THE DISTRIBUTION OF WATER WITHIN THE SOIL AT THE BAIA, SUCEAVA COUNTY, EXPERIMENTAL AGRICULTURAL DRAINAGE FIELD, 5 DAYS SUBSEQUENT TO THE INCIDENCE OF RAINFALL

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Abstract

The exploitation of the production capacity of the agricultural fields and mainly of the arable areas was performed over the time by their improvement with drainage, banking-regulation, underground drainage, soil erosion control and other types of works. According to the data supplied by A.N.I.F., in Suceava County, there is a surface of 44,904 ha with drainage works, of which 27,455 ha with drain works. The results of the research carried out in the pedoclimatic conditions of the Moldova riverbed proved that within 5 days of circa 30 mm rainfall, in the case of absorbing drain lines spaced 15 m and 20 m apart, respectively, on an area of terrain not modeled in strips with ridges, the mean value of soil water content decrease from the median between the drains towards the drainage line. For the drains that service the area of terrain modeled in strips with ridges the lowest value was recorded on the drainage trench, whereas the highest value was measured 2 m from the drainage line due to the surface flow that occurs throughout torrential rain. Concerning the momentary soil water content, categorized by depth, in points situated 2 m from the drainage line and upon the median between drains, the highest value was recorded 40-50 cm deep, whereas for the drain located upon the area modeled in strips with ridges, the highest value was recorded 50 to 70 cm deep, due to the higher elevation of the terrain and to the contribution of rougher soil material resulted from modeling the terrain. Upon the drainage trench the soil water content increases with depth due to the water influx towards the drain's filter during the 34 years of operation.

Keywords: humidity in excess, desiccating- draining system, modeling in strips with ridges, soil water content

The soil quality is less or more affected by one or more restrictions and namely: drought, periodic humidity excess, erosion, landslides etc. Their harmful influences are reflected in the damaging the soil characteristics and functions, in their bio-productive capacity, respectively in affecting the agricultural product quality and food safety with consequences on human life quality. These restrictions are determined either by natural factors or by agricultural and industrial anthropic actions that can synergically act in a negative way.

MATERIAL AND METHOD

Given the pedoclimatic conditions of the moist zone of the Suceava county, respectively, in the meadow and the river basin of the Moldova river, the area has been equipped with experimental shallow drainage field patches, as the major solution for fighting the temporary excess of moisture derived from rainfall, locally associated with various improving agro-pedoclimatic works.

The hydrotechnic layout of the experimental drainage field of Baia stretches across 3.00 hectares divided in plots, in two repetitions of three versions each, in which the following issues were emphasized: the distance between the lines of drainage (12; 15; and 20 meters), the average pipe laying depth (0.80 and 1.00 meter), the nature and the diameter of drainage pipes, the nature and the thickness of filtering materials. To improve the process of eliminating the humidity in excess and for alleviating the agro-physical and agro-chemical features of glossy pseudogley riverbed luvisols, the following works were carried out throughout the period 1978 to 1992 (Moca V. and collaborators, 2000):

- shallow leveling of the drained surface for operational purposes;
- the modeling of the terrain in strips with ridges at the subterranean drainage version "A" ;
- aerating the soil down to the depth of 60 to 70 cm, perpendicular to the 18 absorbing drainage lines;
- agro-technical works of cultivating the drained terrains that had previously been natural pastures with humidity in excess;
- applying calcareous amendments in a dosage of 10-12 tons/ha carrier limestone and re-amending in 1989 using the same amendment, in a dosage of 7-8 tons/ha;
- the basic organic fertilizing in quantities of 40-50 tons/ha manure and re-fertilizing in the same dosage, in 1992;

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- the annual chemical fertilizing according to the cultivated plants requirements.

For determining the momentary soil water content, soil samples were removed, using a tubular probe, in 10 cm depth layers down to 80 cm deep.

The soil samples were taken 5 days subsequent to the occurrence of 30 mm rainfall, the control points being placed on the drainage trench, 2.00 m from it and upon the median between the absorbing drains.

