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REGULATION OF THE VINEYARD'S IRRIGATION MODE UNDER THE MULCHING CONDITIONS

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Historically, Georgia is considered as one of the oldest centre of viticulture and winemaking, and Kakheti (Eastern Georgia) – is the ancient and unique viticulture and winemaking region in Georgia. Here, 65-70% of Georgian vineyards are concentrated, since the soil-climatic conditions of Kakheti are promoted the high quality yield. Despite the favorable climatic conditions, in the second half of the summer season a long-term drought has occurred. Consequently, for obtaining the qualitative and programmed yield, optimum regulation of soil moisture is essential.

Effective use of soil moisture promotes the complex of agro-technical measures, among which one of the priorities is the soil mulching technology, along with drip irrigation that have long been used in Georgia. Especially, high and effective results were obtained by using a black polyethylene film for mulching vines, at which the growth of agricultural crops increased by 40-43 centner/ha.

Soil mulching (covering the surface) is one of the effective agrotechnic measures that affect the soil microclimate. This method provides not only the regulation of soil water mode, but also the natural optimization of soil air and heat regimes, which in turn determines the activation of soil microbiological processes.

Mulching with polyethylene film is carried out by hand or by special machinery. It is possible to cover the entire surface of the soil with complete or different wide strips. The edges of the film can be fixed by different methods, mainly by the soil powder. Perforation of film takes place before or after littering, depending on for which variety of crop mulch is used.

Mulching technology plays a significant role in the arid and semi-arid irrigation farming zone. The efficiency of using this method is mainly reflected by quantitative and qualitative indicators and less attention is paid to the study of ongoing processes in the soil, especially when studying the physical picture of the patterns of moisture and heat dynamics.

The regulation of soil heat mode and balance can be considered by mulching method as one of the effective agro-technical measures to adjust the temperature of the crop root system in soil. Analysis of heat balance shows that in case of polyethylene film as a mulching, spraying heat on the evaporation reduces twice and the turbulent heat transfer in the air decreases by 17%, while the heat flow in the soil increases by 25%. This is especially important in the spring period, when it is necessary to keep the heat and moisture in the soil [1].

Since, the film is characterized by high tightness, under it different conditions of air and soil moisture are formed. For example, in summer, in the atmosphere of the air during the average relative humidity conditions, humidity under polyethylene film rises to 90-95%, and at night it is fully saturated (100%).

Based on analysis of the results of field experiments conducted by us, it is established that:

- ✓ During the drought period, in the first days of irrigation, the humidity of the air reaches about 25% under the perforated film, and a week later - 7-10% more than in the open ground conditions;
- ✓ Air humidity under non-perforated film is about 16% and more than perforated underneath;
- ✓ During the cold season and abundant atmospheric sediments, the soil moisture under the perforated mulch is the same as in the open ground;
- ✓ In hot and dry periods, the soil moisture under the perforated mulch is particularly low in the upper layer, rather than under the non-perforated mulch, and is slightly lower than in the open ground. Therefore, it is necessary to irrigate frequently during the drought period.

According to the above mentioned we can conclude that the smaller the distance between lines of mulch and the high frequency of perforation, the less evaporation and the increase of water in the soil.

As many researchers have found, along with mulching the use of drip irrigation system allows reliable regulation soil moisture and heat. Consequently, the complex of these measures is widely used in arid and semi-arid areas for irrigation of vineyards, gardens, vegetables and a wide variety of field crops, however, in case of joint use of the mentioned methods, during improper selection of crop water requirement and drip irrigation system, irrigation water loss is about 30% [2].

The drip irrigation system may be stationary or portable in vineyards.The distance between irrigation pipelines depends on the distance between the crops and the crop ranges, and the frequency of the drippers‘ distribution on the pipelines depends on the distance between crops, soil water and physical properties and the water flow of drippers [3].

In the clay soils, the area irrigated by each dripper should not be exceed 2.0-2.5 m^2, and in sandy soils - 1.2-1.5 m^2. The greater the consumption of the dripper, the less their number. Irrigation water flow, according to the construction of dripper, in most cases varies by 0.9-7.6 l/h and sometimes even more than -15 l/h.

