DRIP WATERING IMPLEMENTATION IN VINE SCHOOL

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Abstract

Drip watering is the most efficient solution for the irrigation of vegetables culture in greenhouses, solars and for plains, flowers, vine and fruit trees, being suitable for any type of soil, on multiple level and sloping lands, insuring the exact dosage of the quantity of necessary water in different development stages of the plants, removing this way the losses. This paper presents aspects of drip watering implementation in a vine school, cultivated in ridges covered with dark skin and located on a land with a medium slope of 15%. In the vine schools, the stage of grape cuttings development is very important in establishing the watering norm and the interval between watering. Therefore, on a poorly re-graded soil type cambic baticalcaric chernozem, at the beginning of the vegetation period, when the grape cuttings do not have a well developed radicular system, a watering norm of 5 liters/linear meter at an interval of 4-5 days is needed. After the development of the radicular system, the watering norm has to be applied at a longer interval of time, eliminating water losses by the descendent and lateral wetting front advance.

Key words: drip irrigation, watering norm, soil moisture, land slope

As a limited, vulnerable and regenerative natural resource, water represents an essential element for society, being a determining factor in maintaining ecological balance, in supporting life and in carrying out all human activities (Filipov, F. et al., 2004).

The dripping irrigation method was rapidly extended and improved due to the a series of advantages and consists in a controlled and slow administration of water in the area of root system of plants in order to meet their physiological requirements and it is considered a variant of the localized watering method. The use of this equipment, installations and irrigation systems with dripping hose provides a water and energy saving by uniformly distributing water, drop by drop, in a proportion and frequency suitable to plant needs, with the possibility of strict compensation of evapo-transpiration and a minute control of watering rates (Radu O., Filipov F., 2010).

Due to the slow capillary motion of water in soil, almost not a bit of air is extracted from soil due to water penetration. The micro-pores from the soil usually remain dry and aerated, the humidity level being only a little bit over the soil capacity, except a saturated area, relatively smaller being in the near vicinity of the bleeder. This fact allows a corresponding breathing of plant roots during the entire season of vegetation without any strangulation during or immediately after irrigation. (Radu O., Filipov F., 2009).

MATERIAL AND METHOD

The land surveys for applying dripping irrigation were carried out at a grape vine school, located on a sloping land (average slope of 15%), cultivated in ridges covered with a black film (Păduraru, E. et al. 2007), the ridges being oriented along the level curves and spaced at 1.10 m (fig. 1).

The soil was diagnosed as being poor baticalcarious cambic chernozem regraded following the morphological description, the emerging depth of calcium carbonate being 105 cm.

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

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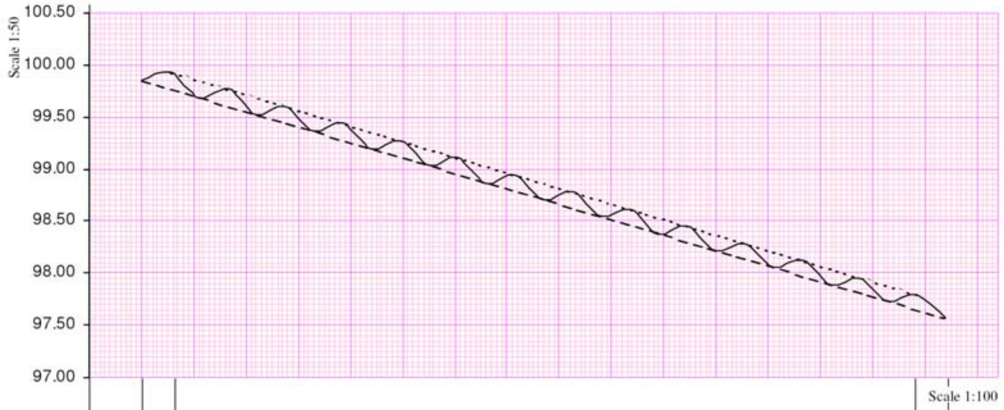
to ploughing, workability, trafficability) owed to the high content of argil, are partially compensated by the glomelural structure and of the humus content, which increases the hydric stability of the structural aggregates, detain the dispersion of soil particles and implicitly, crust formation.



