SOIL WATER DYNAMIC AND DISTRIBUTION WHEN USING BLEEDING IRRIGATION ON MODERATE SLOPES IN THE HILLY PLAIN OF JIJIA

DINAMICA SI DISTRIBUŢIA APEI IN SOL LA APLICAREA UDĂRII PRIN PICURARE PE TERENURILE MODERAT INCLINATE DIN CÂMPIA COLINARĂ A JIJIEI

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Abstract. *The bleeding irrigation method has extended and improved in Romania due to its numerous advantages: water and energy savings, full water deficit compensation for plants, lower water losses through direct evaporation at soil surface, tight control of the irrigation standards and of the irrigation standards application. Bleeding irrigation is the most efficient solution for watering vegetables in greenhouses, solariums or in the field, for watering flowers, vine and fruit-bearing trees. It may be used on almost all types of soil, on uneven land and even on slopes. This paper describes water dynamic and distribution when using bleeding irrigation to water vine stock planted on ridges covered by black membrane located on a moderate 15 % slope, with cambium chernozem soil formed on loess deposits.*
Key words: drip irrigation, soil moisture, land slope

Rezumat. *În România, metoda de irigare prin picurare s-a extins şi perfecţionat datorită numeroaselor avantaje pe care le prezintă: economie de apă şi energie, compensarea în totalitate a deficitului de apă pentru plante, micşorarea pierderilor de apă prin evaporare directă la suprafaţa solului, asigurarea unui control riguros al normelor de udare şi al aplicării acestora. Irigarea prin picurare este soluţia cea mai eficientă pentru irigarea culturilor de legume în sere, solarii şi în câmp, flori, viţă de vie şi pomi fructiferi, pretându-se aproape pe orice tip de sol, pe terenurile denivelate şi în pantă. În această lucrare se prezintă dinamica şi distribuţia apei la irigarea prin picurare a butaşilor de viţă de vie, cultivaţi pe biloane acoperite cu peliculă neagră amplasate pe un teren cu panta medie de 15 % şi pe un sol de tip cernoziom cambic format pe depozite loessoide.*
Cuvinte cheie: irigarea prin picurare, umiditatea solului, panta terenului

INTRODUCTION

As a natural renewable, vulnerable and limited resource, water represents an indispensable element for society, being a determined factor in maintaining the ecologic equilibrium, for life existence and for achieving all the human activities (Filipov F. et al., 2004).

Drip irrigation allows the exact measuring of the water quantity necessary in different stages of plant development. Using these drip hose equipments,

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installations and irrigation systems ensures water and energy economy by distributing water in an uniform manner, drop by drop, using a frequency and proportion appropriate for the plant needs, having the possibility of strictly compensating evapotranspiration and an elaborate control of irrigation norms (Radu O., Filipov F., 2010).

MATERIAL AND METHOD

Field observations for the purpose of distributing water to drip irrigation have been initiated on the vineyard school located on a sloping land (average slope of 15%) cultivated in ridges covered with black film (Păduraru E. et al., 2007), the ridges being orientated across the contour lines and at a distance of 1.10 m (figure 1).

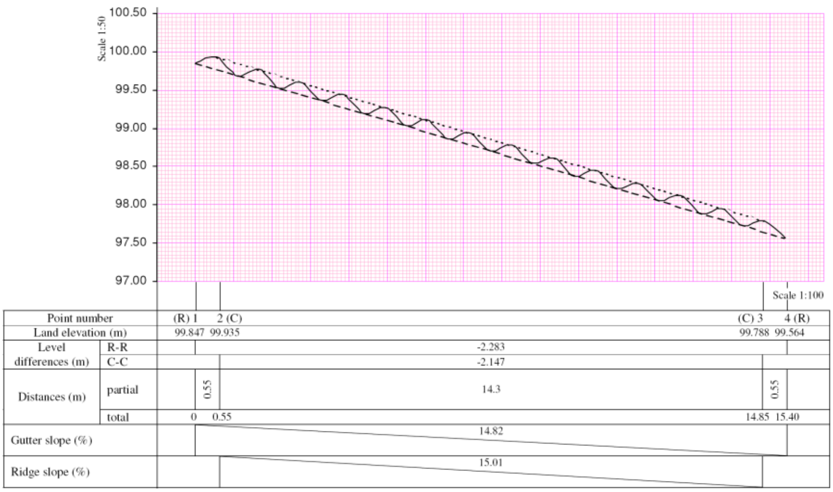


Fig. 1 - Transversal profile through ridges

After the morphologic description, the soil was diagnosed as cambicide building-limestone chernozem slightly regraded, the appearance depth of the calcium carbonate being of 105 cm (figure 2).

