ASPECTS CONCERNING THE WATER REQUIREMENT IN VINEYARD AGRO-ECOSYSTEMS FROM SEMI-ARID AREAS FROM ROMANIA

ASPECTE PRIVIND NECESARUL DE APĂ ÎN AGROECOSISTEME VITICOLE DIN REGIUNI SEMIARIDE DIN ROMÂNIA

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Abstract: *The aim of this paper is to emphasis the aridity conditions from South and South-Eastern Romania and to detail the relations between water and soil-plant-atmosphere system with application in vineyards agro-ecosystems. Of climatic elements by presenting the temperature and precipitations, but also the specific characteristics for drought and aridity and Penman-Monteith reference evapotranspiration. Also are describe the correction coefficients of agricultural crops used in irrigation technique, the optimal real consumption of water for vineyards cultures and is emphasized the territorial repartition of water necessary for these. In order to produce qualitative grapes, the vineyards cultures from semi-arid areas from south and south-eastern of Romania require a greater quantity of water, especially within the summer months, July and August.*

Rezumat: *Scopul acestei lucrări este de a evidenția condițiile de ariditate din sudul şi sud-estul României şi de a detalia relațiile apei în sistemul sol – plantă – atmosferă, cu aplicații în agro-ecosisteme viticole. Pentru evidențierea cantității de apă, necesară culturilor viticole sunt prezentate: distribuția spațială a evapotranspirației ET_0-PM, ca valori anuale, distribuția spațială a evaporației reale maximă (ETc) pentru culturi de viță de vie, precum şi valorile consumului necesar de apă, în perioada de vegetație a viței de vie. Pentru a obține producții optime de struguri, atât calitativ, cât şi cantitativ, culturile viticole din regiunile semiaride din sudul şi sud-estul României, necesită o cantitate optimă de apă, în special în lunile de vară, iulie şi august.*

Key words**:** *vineyards cultures, water requirement, semi-arid areas*
Cuvinte cheie: *culturi viticole, necesarul de apă, regiuni semiaride*

INTRODUCTION

In this paper are presented the climatic conditions from Romanian Plain and Dobrogea Plateau, semiarid regions located in Southern and South-Eastern Romania.

Romanian Plain is characterized by a temperate continental climate, with sub Mediterranean influences, more pronounced in the south-west and aridity influences, emphasized in the east, which is interposed between a transitional region, which interferes circulations from east with the west.

In Dobrogea, a distinct feature of the climate represents a priority means the frequency of droughts phenomenon, which formed the fund of lower quantities of rainfall in Romania.

Viticulture is an old tradition in these areas, where are natural conditions, pedo-climatic and relief quite favourable.

The aim of this paper is to highlight aridity conditions in southern and south-eastern Romania and to present spatial distribution of evapotranspiration reference values (ET_0-PM), the actual maximum estimated evaporation ($ET_{c\text{-}est}$) in southern and south-eastern Romania's vineyard cultures and the needs of water for vine crops, based on relatively new methods, standardized at international level.

MATERIAL AND METHODS

To calculate the optimum water consumption of crops and calculation of water requirements are necessary both rainfall and crops evapotranspiration. Penman-Monteith method for determining evapotranspiration reference (ET_0-PM, Monteith, 1965) was used in this study. Thus, for approx. 40 points of observation (weather stations) in southern and south-eastern Romania were calculated monthly average values of the climatic elements necessary to calculation: ET_o-PM, optimal consumption of water (crop evapotranspiration, $ET_{c\text{-}est}$), the water requirements of crops (WR) and rainfall.

For zoning indicators $ET_{c\text{-}est}$ and WR, their territorial allocation was made for the entire growing season or summer, using the method Inverse Distance Weighted (IDW), to area of study.

Results for the average climatic conditions were obtained based on the methodology proposed by Allen et al. (1998), reviewed extensively at international level (e.g. Ortega Farias, 2004) and Romania (PĂLTINEANU et al., 1999, 2000; PĂLTINEANU, 2005), provided that the technology of production for this crop. It should be noted that the results relate to the average weather conditions in southern and south-eastern Romania, characterized of more arid climate compared to other regions of Romania.

RESULTS AND DISCUSSIONS

The average annual temperature of the air. The higher average multiannual of the air temperatures, over 11˚C and 13˚C over on the surface of the soil, it is noted in the half south of Romanian Plain, on the Black Sea coast, on a narrow area in Central Dobrogea and a wide area in South Dobrogea, where solar radiation and global values are higher.

