CLIMATE AND SOIL FEATURES IN SMEDEREVO AREA IN THE FUNCTION OF FRUIT GROWING AND VITICULTURE[1]

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Abstract

This paper analyzes the climatic and pedological conditions for fruit and grapevine cultivation on the territory of the city of Smederevo. The analysis of climate parameters and the availability and quality of land resources, of which agricultural production depends on, led to the conclusion that this area has favorable weather conditions and good quality land resources for intensive and profitable fruit and grape productions. In the second part of the paper, the authors analyze the structure of production and yields of fruits and grapes in the period 1997-2013 and propose measures for their improvement by introducing complex agro-technical and hydro-ameliorative measures.

Key words: *climate, soil, fruit growing, viticulture, Smederevo.*

Introduction

The climate system is a complex dynamic system that shows the natural variability and is of global scale. Any disturbance in one part of the planet has a complex, non linear reflection to the other parts of the climate system.

Climate of Serbia can be described as mild continental with more or less localized characteristics. Spatial distribution of climate parameters is caused by geographic location, land relief and local influence as a result of combination of the relief, the distribution of air pressure on a major scale, terrain exposition, presence of river systems, vegetation, urbanization, etc.

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Trend analysis of annual air temperature for the period 1951 - 2012 indicates that rise in temperature is present on the whole territory of Serbia and it is the most intense in the north of Vojvodina province, in *the wider vicinity of Belgrade* and in the Negotin lowland. Summer 2012th was twenty-third consecutive warmer summer than average (*SEPA, 2013.*).

By the end of this century, we can expect further increase in temperature in the territory of the Republic of Serbia (2 °C – 2,2 °C by 2070 and 3,6 – 4,0 °C at the end of the period 2071-2100). Warming is most pronounced during the summer and autumn seasons. Changing rainfall is positive during the period 2011 - 2040 in order to became negative to the end of century when will reach -20%. During the summer season deficit is most pronounced, with a reduction of over 30% in some parts of Serbia by the end of the period 2071-2100 (*UNDP, 2015.*).

Considering viticulture, climate change will change the geographic distribution of wine grape varieties and this will reduce the value of wine products and the livelihoods of local wine communities in Southern and Continental Europe *(Kovats et al., 2014.)*. Some adaptation is possible through technologies and good practice in vineyards, including suggestions to replace rigid concepts of regional identity with a geographically flexible "terroir" that ties a historical or constructed sense of culture to the wine maker and not to the region (*White et al., 2009.*).

Many sustainable soil and biophysical processes management techniques, technological and infrastructural solutions and socio-economic and policy responses are implemented in agriculture in order to adapt to climate change, including permanent vegetation cover, pesticide and fertilizer treatment dates and methods, varieties better adapted to changing climate, early warning systems of droughts and other extreme weather events, pest and diseases risk monitoring, improved irrigation practices, wind, heal and frost damage protection in orchards, etc. (*Popović, Mijajlović, 2013.*).

Material and working methods

Climate specificities in the area of Smederevo were analysed on the basis of the monthly values of climate parameters in the period 1984-2014, received from the meteorological station Smederevska Palanka of the Republic Hydrometeorological Service of Serbia. In doing so, evapotranspiration was determined by the FAO *Penman-Monteith* method, using the following equation:

$$ET_0 = \frac{0.408 \cdot \Delta \cdot (R_n - G) + \gamma \cdot \frac{900}{T+273} \cdot u_2 \cdot (e_s - e_a)}{\Delta + \gamma \cdot (1 + 0.34 \cdot u_2)}$$

where: **ETo** reference evapotranspiration (mm / day); **Rn**-net radiation from the surface of the crops (MJ / m2xday); **G**-energy spent on heating the soil (MJ / m2xday); **T**-average monthly air temperature measured at 2 meters height (° C); $\mathbf{u_2}$-wind speed measured at 2 meters height (m / s); $\mathbf{e_s}$ -saturated vapour pressure (kPa); $\mathbf{e_a}$ - actual vapour pressure (kPa); $\mathbf{e_s}$-$\mathbf{e_a}$ - vapour pressure deficit (kPa); **Δ**-slope of vapour pressure (kPa/°C); **γ**- psychrometric constant (kPa/°C), *(Kljajić and al. 2006.)*.

Data on land resources and the structure of production have been taken from the Statistical Office of the Republic of Serbia, and when analyzing the situation and looking at measures to improve fruit and grape production a number of scientific papers was quoted and appropriate local development documents consulted.