The formation processes of the cambicide chernozem consisted of calcium carbonate bioaccumulation, argillization and levigation and a slight gleization, starting with the depth of 102 cm. Bioaccumulation has been favored by abundant rainfall and the saturation of the absorptive complex with $Ca2^{+}$ ions gives stability to the humic fractions. Argillization consisted of altering the primary materials after removing the $CaCO_3$ and the formation of iron hydroxides and oxides, which gives to the horizon a more red color, compared to the adjacent horizons. Weak gleization is due to water lateral circulation.

The cambicide chernozem is a soil with a great and useful edaphic volume and with a good aerohidric regime. The relatively uniform colors of the soil matrix at a depth of 0-100 cm show that the soil is not affected by excesses of stagnant humidity. From an agronomic point of view, the soil does not present major restrictions for the arable land. Some restrictive physical features (resistance to ploughing, workability, trafficability) owed to the high content of argil, are partially compensated by the glomelural structure and of the humus content, which increases the hydric stability of the structural aggregates, detain the dispersion of soil particles and implicitly, crust formation.

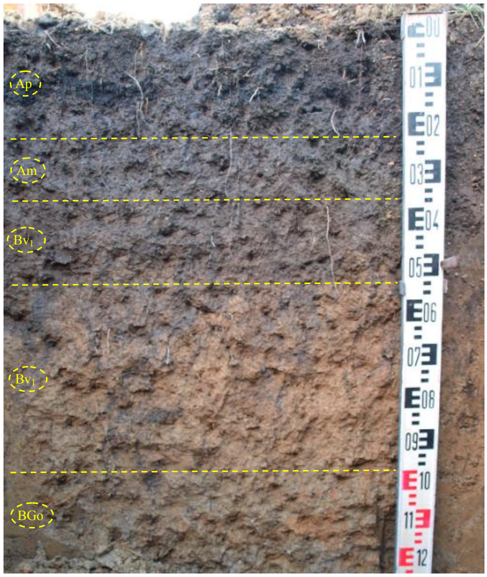
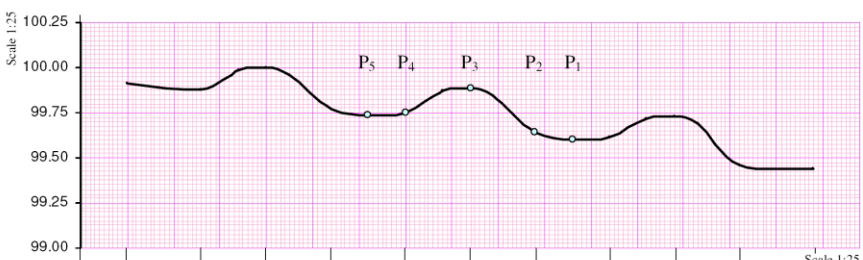


Fig. 2 - Cambicide building-limestone chernozem with argillaceous clay texture

In order to determine the water content of the soil, soil samples have been prevailed with tubular probe on stages of 10 cm, up to a depth of 50 cm, before the irrigation, immediately after the irrigation, at 6 hours, 24 hours and 72 hours from the irrigation. The irrigation norm is of 5 l/linear meter and it has been implemented at a period of 7 days by means of the irrigation band with drip holes distanced at 20 cm. The control points have been located in the middle of the ditch (P_1 and P_5), on the basis of the downstream billon (P_2), on the basis of the upstream billon (P_4) and on the billon crown, point P_3 (figure 3).



Point number	1	2	3	4	5	6	7	8	9	10	11
Land elevation (m)	99.909	99.880	100.000	99.771	99.753	99.888	99.639	99.613	99.732	99.458	99.441
Level differences (m)		-0.029	0.120	-0.229	-0.018	0.135	-0.249	-0.026	0.119	-0.274	-0.017
Distances (m) partial		0.40	0.35	0.35	0.40	0.35	0.35	0.40	0.35	0.35	0.40
Distances (m) total	0	0.40	0.75	1.10	1.50	1.85	2.20	2.60	2.75	3.30	3.70
Slope (%)		7.25	34.29	65.43	4.50	38.57	71.14	6.50	34.00	78.29	4.25

Fig. 3 – Locating the points of taking soil samples

In order to determine the quota of the land surface from the studied area, topographic measurements of precision geometric leveling have been performed by radiation method; based on these measurements transversal profiles have been drafted. Level observations have been performed with an average level of accuracy of type Zeiss Ni-030 and of the centimetric topographic rangers, the level differences being determined by means of two horizons of the level instrument.