Annual isotherms (figure 1) are diminishing, as a value, with the increase of relief altitude and distance over the coast in south-east. Along the years have noticed large unperiodically variations the air temperature and soil temperature. Thus, under the advection influence of hot tropical air, the highest values have exceeded 12˚C almost throughout the region. On the soil surface, the highest values have exceeded 15˚C, with 3˚C, more than air, and the lowest values was 11˚ - 12˚C.

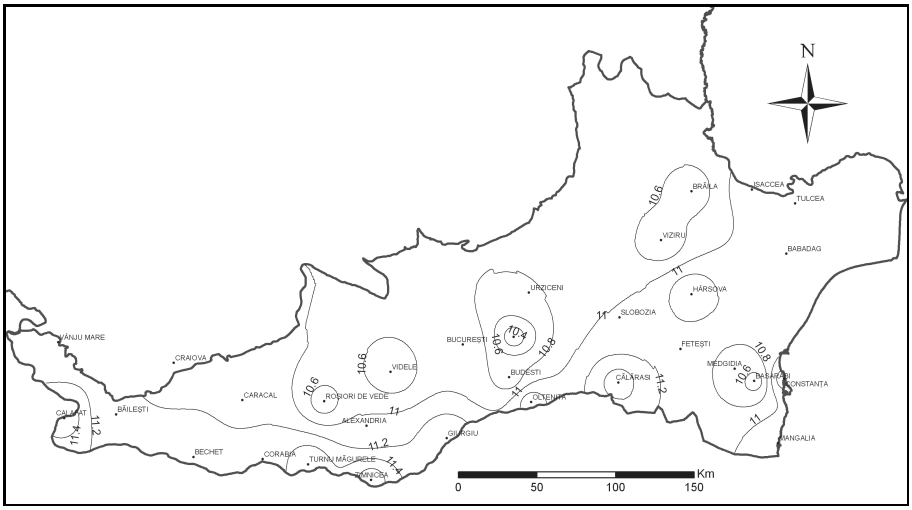

Figure 1. Spatial distribution of annual average air temperature (°C) in Southern Romania

Average annual rainfall quantities (figure 2) show a general trend of gradual reduction from the west (Vânju Mare, 590 mm) to the east (Braila, 458 mm) in Romanian Plain, as the influences of maritime air to reduce and increase influences of continental air. In the central plain, the rainfall are the richest (550 to 600 mm) being the area of interference west circulation with the east. Also rainfalls are reduced from north to south, while reducing altitude.

In Dobrogea, the annual average quantity of rainfall increases from the Black Sea coast to the western extremity of Dobrogea and isohyets tend to become parallel with the shore of the Black Sea in eastern Dobrogea, in the area with influence of marine breezes. The annual values of isohyets increase in the middle of the land from under 350 mm, up to 400-450 mm.

Along the years, the annual average amount of rainfall may lower to 200-250 mm, hydrous deficit being filled by irrigations.

The correlation between the amounts of rainfall and distance from the Black Sea increases during warm semester of year (months IV-X). The amounts of rainfall increase gradually in the interior of the land, on a distance of 30-35 km towards the coast, in relation with reducing the influence of marine breezes.

Distribution quantities of rainfall in Dobrogea are distinguished, as in other steppe regions around the Black Sea, through an accented variability, especially during the warm period of year (months IV-X).

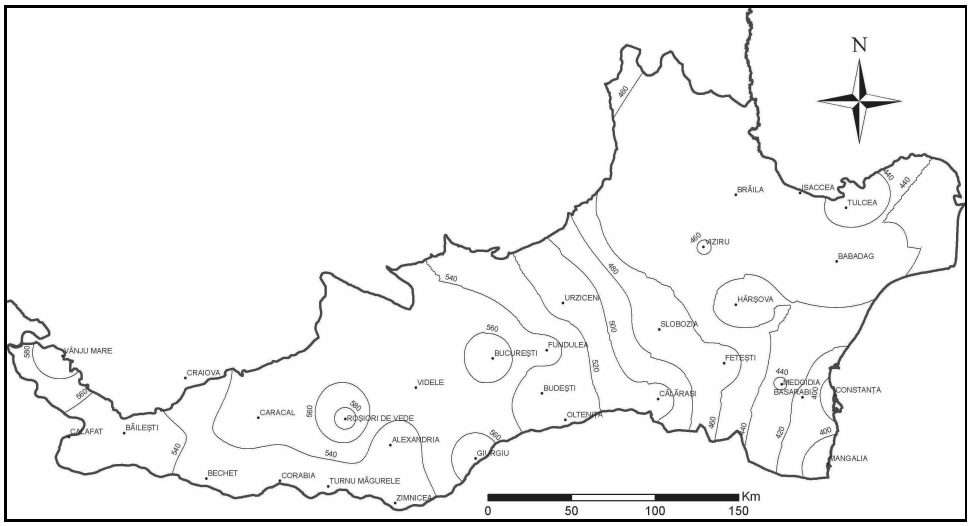

Figure 2. Spatial distribution of annual average rainfall (mm) in Southern Romania