Research results

Climate is the result of the complex and dynamic climate system and affects the development of economy and society of an area. Climate elements have a natural variability of which we learn directly, by meteorological measurements, or indirectly, by using some other methods. With regards to global climate changes on Earth, understanding of climate conditions is essential for the economy of an area and within it, the agriculture with all its branches *(Kljajić et al., 2011.)*.

Two basic climate characteristics, which express the impact of energetic and aerodynamic state of the lower layers of the atmosphere on the amount of energy that land under cultivation receives and gives back to the atmosphere, are: - the reference potential evapotranspiration ETo (mm /day); and - effective precipitation Pe (mm). The energetic state of the lower layers of atmosphere is determined by air temperature and insolation and the aerodynamic state of the lower layers of the atmosphere is defined by relative humidity, wind speed, and amount of effective precipitation.

The data used to determine these characteristics included the following climate elements presented in Table 1: the maximum,minimum and mean air temperature (T, °C); the average sunshine duration (n, hour); the average relative humidity (RH, %); the average wind speed measured at 2,0 m above the soil surface (V, m/s); and the amount of precipitation (P, mm).

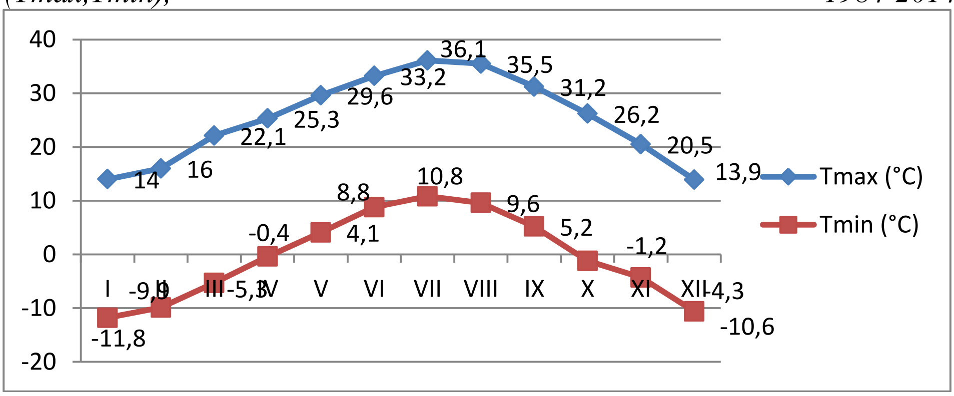
Table 1. *Average values of the climate parameters, 1984-2014*

Climate parametrs	Months											
	I	II	III	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	X	XI	XII
Tmax (°C)	14,0	16,0	22,1	**25,3**	**29,6**	**33,2**	**36,1**	**35,5**	**31,2**	26,2	20,5	13,9
Tmin (°C)	-11,8	-9,9	-5,3	**-0,4**	**4,1**	**8,8**	**10,8**	**9,6**	**5,2**	-1,2	-4,3	-10,6
Tmean (°C)	0,9	2,2	6,6	**12,1**	**17,0**	**20,3**	**22,4**	**21,9**	**17,0**	11,8	6,6	2,0
RH (%)	81,1	75,6	68,3	**66,3**	**67,5**	**68,2**	**64,9**	**65,4**	**70,8**	75,3	78,5	82,2
n (hour)	81,0	105,3	159,4	**190,0**	**240,2**	**268,2**	**304,6**	**287,8**	**208,5**	167,6	106,1	73,5
V (m/s)	2,0	2,2	2,4	**2,3**	**2,0**	**1,8**	**1,7**	**1,6**	**1,6**	1,7	2,1	2,0
P (mm)	45,5	43,0	42,1	**52,3**	**64,4**	**75,6**	**59,6**	**56,2**	**55,1**	51,8	46,9	52,6

Source: *Republic Hydrometeorological Service of Serbia, data for the period 1984-2014.*

The highest values of **air temperature** are typical for the months of July and August, and the lowest for January and February. For the investigated period the highest average value of maximum air temperature was 36,1 °C and the lowest was in January and it was 13,9 °C. The average values of minimum air temperatures ranged between -11,8 °C in January to 10,8 °C in July. Average monthly values of air temperatures ranged from 0,9 °C in January to 22,4 °C in July. The values of air temperature are shown in Graph 1.

Graph 1. *The long term course of monthly air temperature values (Tmax,Tmin), 1984-2014*



Insolation, as the main source of energy for all physical and chemical processes and phenomena in the nature, and thus the source of life on Earth, by the intensity of its radiation increases the intensity of photosynthesis.