RESULTS AND DISCUSSIONS

By analyzing the momentary soil water content values categorized by depth, recorded 5 days subsequent to the occurrence of 30 mm rainfall at the absorbing drains D_5, D_{13}, D_{14}, D_{15} spaced 15 m apart, we noticed that, at the control points located 2 m from the drainage trench and upon the median between drains, the value of the humidity increase, in general, from 10-20 cm deep down to 40-50 cm deep, decreasing afterwards relatively easily due to the less permeable layer (*fig. 1, 2, 3, 4*).

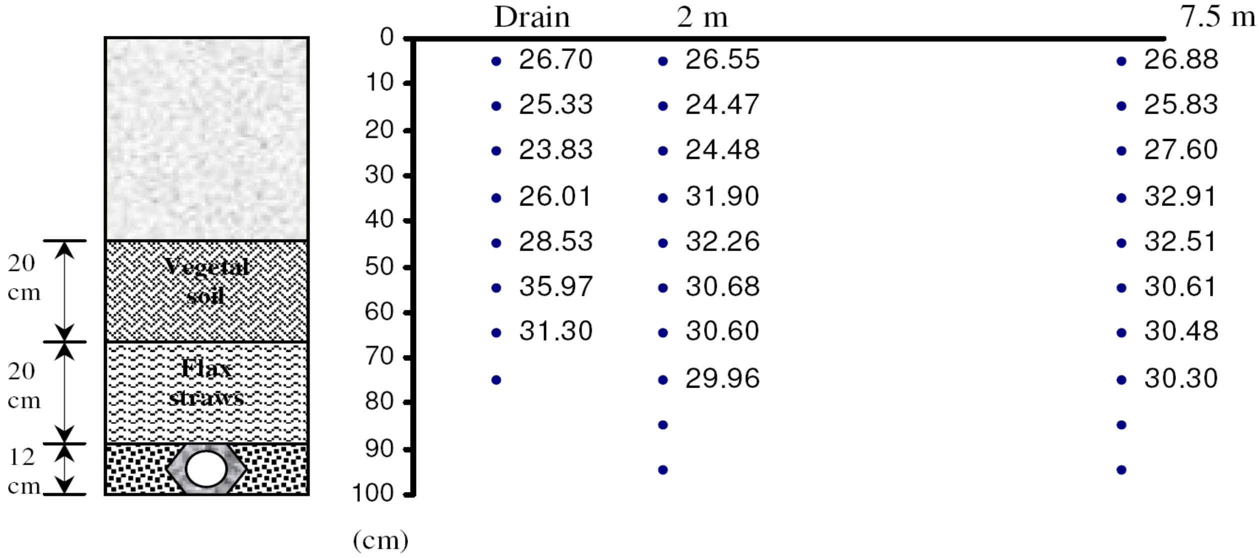

Figure 1 **The soil water content in relation to depth, measured on drain D_5**

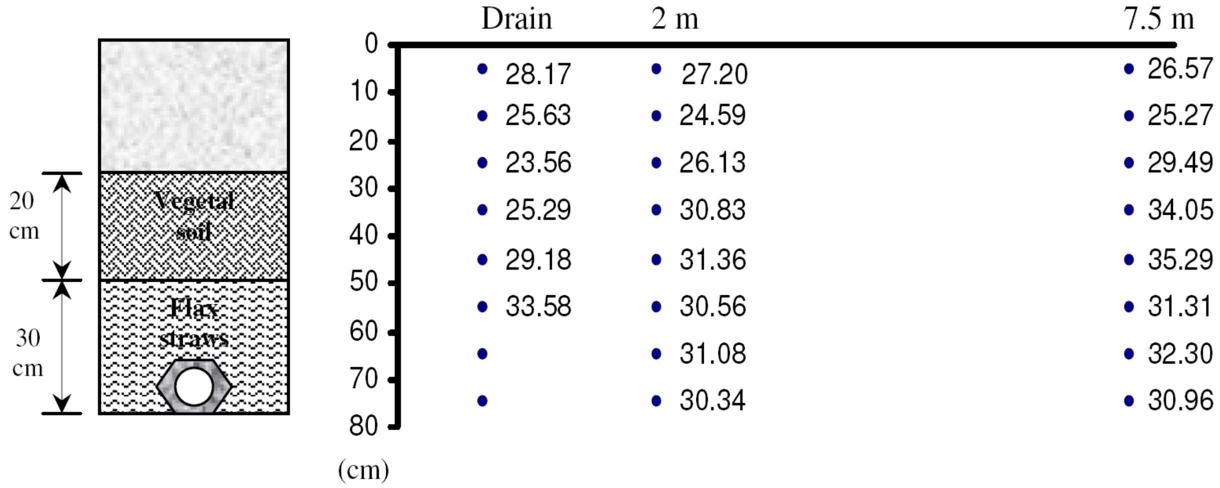

Figure 2 **The soil water content in relation to depth, measured on drain D_{13}**

The greater values recorded within the 0-10 cm depth, as opposed to those recorded at 10-20 cm deep, are due to water retention by the organic material present within the discontinuous celery layer, the drained surface having been used as pasture since 1992.

