slopes than 5%, applying strip cropping system on lands with slopes comprised between 5 and 12% and applying the cropping system with strips covered with grass on slopes comprised between 10 and 18%.

The investigations conducted at C.C.D.C.E.S. Perieni have shown that hoed crops had a high percent in the crop structure on sloping lands, although they belong to the category of lowly protecting crops, allowing a soil coverage degree below 25% (*tab.1)*.

Table 1

Crop structure on sloping lands, according to C.C.D.C.E.S. Perieni

Crop percent, %	Slope size, %			
	< 5	5 - 10	10 - 20	20 - 25
Cereals	20	20	40	35
Hoed crops	60	50	30	15
Annual legumes + technical crops	15	20	20	15
Fodder crops	5	10	10	35

Even under the implementation of a coherent anti-erosion system, hoed crops lead to great soil losses on the farming lands with a slope over 15% (*tab. 2*).

Table 2

Soil losses (mean values during 13 years) at C.C.D.C.E.S. Perieni

Crop	Slope			
	16%		24%	
	Eroded soil		Eroded soil	
	t/ha	%	t/ha	%
Perennial grasses, second year	0.5	1.5	1.2	1.3
Winter wheat	4.0	12.3	10.0	13.7
Peas	7.0	21.5	14.0	19.3
Grain maize (control)	32.5	100.0	72.3	100.0

Investigations conducted at ICITID Băneasa Giurgiu and ICSITMUA Bucureşti have developed the concept of anti-erosion system with the notion of **divided furrow.** As working method, we proposed making furrows on the direction of level curve, divided in pools, of pre-established lengths, with the transversal section able to take over the difference between the water resulted from rainfalls or administered by applying watering and infiltrated in soil, according to the infiltration speed stabilized for the respective texture category.

Making divided furrows on these lands is required on the farming areas, which are not designed for irrigation, the useful water for plants resulting exclusively from rainfalls, their distribution during the crop vegetation being aleatory. As a result of the studies carried out on the achievements in this field on the entire world, DBM-5

equipment was achieved *(fig. 1)*, on which inter-changeable equipments are mounted for modelling continuous flow furrows, respectively for modelling and dividing furrows made on the direction of the level curve, on sloping lands.

The DBM-5 is homologated, series ZERO being made at the Metallurgical Enterprise of Buzău.

Figure 1 **DBM-5 with the equipment used for making divided furrows on sloping lands**

The dividing equipment uses sensitive devices to the furrow length, crossed by the drag scraper that collects the earth on the contour furrow and releases it periodically as plugs.

Dividing devices afferent to working sections (*fig. 2)* are mounted on bars bridge plough by special supports. The main element of dividing device is four palette-rotors (2). At "blocked" position, the active palette of rotor scraps the soil on lateral walls and on the furrow bottom and at "unblocked" position, it rotates by 90^{o}, deposing the gathered soil as a plug that divides the furrow into pools.

Palette blocking and unblocking, for making soil plug, are done by a lever system (4), acted by cams with rolls mounted on disks (5). The disks, which are found at an equal number with the working sections, are fixed by parallel springs on a training axle, acted in rotation movement by machine copying belt, from an additional belt or from a slow rotative hydraulic motor.

The pool length can be adjusted by the adequate configuration of mechanical transmission, respectively by disposing the corresponding number of cams on acting disks of lever system.

The active palette of rotor is kept in touch with furrow contour through the force exerted by compression spring (12) on support arm (3).

Palette blocking is done by means of a key (15), which relative position to the palette was adjusted by threading the nut pipe (7; 8) from lever system. The plug height was adjusted by the corresponding positioning of guide (14).

The rotor arm is supported during transportation by the adjustable rod (11), which superior end can slide in the lengthened hole practised in support (10).