Index of aridity ***Emm. de Martonne***. Romanian Plain and Dobrogea Plateau required in the geographical landscape of Romania by the phenomena of dry and drought, which are typical for the continental temperate climate in the country. These phenomena are very complex, determined of several factors: the dynamics of the atmosphere, surface active particularities, human influence etc.

Predominant role they hold dynamic factors, as the influence of anticyclones, with predominant clear sky, sunstroke, reducing rainfall, or even the absence of their total at least 10 to 15 days consecutively.

Given their ecological importance, these phenomena have been addressed along time under various aspects: the criterion Hellmann, indices of aridity, a deficit of water from the soil, indices bioclimatic or climate charts.

Geographical distribution of this index shows that on the territory of Romanian Plain, the level of continental influence increase from north to south and from west to east.

The lowest values of this (<22) are characteristic of extreme aridity area from the eastern periphery of Romanian Plain and Danube wetlands, which corresponds to the smallest annual quantity of rainfall (<450 mm). Following, the east half of Bărăgan Plain, with values of aridity index between 22 and 24, which correspond to the field with a temperate continental influences of aridity.

Aridity indices of 24 to 26 characterized the field of temperate continental climate with reduced influence of aridity corresponding to half west of Bărăgan, Burnas and southern portion of Gănvanu - Burdea, Romanați and Băileşti plains.

Aridity indices greater than 26 correspond to a temperate continental climate moderated covering most of Oltenia, Teleorman and Ialomița plains in which share of rainfall with 50 to 100 mm greater than in previous areas.

In Romanian Plain to separate two large areas where are present the phenomena of dry and drought: western part of this plain, where sub Mediterranean influences occurring annually from consecutive 3 to 3.5 months with the phenomena of dry and 1 to 2 months with the phenomena of drought, and eastern part with the continental influence of aridity, with consecutive 3 to 4 months of dry and 1 to 2 months of drought.

The lower quantities of rainfall in Dobrogea occur in the area of maximum influence of marine breezes, through attenuation of torrential rainfall and absence of extremely dry periods. Under the distance of 30 km over sea shore and under 20 m altitude, extremely dry periods are missing, but the quantities of rainfall are the lowest.

In Dobrogea, in an average year occur consecutively from 4 to 6 months of dry (that is the prelude drought), increasing gradually from west to east and from north to south and records 2 to 3 consecutive months of drought. This requires the introduction of irrigations systems as an effective means to combat their effect.

The annual ET_0-*PM* (evapotranspiration reference, calculated using the method Penman-Monteith) values varies between 750 and 800 mm, they generally increasing from north to south. ET_0-PM isoline of 750 mm means actually, the upper limit of plains and low tablelands. The south-west of the Romanian Plain and south-west of Dobrogea Plateau, with large areas of vines crop, highlights by the highest values of ET_0-PM, by 800 mm annually.

From this allocation result, obviously, that there are regions where the annual values of ET_0-PM greater than 700 mm and an average amount of rainfall, less than this amount needs irrigations during the summer. An acute need for irrigations during the summer presents territories where the ET_0-PM are greater than 750 mm, especially with values of 800 mm annually. Of these, Dobrogea and Bărăgan are most dry, must be considered as priorities in the implementation of irrigation, important both economically and as a modifier of the landscape factor.

Figure 3 illustrates the $\boldsymbol{ET_{c\text{-}est}}$ (real evaporation for vine crops) values for vine crops during the growing season, with values between 430 and 470 mm. The highest values (460-470 mm) is recorded in the south-west of Romania through high values (440-450 mm) in the southern part of the Romanian Plain and Bărăgan, and in Dobrogea, the values are higher in south - west (over 450 mm) and the lowest up to 430 mm in the central-north part.

Vine crops are not big consumers of water, but in some summer months, especially in July and August, water needs could increase to increase the production of grapes.