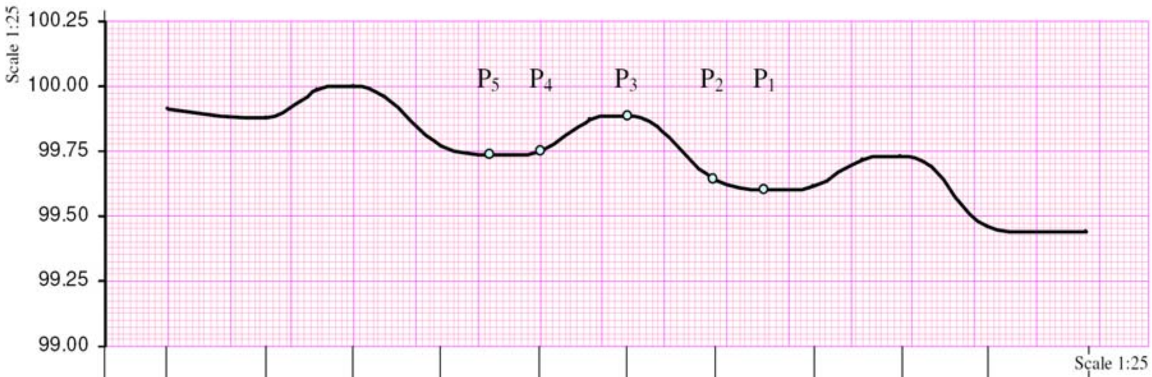
Point number	(R) 1	2 (C)	(C) 3	4 (R)
Land elevation (m)	99.847	99.935	99.788	99.564
Level differences (m) R-R	-2.283			
Level differences (m) C-C		-2.147		
Distances (m) partial	0.55	14.3	0.55	
Distances (m) total	0	0.55	14.85	15.40
Gutter slope (%)	14.82			
Ridge slope (%)		15.01		

Figure 1 **Transversal profile through ridges**

In order to determine the water content of the soil, soil samples were taken with the tubular probe on levels of 10 cm until the depth of 50 cm, before watering application, soon after watering, at 6 hours, at 24 hours and at 72 hours from watering application. The watering rate of 5 l/linear meter was applied at an interval of 5 and respectively 7 days through the watering band with dripping holes spaced 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 (fig. 2).

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.



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
Distances (m) total	0	0.40	0.75	1.10	1.50	1.85	2.20	2.60	2.75	3.30	3.70

Interval	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11
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
Slope (%)	7.25	34.29	65.43	4.50	38.57	71.14	6.50	34.00	78.29	4.25

Figure 2 **Locating the points of taking soil samples**

RESULTS AND DISCUSSIONS

The performance of implantation of cuttings in the vine schools depends, besides other factors, in a large extent on the watering rate and the interval between watering. For their estimation, on the bati-calcarious cambic chernozem type soil with a texture of clayish loam, the values of the soil water content were determined in various moments, and namely: before watering, soon after water, at 6 hours, at 24 hours and respectively at 72 hours from watering application.

The watering was carried out with the same water quantity, 5 l/ml but, the interval between watering was of 5 and respectively 7 days.

The variation interval of the average water content of the soil on the ridge crest on irrigation with the interval between watering of 7 days is between 24.65% before watering and 32.82% soon after watering, recording a gap of 10.17 percentage units (fig. 3).

Compared to the value recorded soon after watering, the average water content of the soil decreases with about o percentage unit at 6 hours, with 4 units at 24 hours and 9 percentage units at 72 hours from watering application.

Comparing the values of the average soil water content with the value of capacity for water in field (26.40%), higher values are recorded compared to it soon after watering, at 6 hours and respectively 24 hours from watering application, the highest difference being of 8.42 percentage units soon after watering. The differences are decreasing at 7.52 percentage units at 6 hours and to 4.02 units at 24 hours from watering application. At 72 hours from watering application, the value of the average water content of the soil is approximately equal with the one of the capacity for water in the field, and before watering, is lower with 1.75 percentage units.