If the highest soil water content was recorded within 48 hours of the start of rainfall at 30-40 cm deep (Radu O. and collaborators 2012), after 5 days the highest value is recorded at greater depths (40-50 cm) due to the elimination of excess water and to water being absorbed by plants.

At the control point situated upon the drainage trench the values decrease down to 20-30 cm deep, subsequently increasing, in general, with depth, down to the filtering layer, due to water flowing towards the drain's filter created throughout the 34 years of operation. The greater values recorded down to 20 cm deep are due to the reticulate system of plants' greater development upon the drainage trench.

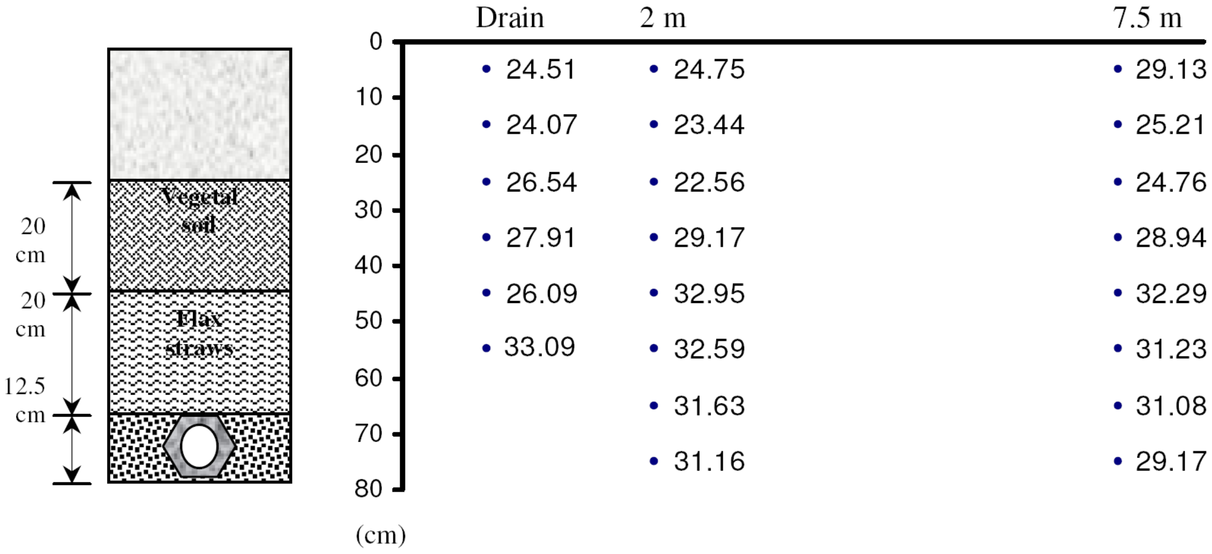

Figure 3 **The soil water content in relation to depth, measured on drain D_{14}**