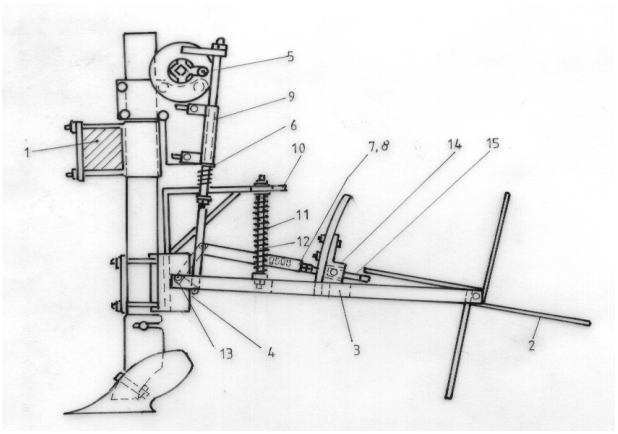

Figure 2 **Working section with furrow dividing equipment:** 1. Equipment frame for opening watering furrows; 2. Palette rotor; 3. Support arm; 4. Lever system; 5. Turning cam with roll revolving; 6. Spring; 7. Adjusting pipe of the position of palette blocking key; 8. Nut; 9. Guide; 10. Support; 11. Rod; 12. Spring; 13. Joint; 14. Guide; 15. Blocking cam of rotor palettes

The rotation movement of rotor support arm is done around a cylindrical joint on the specially fixed support to the vertical bar port-ridge plough.

Working sections are mounted on the posterior bar (1) of machine.

RESULTS AND DISCUSSIONS

DBM-5 is used for making and modelling continuous watering furrows in vegetation hoed crops. The work was substituted to the last mechanical hoeing, being carried out in a period of rapid plant growth, when their height is of 30-60 cm and soil moisture is within the interval of active moisture.

On sloping lands, divided furrows contribute to the superior valorisation of water from rainfalls, to limitation or prevention of soil erosion, as influenced by rainfalls.

Working schemes of DBM-5 can be correlated to sowing schemes for main hoed crops.

Testing the equipment under real working conditions was done in agricultural units from Giurgiu, Constanţa and Buzău counties.

The constructive and technical-functional characteristics of the DBM-5 equipment for opening watering furrows, which has furrow dividing equipment, are shown in *table 3*.

The energetic indices, determined at testing the equipment of opening watering furrows with dividing equipment for different work variants, under heavy soil conditions, with moisture of 10 – 12 % at layer 0 - 10 cm and of 14 – 16 % at layer 10-20 cm, were: working speed v_l; traction resistance R_t; hour fuel consumption C_h; fuel consumption per ha C_{ha}; effective working capacity W_h;

sliding. Their values for working variant with five ridge ploughs, disposed at 70 cm, are shown in *table 4*.

Table 3

Constructive and technical-functional characteristics of DBM-5 with dividing equipment

No.	Traits	Values, Observations
1	Type of equipment	- carried on the hydraulic tractor lift U-650 M
2	Number of working sections	- 5, 4 or 3
4	Minimum distance between working sections	- 600 mm
6	Type of working organs for making furrows	- ridge ploughs with adjustable wings and changeable knife R 25
7	Type of dividing organ	- rotors with four scraper palettes
8	Furrow sizes	- depth: 18-20 cm - bottom length: 10-15 cm - headpiece opening: 45-60 cm
9	Length of divided furrows, m	- 4; 6; 12;
10	Sizes of soil plug, cm	- length: 20-40; - height: 18-20.
4	Hour working capacity, ha/h	- 3 furrows: 1.1; - 4 furrows: 1.35; - 5 furrows: 1.75.
7	Working speed of equipment	- 3.6 km/h – speed step IR - 5.4 km/h - speed step IIR

Table 4

Energetic indices of tractor aggregate U-650M- DBM-5, for the work variant with five ridges ploughs at 70 cm

Working depth, cm	Speed step	Working speed, km/h	Traction resistance, kgf	Fuel consumption, kg/ha
18	I R	3.6	1100	7.5
	II R	5.2	1100	7.9

CONCLUSIONS

In the assembly of anti-erosion system, making divided furrows on the direction of level curve is an efficient method of controlling soil erosion on lands with the longitudinal slope of 12%, contributing to the use of water from rainfalls for plant nutrition.

In the variant shown in this scientific paper, DBM-5 allows making divided furrows with the length of 4; 6; 12 m, conditioned by the diameter of training wheel, number of steps within the mechanical transmission and transmission reports, number of cams placed on the disk of the driving device of dividing equipment;

IHP Bucharest has elaborated the technical solution on electro-hydraulic driving of dividing equipment, in order to remove disadvantages involved by using above-mentioned transmissions.

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