In case of watering with the same water quantity but at an interval of 5 days between watering, the variation of the average water content of the soil on the sample collection moments, determined on the ridge crest (*fig. 3*), is also about 10 percentage units, the highest value being recorded soon after watering (37.76%) and the lower before watering (28.12%). However, it is found out higher values of the average water content of the soil with about 3 percentage units compared to the values recorded at the return of watering after 7 days, the differences ranging between 2.87 and 3.47 percentage units. The highest difference were recorded at higher intervals from watering application and namely 3.40 units at 72 hours from watering application and 3.47 percentage units before watering.

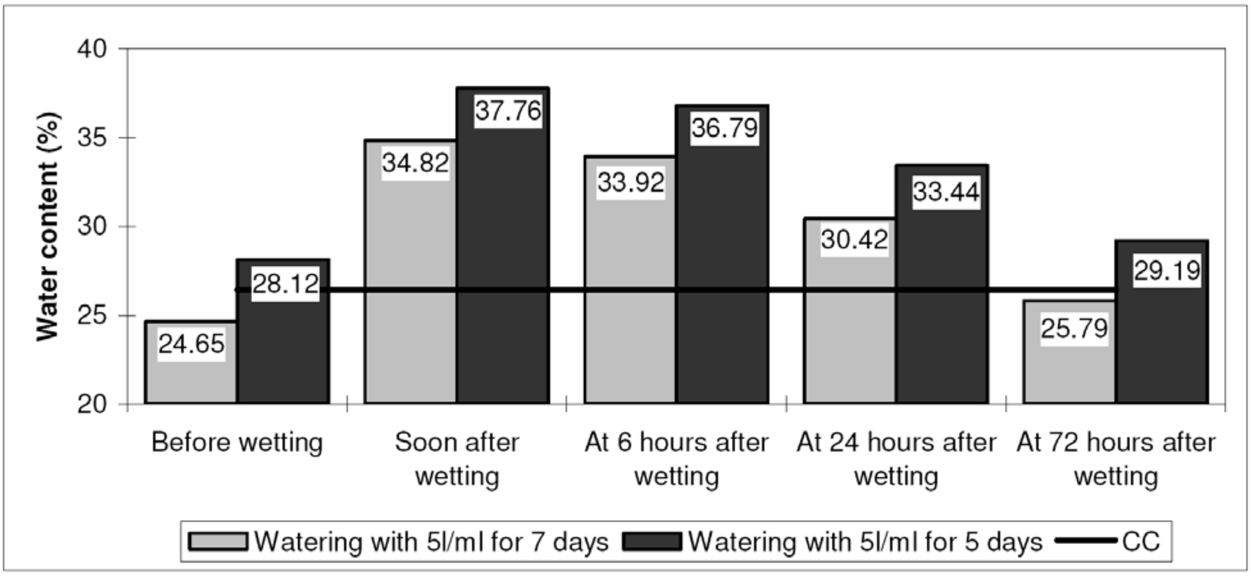


Figure 3 **Average water content of soil, determined on the ridge crest**

Comparing the values of the average water content of the soil on collection moment wit the value recorded soon after watering (37.76%), it decreases with one percentage unit at 6 hours (36.79%) with 4.32 units at 24 hours and with 8.57 units at 72 hours from watering application.

Analyzing the average water content obtained on the ridge crest, on watering with 5 l/ml at an interval of 5 days, compared to the value of the capacity for water in the field, it is found out that, on all sampling moments, higher values are recorded. Regarding their size compared to the value of the capacity for water in the field, and in this case, these are decreasing with the increase of the interval of watering application. The differences are of 11.36 percentage units, soon after watering, 10.39 units at 6 hours, 7.04 at 24 hours, 2.79 at 72 hours and respectively 1.72 percentage units at 6 days (before watering).

Since the differences between the value of the average water content of the soil determined on the sampling moments and the value of the capacity of water in the field, at the irrigation with an interval of 5 days between watering, are higher with about 3 percentage units compared to those recorded at the return of watering after 7 days, as well as the fact that the values are higher in all the sampling moment, including before watering, it results that, by the return of watering after 5 days, water is lost by descending and lateral advance of watering front.