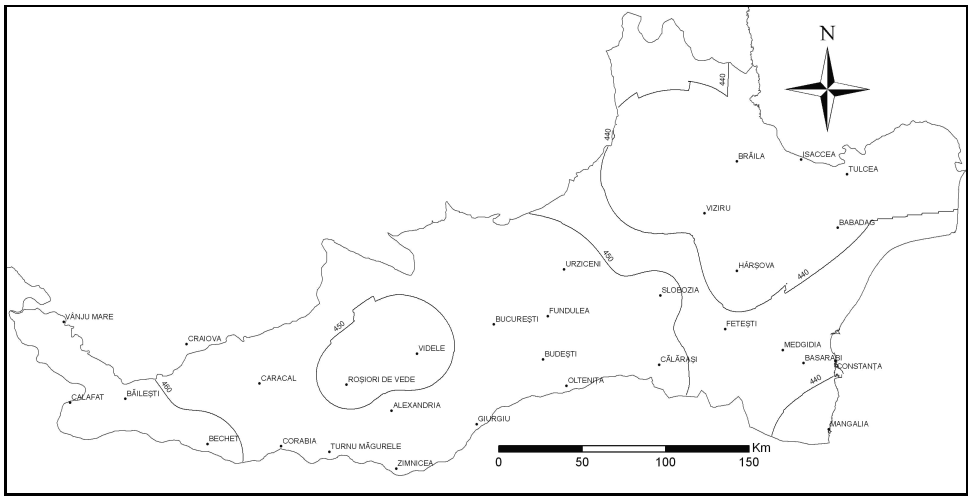

Figure 3. Spatial distribution of annual ETc-est (mm) in Southern Romania

During the growing season, the *Water Requirement* (WR) for vine crops amounted to 220 mm in the eastern part of Dobrogea, 200 mm in the south-west of Dobrogea and in the south-west of Oltenia Plain. In the central part of Dobrogea is worth noting the 180 to 200 mm, while in southern Romanian Plain, the decrease from south to north, from 180 to 150 mm. The above, of the territories mentioned represented in Figure 4 the quantities of water requirement for vine crops in southern and south-eastern Romania. Most of the Dobrogea Plateau and south-west of the Romanian Plain are characterized by the values of the water requirements of 180-220 mm.

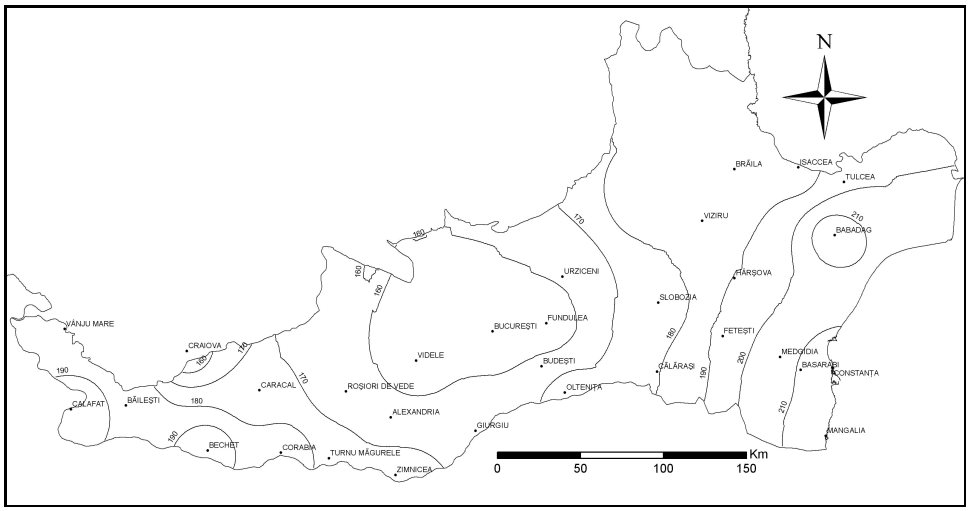

Figure 4. Spatial distribution of Water Requirement (mm) in the growing season in Southern Romania

CONCLUSIONS

The highest values (460-470 mm) of $ET_{c\text{-}est}$ during the growing season for crops vines are located in the south-west of the Romanian Plain, crossing the average (440-460 mm) in south-west of Dobrogea, in south of Romanian Plain and Bărăgan, and the lowest values, under 440 mm in the northern Dobrogea.

During the growing season of the vine, water requirements (WR) for vine crops, amounted to 200-220 mm in the east and south-west of Dobrogea and in the south-west of the Romanian Plain.

Most of the Romanian Plain and north-central part of Dobrogea Plateau are characterized by values of the water requirements between 180-200 mm.

Most small amounts, less than 180 mm correspond to central-southern sector of the Romanian Plain.

The above values, of the territories mentioned, represent the greatest volume of water requirements for Romania vine crops.

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