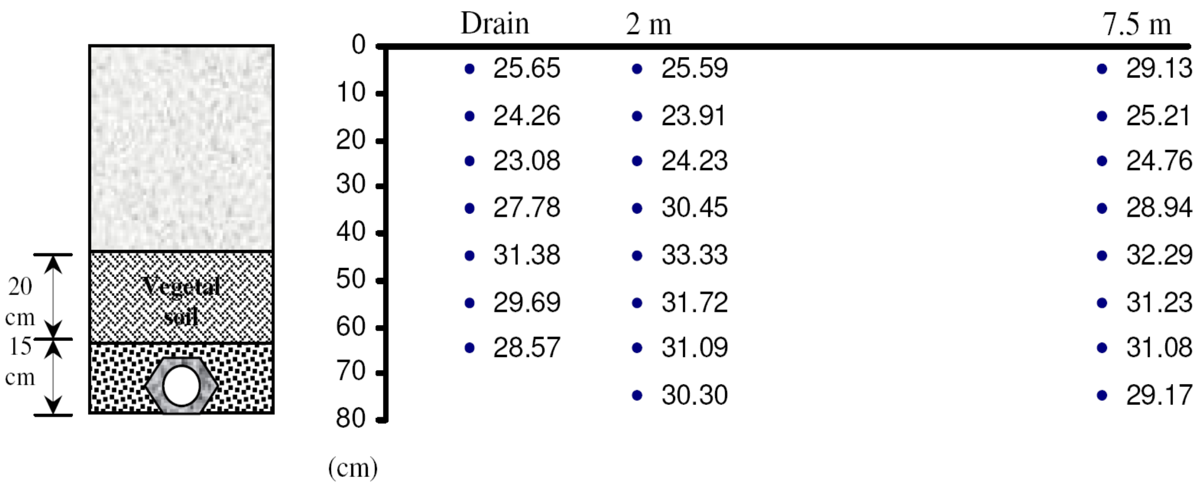

Figure 4 **The soil water content in relation to depth, measured on drain D_{15}**

At the D_3 absorbing drain, with a distance of 20 m between drainage lines, the laying depth of 1 m and with the serviced surface modeled in strips with ridges, at the control point situated 2 m from the drain line, the soil water content values increase according to depth down to 50-60 cm, afterwards decreasing slightly (*fig. 5*).

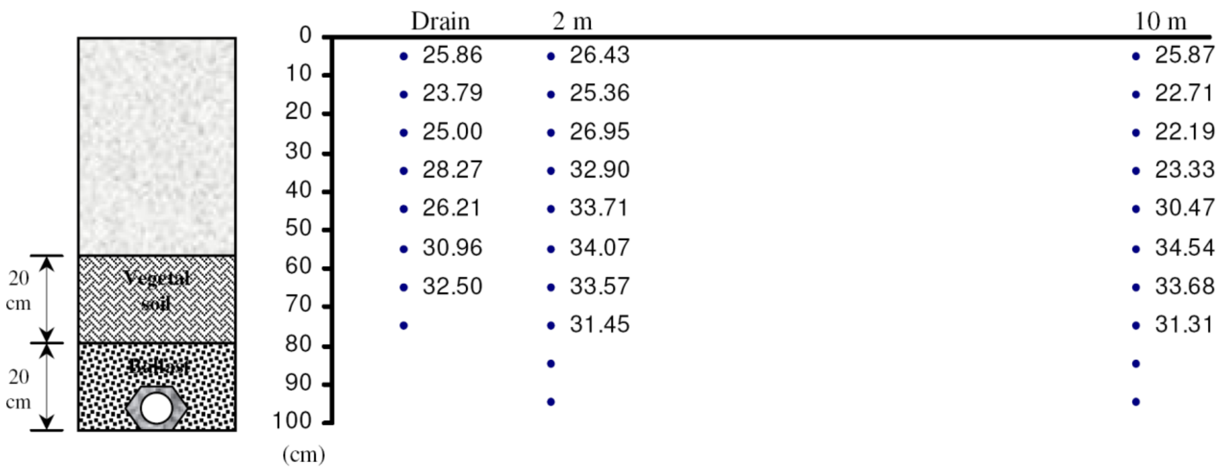

Figure 5 **The soil water content in relation to depth, measured on drain D_3**

Halfway between drains (10 m), the values decrease down to 20-30 cm, increasing afterwards down to 60-70 cm. The lesser water content values within the soil's upper layer is ascribed to both the terrain's higher elevation and to the contribution of rougher material caused by modeling in strips with ridges.