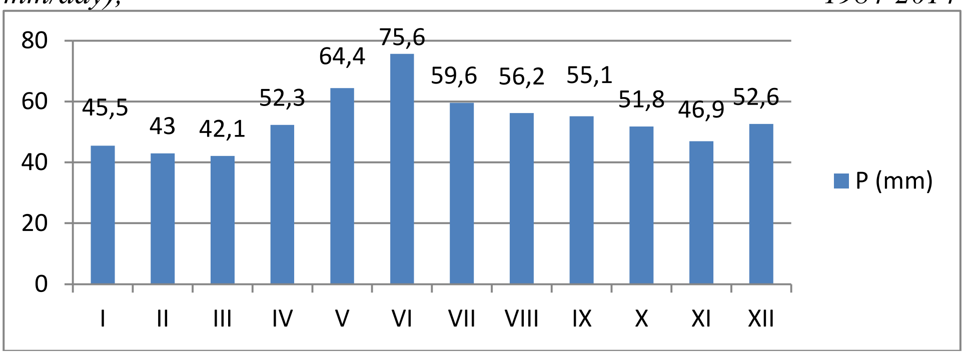
However, insolation can be favourable for the growth and development of plants up to a certain limit, beyond which its effect can be negative. Insolation also affects the intensity of evapotranspiration (ET), specifically the amount of water that is lost from the soil through the physiological processes of plant transpiration (T), and through physical evaporation from the soil surface (evaporation, E) *(Kljajić et al., 2012.)*. In the investigated area insolation varies between 73,5 hours (December) to 304,6 hours (July).

Humidity is a climate parameter that is inconsistent with the intensity of evaporation. If the humidity is lower, the intensity of evaporation is higher, and vice versa. Humidity is the highest in December with average values for the investigated period in the area of Smederevo of 82,2%, while its lowest value is 64,9% in July. With regard to the vegetation period its values range from 64,9% (July) to 70,8% (September).

The effect of **wind** on the amount of water that is lost from the soil and plants through evapotranspiration is very important. The biggest influence is at noon and the lowest at night. Wind speed ranges from 1,6 m/s (August and September) to 2,4 m/s (March). The most prevailing winds are south and north, followed by south-east wind.

Precipitation is the main source of water for plants. To be able to assess how much water plants receive from precipitation, it is important to know not only the annual amount of precipitation, but also its distribution during the growing season by plant phenophases. Average annual precipitation in the investigated period amounted to 645,1 mm. In the vegetation period the average amount is 363,2 mm. Monthly precipitation values in the investigated period in the territory of Smederevo are shown in Graph 2.

Graph 2. *The long term course of monthly precipitation values (P, mm/day), 1984-2014*



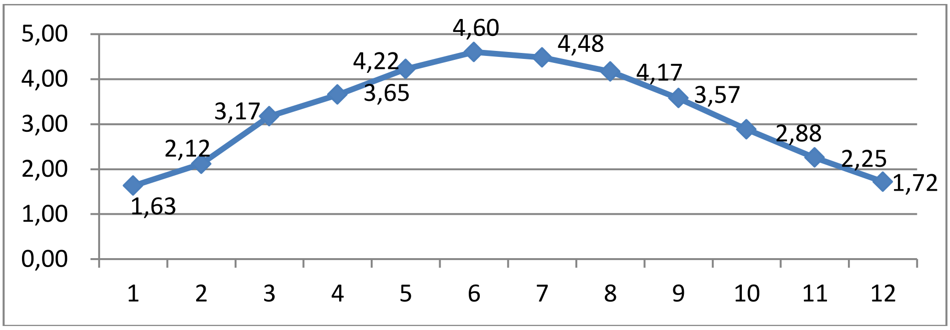
Plants use only a portion of water from precipitation, while the rest of it runs off the surface, or is drained beyond the root zone system, or evaporates from the leaf surface and doesn't even touch the soil surface. Those precipitation amounts that are available to plants represent effective precipitation. The soil usually absorbs about 80% of the total precipitation and that is - effective precipitation (Pe, mm).

The value of effective precipitation depends on the intensity of precipitation, absorption, runoff, terrain slope, soil properties, soil coverage and so on. The total amount of precipitation doesn't take into account less than 3 mm of daily rainfall, and during the summer less than 5 mm of daily rainfall. The amount of water in the soil: During the winter a certain amount of water is accumulated in the soil and is available to plants in the early growing season (early spring crops).