In case of soil mulching, the vineyard is irrigated locally. In this case, the pipelines are placed under the mulching film, while the drip irrigation system is calculated in the usual manner and the irrigation mode is carried out in accordance with the water requirement, natural-climatic conditions, soil structure, evapotranspiration and other factors.

In recent times, scientists have developed a number of methods of calculation of evapotranspiration (ETo) according to various climatic data. These methods are often localized and cannot be used in different regions. The test of this method is quite a laborious process in other conditions, and determination of ETo should be done instantaneously. To solve this problem, FAO (UN Food and Agriculture Organization) recommends Penman-Monteith equation for calculation *ETo* [4]:

$$ETo = \frac{0.408 \cdot \Delta \cdot (Rn - G) + \gamma \cdot \frac{900}{T + 273} \cdot u_2 \cdot (e_s - e_a)}{\Delta + \gamma \cdot (1 + 0.34 \cdot u_2)},$$

where: ET_o is reference evapotranspiration (mm day^{-1});

Rn - net radiation at the crop surface (MJ m^{-2} day^{-1});

G - soil heat flux density (MJ m^{-2} day^{-1});

T - air temperature at 2 m height (°C);

u_2 - wind speed at 2 m height (m s^{-1});

Δ - slope vapour pressure curve (kPa °C^{-1});

γ - psychrometric constant (kPa °C^{-1});

e_a - actual vapour pressure (kPa);

e_s - saturation vapour pressure (kPa);

e_s-e_a - saturation vapour pressure deficit (kPa).

Along with this method, in the irrigation farming, the greatest use of bioclimatic method for calculation of evapotranspiration is based on biological coefficients (K_d) of total evaporation. This method is based on water consumption, air humidity deficit and biological indications of irrigation crop. This can be expressed by the following equation:

$$ET_0 = K_d \cdot \sum d; \quad ET_0 = K_t \cdot \sum t; \quad ET_0 = K_E \cdot E_m,$$

where: K_d, K_t, K_E are Biological (bio-climatic) coefficients of crop water consumption and depends on crop growing period;

Σd - total average daily deficit of air humidity (mb);

Σt - Total average daily air temperature (^{0}C);

E_m - maximum evaporation (mm).

The accuracy of this method depends on quantitative importance of bio-climatic coefficients of water consumption, which is appropriate for various agricultural crops based on multi-year field studies.

Based on the results of our studies and the recommendations of the United Nations Food and Agriculture Organization (UN FAO), using the fertigation and nanotechnologies, we have developed the optimal irrigation mode of vineyards for the different administrative municipalities of Kakheti Region (Eastern Georgia), taking into consideration the mulching technology and drip irrigation:

- ✓ Lagodekhi, Kvareli, Upper Alazani Irrigation Lands up to Tsinandali: irrigation rate - 800 m^3/ha; irrigation dates – from 1 April to 10 April; from 1 July to 10 July;
- ✓ Akhmeta, Telavi, Gurjaani, central lands of Alazani irrigation System: irrigation rate - 800 m^3/ha; irrigation dates – from 1 April to 10 April; from 1 August to 10 August;
- ✓ Tsnori-Milari massif of Alazani Irrigation System and Gombori foothill massifs: irrigation rate - 800 m^3/ha; irrigation dates – from 1 October to 10 October; from 11 April to 20 April; from 11 August to 20 August.

The adjusted mode of the vineyard we have received will greatly support local farmers in order to obtain programmed and high quality grapes.

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ვაზის რწყვის რეჟიმის რეგულირება მულჩირების პირობებში

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ისტორიულად, საქართველო ითვლება მევენახეობა-მეღვინეობის ერთ-ერთ უძველეს კერად, ხოლო კახეთი - უძველესი და უნიკალური მევენახეობა-მეღვინეობის რეგიონი საქართველოში. აქ კონცენტრირებულია საქართველოს ვენახების 65-70%, ვინიდან კახეთის ნიადაგურ-კლიმატური პირობები ხელს უწყობს ხარისხიანი მოსავლის მიღებას. მიუხედავად ხელსაყრელი კლიმატური პირობებისა, ზაფხულის მეორე ნახევარში მოხშირდა ხანგრძლივი გვალვიანი პერიოდი. შესაბამისად, ყურძნის ხარისხიანი და პროგრამული მოსავლის მისაღებად, აუცილებელია ნიადაგის ტენის ოპტიმალური რეგულირება.

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