The values of the average water content of the soil recorded at the ridge base, in case of watering at an interval of 7 days (*fig. 4*), are between 25.76% before watering and 29.09% at 6 hours of watering application, recording a gap of 3.33 percentage units, lower with about 5 percentage units compared to that recorded on the ridge crest at the return of watering after 7 days and with 8 percentage units at the return of watering after 5 days.

Regarding the size of values on sampling moments, the water content increases with 2.22 percentage units soon after watering, with 3.33 units at 6 hours, when also the highest value is recorded, then decreasing with 1.15 units at 24 hours and with 1.87 percentage units at 72 hours from watering application.

Comparing the recorded value of the average water content with the value of the capacity for water in the field, it is found out that these are lower at 72 hours and before watering, and, at the other sampling moments, that are higher with 2.69 percentage units at 6 hours and with 1.58 and respectively 1.54 percentage units soon after watering and at 24 hours from watering application.

On watering with 5 l/ml at an interval of 5 days, the values of the average water content on sampling moment from the ridge base are higher than the value of the capacity for water in the field except the value recorded before watering which is equal with it (*fig. 4*). The maximum gap between the recorded values and the value of the capacity for water in the field is 4.12 percentage units, a value reached at 6 hours from watering application, Soon after watering, the difference between the average water content of the soil is about 2.00 percentage units, of 3.00 units at 24 hours and one percentage unit at 72 hours from watering application.

The values recorded at the return of watering after 5 days are higher than those obtained at the return of watering after 7 days, the maximum gap being of 1.48 percentage units.

In this case also, at the ridge vase, the values of the average water content of the soil are higher than the value of the capacity for water in the field at all sampling moments, recorded at the return of watering at 5 days, indicating a more rational use of water by applying the quantity of 5 l/ml at an interval of 7 days.

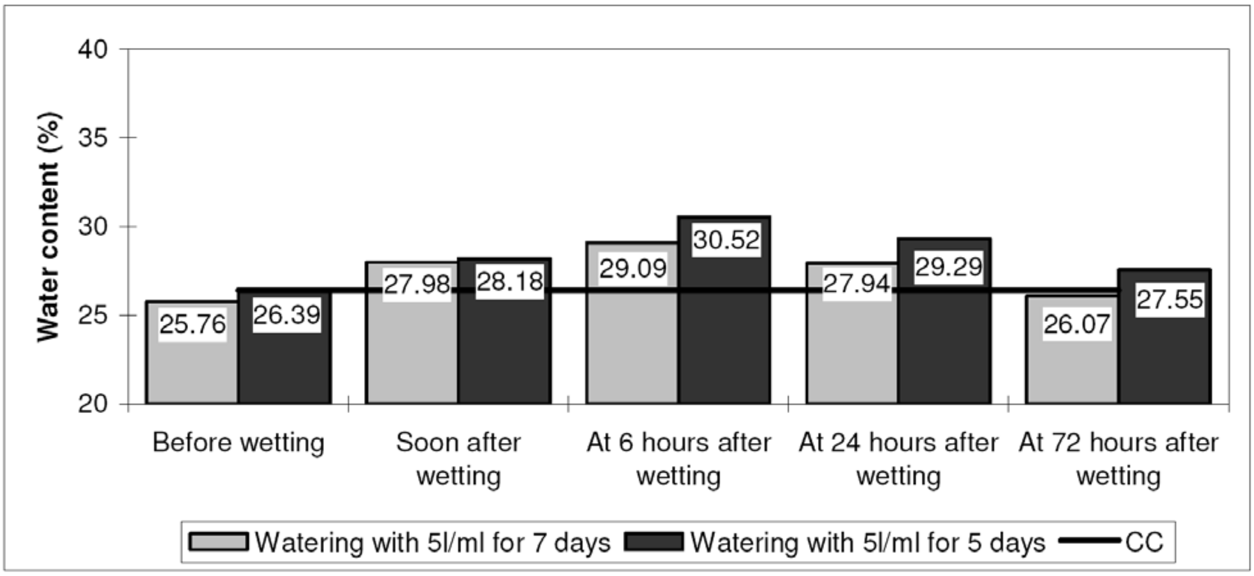


Figure 4 **Average water content of soil, determined on the ridge base**

The values of the average water content of the soil determined on the ditch, at watering application at 7 days are lower than the value of the capacity of water in the field, ranging between 23.75% and 25.45% (*fig. 5*). The values recorded before watering, soon after watering and at 6 hours from watering application are relatively equal and then increase with about 1.50 percentage units, with the highest value being determined at 72 hours from watering application.