In the case of absorbing drain D_{12}, distanced at 20 m, yet with the surface of terrain not modeled in strips with ridges, the highest momentary soil water content in control points spaced 2 m and 10 m, respectively, from the drain line, is recorded at 40-50 cm deep, the same as in 15 m apart spaced drains (*fig. 6*).

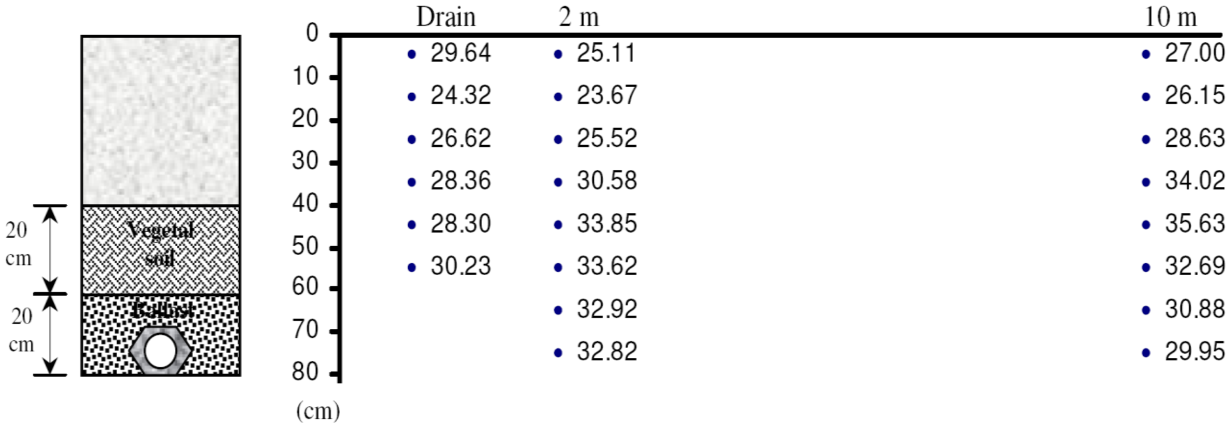

Figure 6 **The soil water content in relation to depth, measured on drain D_{12}**

The mean soil water content at control points, recorded 5 days subsequent to circa 30 mm rainfall, in the case of 15 m apart spaced drains, is least at the control point located on the drainage trench, and highest at the control point situated halfway between drains (*fig. 7*). The decreasing mean soil water content values, at halfway between drains towards the drainage trench, highlight the drain lines operability even after 34 years in operation.