RESULTS AND DISCUSSIONS

Analyzing the values of the soil water content determined before the irrigation, we can see that these ones increase proportionally with the depth (figure 4). In the depth interval 0-30 cm, the values of the soil water content are smaller than the value of the capacity for water in the field. In point P_3, located on billon's crown, the values of the current water content are smaller than the one registered at billon's basis, in points P_2 and P_4, because of the superior quota of the control point and of the water consumption by plants. The most increased values of the water content of the soil on the depth interval of 30-50 cm are registered in the control points located on the billon's crown and at its basis.

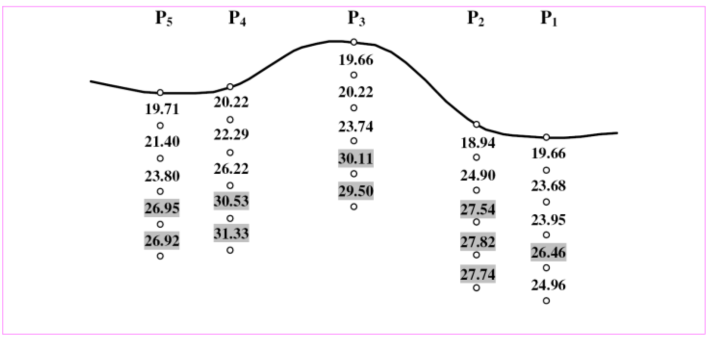


Fig. 4 – Soil water content on depths, before the irrigation

Immediately after the irrigation (figure 5), we can see that in the control point located on the billon's crown the values of the water content of the soil decrease proportionally with the depth.

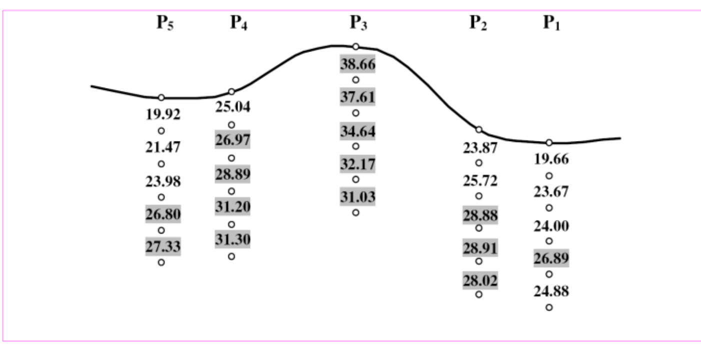


Fig. 5 – Water content of the soil on depths, immediately after the irrigation

In the first 30 cm, there are values of the water content greater with 15-20 percentage units compared to the values registered before the irrigation.

Moreover, the values of the soil water content in the control points from the billon's basis start increasing

After 6 hours from the irrigation, we can notice water redistribution in the billon; water content values within the billon are higher than the value of the capacity for water in the field (figure 6). The highest values, with about 8 percentage units over the capacity for water in the field, is registered in point $P_{3,}$ located on the billon's crown, and in point $P_{4,}$ located on the basis of the upstream billon, because of the smaller distance between the irrigation band, this one being located on the billon's crown, in the upper part of the control point P_3.

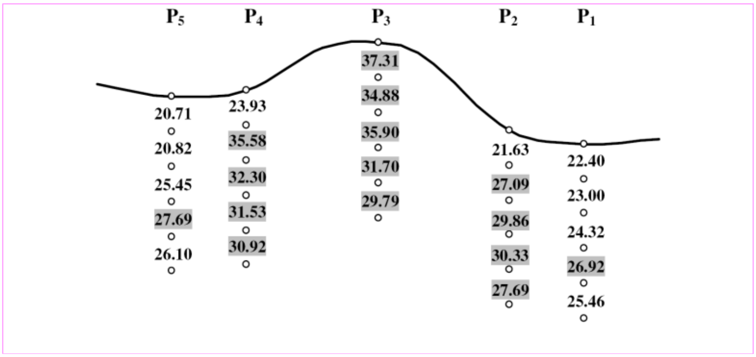


Fig. 6 – Soil water content on depths, at 6 hours from the irrigation

In figure 7 we can notice that after 24 hours from the irrigation with 5 l of water / metric linear unit, in the control points P_2, P_3 and $P_{4,}$ water content values are close to the capacity for water in the field. This is due to the increase and lateral advance of the humidification line, but also of the water consumption by plants, in the depth interval 0-30 cm.