Also, as in the case of watering at an interval of 5 days, the values of the average water content of soil are relatively uniform before watering, soon after watering and at 6 hours, and higher with about 1.50 percentage unit at 24 hours and at 72 hours from watering application (fig. 5).

Compared with the values recorded at the return of watering after 7 days, these are higher with about 1.50 percentage units, and at 24 hours and 72 hours from watering application are higher than the value of the capacity for water in the field, reflecting less water losses in the case of watering with 5 l/ml at the interval of 7 days between watering.

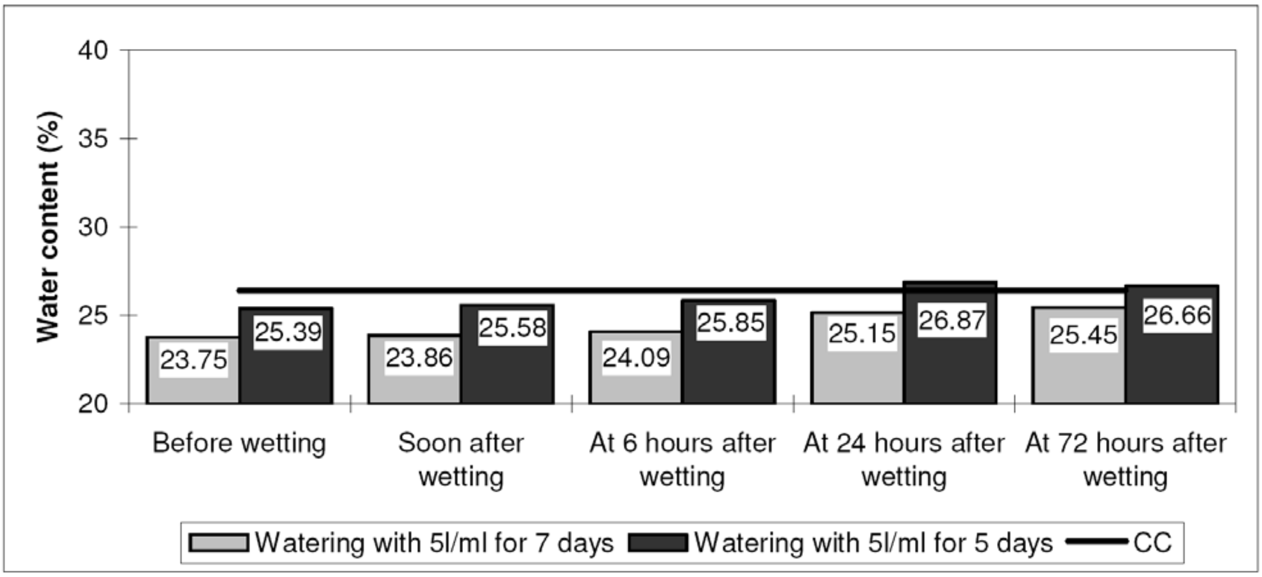


Figure 5 **Average water content of soil, determined on the ditch**

Regarding the averages of soil water content on control points and on sampling moments, it is found out in case of watering at the interval of 5 days, values between 26.63% and 31.05% higher with 1.62-2.03 percentage units compared to those obtained at the interval between watering of 7 days (fig. 6).

On watering at 7 days, the average values are ranging between 24.72% and 29.03%, the gap of values being of 4.31 percentage units and the values recorded before watering and at 72 hours from watering application are lower than the values of the capacity for water in the field. At the watering at 5 days, also the difference between the maximum value and the minimal one is the same (4.42 percentage units), but the recorded values are higher at all sampling moments compared to the capacity for water in the field.