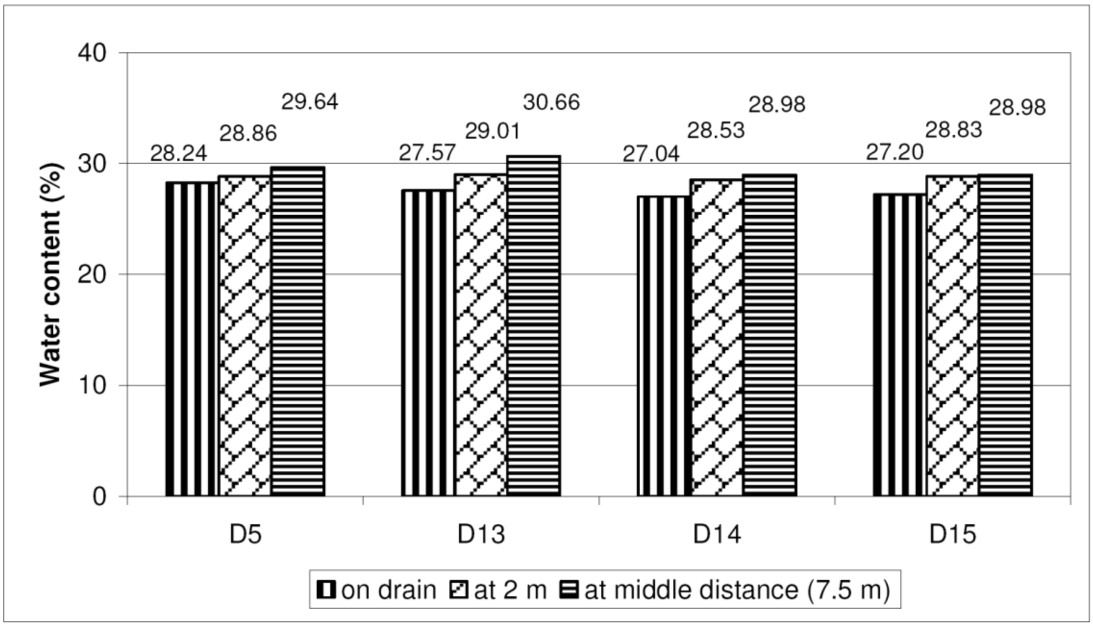

Figure 7 **The mean content of water within the soil at control points, in the case of drains spaced 15.00 m apart**

At the absorbing drain D_3, with 20 m distance between drain lines and modeled in strips with ridges, the lowest mean soil water content is also recorded on the drainage trench, yet the highest value was obtained at the control point located 2 m from the drain (*fig.8*). The mean soil water content halfway between drains (on the ridge), is lower than at 2 m from the drain line, due to water flow that occurs on the surface during heavy rain, the surface having been leveled and used as pasture, as well as to the contribution of rougher material caused by the modeling in strips with ridges, in which case the hydro-physical indicators values (withering coefficient, the field water capacity) are lower that that of fine-textured material (high content in clay).

By comparing the mean soil water content values recorded at the D_{12} (*fig. 8*), absorbing drain, distanced at 20 m and un-modeled, to those recorded at the D_3 drain with the drainage lines spaced at the same distance, yet with the terrain modeled in strips with ridges, we notice that here as well the least value is recorded on the drainage trench, yet the highest value is still halfway between drains. Also, one notices a greater amplitude of values at the control point situated halfway between drains (at 10 m), the value recorded at the absorbing drain D_3 modeled in strips with ridges is 2.61 units lower compared to the value obtained at drain D_{12}, fact that highlights surface water flow occurrence.

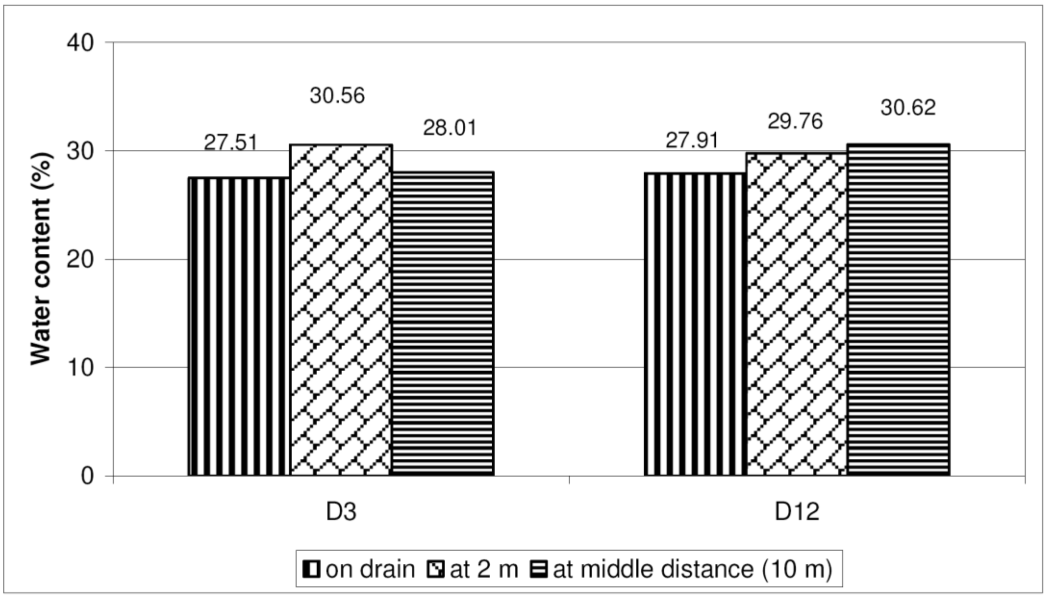

Figure 8 **The mean content of water within the soil at control points, in the case of drains spaced 20.00 m apart**

By analyzing the mean soil water content values on the control section of the analyzed drains (*fig. 9*), one notices that that the highest values are recorded at the D_{12} absorbing drain, spaced at 20 m, with a filtering layer made of 20 cm thick ballast and at the D_{13} drain spaced at 15 m, yet with a filtering layer initially made of flax strains alone, whose permeability got reduced by its transformation, in time, into organic matter. The least value was obtained at the D_{14} absorbing drain (28.18%) spaced at 15 m and having a filtering layer made of ballast and flax strains.