For the purposes of this study it was assumed that all the precipitation that reaches the ground is effective, regardless of its daily amount, because for the slightest rain to fall it needs to be cloudy, which consequently reduces insolation and air temperature at the same time. When raindrops pass through the atmosphere and evaporate, relative humidity is reduced, consequently reducing the overall soil water deficit. Based on this, for the purposes of this analysis, the amount of effective precipitation (average for the period of several years) is 645,1 mm, while during the vegetation period (IV-IX) when plants need largest quantities of water it is 363,2 mm.
Besides precipitation, **evapotranspiration** is the basic element of the water regime and soil water balance, without which one can not imagine neither implementing nor functioning of irrigation. Evapotranspiration is a complex process of water loss through atmospheric evaporation and evaporation through life processes of plants. Potential evapotranspiration is, therefore, the amount of water that may evaporate in any area. It has such an important role in the life and production processes of all kinds of plants, that any crop yield largely depends on it.

Reference potential evapotranspiration (ETo) is the basic numerical value used when assessing it. It expresses the energetic and aerodynamic pressure of the surface atmosphere above the plants, which influences the amount of water, that is, the atmospheric demand that by evaporation and transpiration through stomata a certain amount of water is delivered to it, which will in the form of water vapour saturate the air up to a maximum possible level. Hypothetically, it is equal to evaporation from the soil covered with thick grass in full growth, of uniform height of 0,12 m, an albedo of 0,23, on medium dry soil surface watered in weekly shifts *(Allen and assoc., 1998.)*. The values of the reference potential evapotranspiration for the investigated area are shown in Graph 3.

Graph 3. *Long term course of monthly values of ETo (mm/day), 1984-2014*



ETo varies in the range of 1,63 mm/day (January) to 4,60 mm/day (July). Its largest values are in June and July, when at the same time there is the biggest soil water deficit. During the vegetation period, its values are in the range of 3,65 mm/day to 4,60 mm/day.The average annual value of the reference potential evapotranspiration is 1.171,68 mm, while in the vegetation period it is 753,40 mm.

Comparing effective precipitation revenue (Pe, mm) and evapotranspiration (ETo, mm/day), expenditures it is clear that in the productive part (vegetation period April-September), precipitation is not able to provide the plant with enough water. The greatest moisture deficit occurs when water is needed most, in the so-called ' critical period ' when the sensitivity towards moisture deficit is increased, and therefore the irrigation intervention is necessary in order to increase crop yield and to establish a stable production.

However, this deficit (or surplus) regarding the climate norm, must not be equated with the irrigation norm, because this is not the same as the deficit-surplus of the soil water balance under cultivated crops, which is the basis of the irrigation regime. However, in the vegetation period soil lacks a certain amount of water which needs to be compensated by irrigation in order to achieve high and stable yields of cultivated crops *(Kljajić et al., 2012.)*.

The implementation of **irrigation** as hydro-technical and hydro-ameliorative measure in fruit production contributes to the production volume increase, improvement of fruit quality and improvement of the economic effects of investments. Depending on the conditions of production itself and on climate conditions, irrigation can increase crop yields up to 100% and in extremely dry years even up to two or three times *(Kljajic, 2012.)*

For our country, which has variable climate conditions and where precipitation varies in quantity and occurence from year to year, irrigation is an important factor to increase and stabilize agricultural production. Along with the irrigation system other objects are built which can have direct or indirect positive affect on the development of the economy and standard of living. Thus, irrigation has technical, technological, socio-economic and environmental character. Advantages of irrigation can be summarized as follows: more rational use of natural resources, especially soil; the risk of droughts is reduced or eliminated; soil-water-plant ratio is more adjusted; a high yield per unit of capacity is achieved; production is economically more efficient; higher income and a better standard of living for employees and the population is achieved, and the like (*Sredojević et al., 2006.*).

For irrigation to give its maximum effect it is necessary to pay close attention to the proper selection of technologies to be applied and to the choice of the system, all in order to bring the necessary amount of water to the plants rationally and economically. The appropriate standard of watering must be determined, and attention must be paid to the quality of water used for irrigation because of the increasing water pollution.

Watering standard *(Bosnjak, 1999.)* depends on physical properties of the soil, irrigation methods, cultivated crops and root system development (depth and breadth of the active rhizosphere). Water quality testing is required in order to determine the presence of various harmful substances especially the salt content which can significantly affect the process of soil alkalization and salinization that directly affect plants.

The questions of water efficiency did not receive the adequate attention in the Republic of Serbia up until recently, due to underdeveloped irrigation and small water consumption in the sector. With irrigation development, and the advancement of the EU joining process, the questions of rational water use and sector modernization from the technological and institutional aspect are receiving higher significance and must take an adequate place in legislation and strategic development documents in the area of water management (*Popović, Ugrenović, 2015.*).