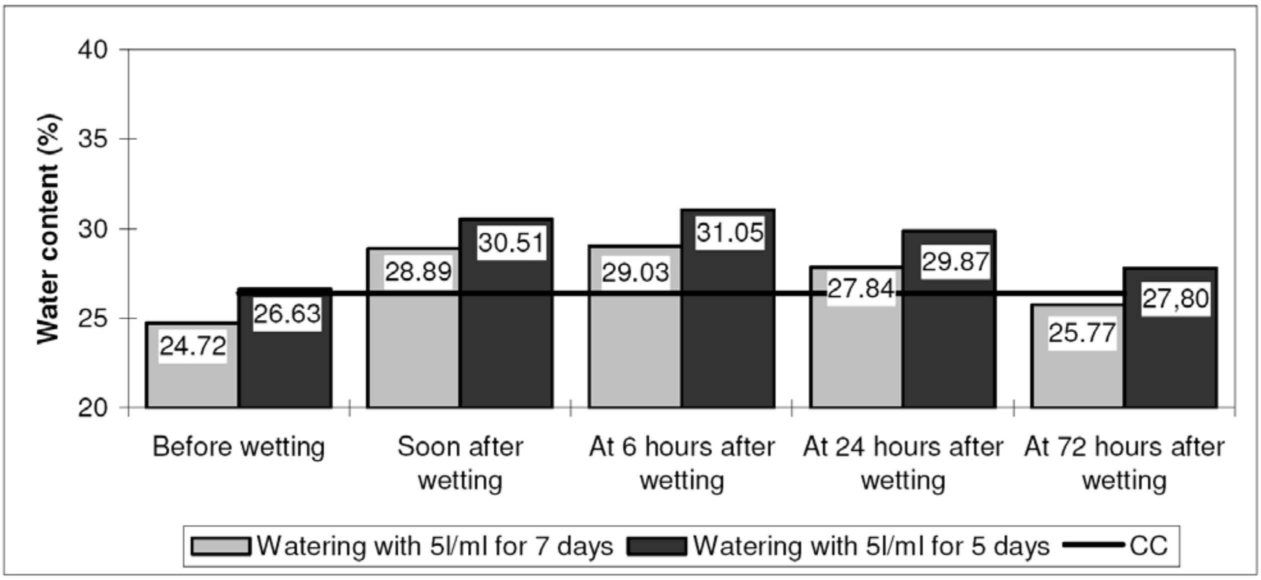


Figure 6 **Average water content of soil on control points and sampling moments**

In both cases, the highest values are recorded at 6 hours from watering application and the lower before watering.

The higher values of the average water content of the soil on control points and sampling moments in case of watering with 5 l/ml at an interval of 5 days confirm the more efficient use of water at watering with the same water quantity but at an interval of 7 days.

Although watering with 5 liters of water on linear meter at the interval between watering of 5 days maintains the soil super-wetted, this fact should be admitted in the first part of the vegetation period at grape vine school when the cuttings have a poor developed root system with the risk of losing some water quantity by the descending and lateral advance of the wetting front. However, in the second part of vegetation when the root system is developed, the return of watering after 5 days is not economically justified.

CONCLUSIONS

The irrigation by dripping allows the precise dosing of water content needed in various developing phases, a stringent requirement of grape vine schools.

For a better implantation of cuttings, in the grape vine schools, it is necessary at the beginning of the vegetation period the watering at a lower interval and, after formation and development of root system, the watering at a higher interval.

The maximum value of the average water content of the soil on control points was recorded irrespective of the interval between watering, soon after watering application on ridge crest, at 6 hours from watering application on the ridge base and at 72 hours at the middle of the ditch.

After 72 hours from watering application the average water content of the soil on control points is relatively uniform due to the water consumption of plants and descending and lateral advance of the wetting front.

The watering by dripping with watering rates and well established intervals between watering determines a significant increase of water content of the soil only inside the ridge, in the area of the main mass of plant roots, providing the controlled and rational use of water.

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