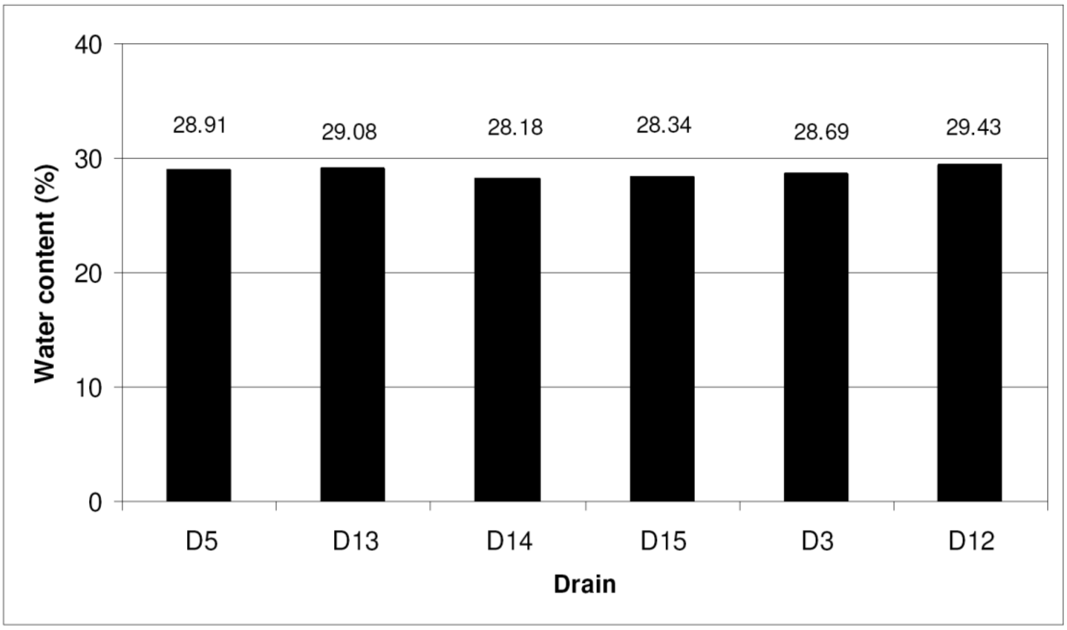

Figure 9 **The soil mean water content within the controlled section**

By modeling the terrain in strips with ridges at the D_3 absorbing drain, with drainage lines spaced 20 m apart, a better elimination of the excess water is achieved, due to the water flow that occurs towards the drain's filter and that of the surface water flow being directed towards the drainage line, by bettering the drain's interception of water flow during the first days and hours of evacuation.

CONCLUSIONS

Within 5 days of rainfall, at the control points spaced 2 m from the drainage line and halfway between drains, the highest momentary soil water content was recorded at a depth of 40-50 cm. At the D_3 absorbing drain with a distance between drains of 20 m and the surface of terrain modeled in strips with ridges, the highest value was obtained at the depth of 50-70 cm, due to the terrain's higher elevation and to the contribution of rougher material created by modeling in strips with ridges.

In case of drains at 15.00 m and 20.00 m apart with the land surface unmodeled in strips with ridges, the values of the mean water contents in the soil 5 days after rainfall decrease from mid drain distance to the drain line.

At D_3 drain with the land surface modeled in strips with ridges, the least value of the mean water contents in the soil is recorded on the drainage trench and the highest value at 2.00 m from the drain line. The lesser value recorded halfway between drains (on the ridge), is due to surface water flowing towards the drainage line during heavy rain and to the contribution of rougher material (of lesser hydro-physical indicators values) created by modeling the terrain.

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