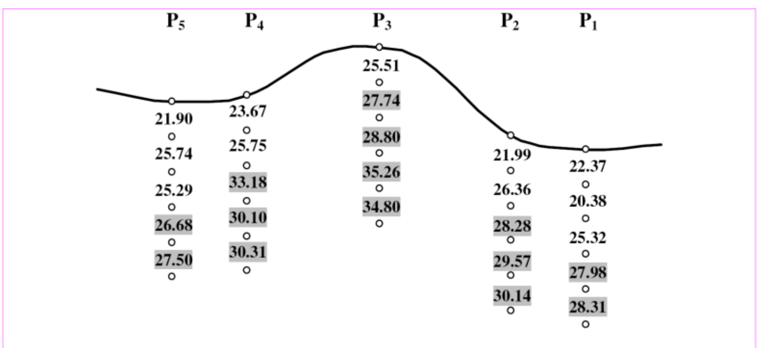


Fig. 7 – Soil water content on depths, at 24 hours from the irrigation

Water content values of the soil registered after 72 hours after the irrigation (figure 8) highlight a relative unification of the water content on the control points, because of the lateral advance of the humidification line. Higher values than the capacity for water in the field are registered in the depth interval 20-50 cm, except the point located on the billon's crown, where in the first 30 cm the registered values are lower than CC, due to the level difference between points and the water consumption by plants.

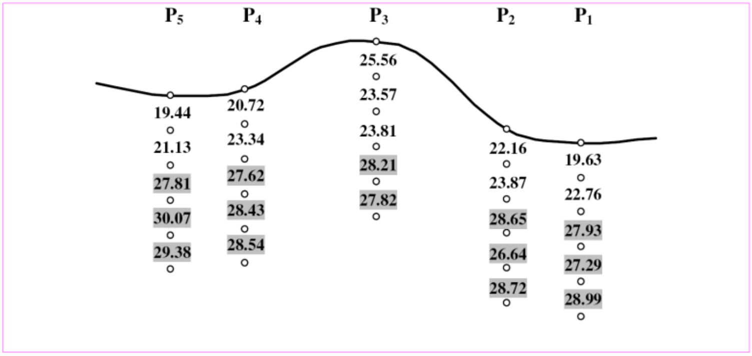


Fig. 8 – Soil water content on depths, at 72 hours from the irrigation

CONCLUSIONS

1. Soil water content values in the point located on the billon's crown raise proportionally with the depth before the irrigation, at 24 hours and 72 hours from the irrigation and they decrease immediately after the irrigation and at 6 hours from finishing the irrigation.

2. Soil water content value on the billon's crown, immediately after the irrigation, on an interval of depth of 0-30 cm, is higher with about 15-20 percentage units compared to the capacity value for water in the field and it reaches similar values at 24 hours from the irrigation.

3. Soil water content at 72 hours from the irrigation is relatively uniform on the entire control section, due to the water consumption of the plants and to the lateral advance of the humidification line.

4. Drip irrigation determines the significant increase of soil water content only within the billon, in the area of the main mass of the plant's roots, which reflects controlled and reasonable use of water.

REFERENCES

1. **Filipov F., Tomiţă O., Lupaşcu Angela, 2004** – *Procese de degradare a solurilor din sere.* Lucr. Simp. şt. „Factori şi procese pedogenetice din zona temperată", vol. 4, serie nouă, Editura Universităţii „Al. I. Cuza", Iaşi.
2. **Păduraru E., Stan C., Stan N., Munteanu N., 2007** – *Aspecte practice privind utilizarea textilelor neţesute ca materiale de mulcire la o cultură comparativă de ardei gras (Capsicum annuuum).* Lucr. şt., seria Horticultură, vol. 50, U.Ş.A.M.V. Iaşi.
3. **Radu O., Filipov F., 2010** – *Rational use of irrigation water in a household system on sloping lands.* Lucrări Ştiinţifice, Universitatea din Craiova, Facultatea de Agricultură, Ediţia a VI-a. ISSN 2066-950X.