Irrigation in Smederevo area is implemented on a total of 710 ha, from which: 563 ha of arable land, 142 ha of orchards, 4,0 ha of vineyards. Irrigation for wheat and corn silage is carried out on 197 ha, for vegetables and strawberries on 337 ha, and for other crops on arable land and fields on 29 ha. Surface irrigation method is applied on 47,1% of the land, irrigation using sprinkler system on 13% of the land, and drip irrigation method on 39,80% of the irrigated area. The main sources of water for irrigation are: 69,7% is groundwater on the farm, 4,7% is surface water on the farm, 12,8% is surface water outside the farm, 7,4% is tap water and 5,4% (*SORS, 2013a*).

Development of General irrigation project Udovički Plato is in progress and in the first phase, it will enable the irrigation of 500 ha, and by the end of the irrigation project, of 2.000 ha of agricultural land, mainly orchards. Irrigation will greatly contribute to the stabilization and growth of the crop yields (http://www.smederevo.org.rs/Print-Smederevo_1955_lat).

Land area of Smederevo

The municipality of Smederevo is an agricultural area with soil of high production capacity. It is located at an altitude of 70 -90 m, and the hills on the left bank of the river Velika Morava and the Danube are at 100 -250 m above sea level. There are three dominant soil types in the municipality of Smederevo. In the plain area, which includes the coastal area of the Velika Morava, the Danube and the Jezava, the *alluvial* soil is prevailing. In Sumadija area there is a distinctive soil type, forest soil *gajnaca*, which occupies over 90% of the area. The third soil type is *smonitsa* which extends mainly between the two previously mentioned soil types (Table 2).

Table 2. *Soil types in the municipality of Smederevo*

Number	Soil type	Area (ha)	Percentage (%)
1	Gajnjaca	16.934	40
2	Smonitsa	14.817	35
3	Alluvial	10.584	25
Total	42.335		100

Source: *Support measures program for the implementation of agriculture and RD policies in the city of Smederevo, 2015, OG of the City of Smederevo, no. 3/2015a.*

Gajnjaca *(Eutric Cambisol)* was formed on the river terraces of Velika Morava, Danube and on tertiary lake terraces. Chemical characteristics generally indicate a weak acid to acid reaction of the soil solution, with a high degree of saturation of colloidal complex with alkali cations, poor in humus and total nitrogen, with medium provision of accessible potassium, and low in phosphorus. Ameliorative measures are primarily calcification (decreasing acidity), and humification (incorporation of organic fertilizers to increase the humus content). This soil type is suitable for cultures like wheat, corn, sunflower, vegetables, fruit and grapevine.
Smonitsa (Vertisol) in Smederevo area stretch at an altitude of 100 to 140m and occupy the bording areas of the Velika Morava alluvion ie. the first terrace above the alluvial belt. Smonitsa is better than gajnjaca regarding its production characteristics and suitability for agricultural production. The reaction of the soil solution is around neutral with medium content of humus, nitrogen and potassium, but a low phosphorus content. Ameliorative measures applied in maintenance and repair of smonitsa are calcification and phosphation in order to repair pH value and phosphorus content. It is possible to have both vegetable and fruit production on this soil type.

Alluvium occurs in the deposit of the rivers Velika Morava and Danube and is the result of accumulation of fine soil material, sand and other materials. Alluvium in farmland areas of Smederevo contains 3-5% of humus which is a meddium value in humus classification. The amount of humus is sufficient to provide favourable water-air and temperature conditions for growing crops. However, it is necessary to maintain the level of humus by entering manure in an amount of 30-50 t / ha in every 4-5 years.

According to data of Republic Geodetic Authority - Real Estate Cadastre Smederevo (2015), the city of Smederevo has 30 cadastral municipalities with 42.116 ha of agricultural land, of which 39.586 ha of utilized agricultural land (fields, gardens, orchards, vineyards, meadows and pastures). The average size of holdings is 4,16 ha and average size of the parcel is 0,34 ha (*OG of the City of Smederevo, no. 3/2015b)*. According to the agricultural census (2012), 7.105 agricultural holdings have at their disposal 38.495 ha of land of which 26.560 ha of utilized agricultural land and 2.609 ha of non-utilized agricultural land (*SORS, 2013a*).

Land degradation due to intensive agricultural production, soil degradation and contamination by industrial activities and excessive use of fertilizers and pesticide, uncontrolled urban sprawl and irregularities in the privatization of agricultural enterprises, are just some of the acute problems that are

registered in the Danube region in Serbia. The City of Smederevo belongs to the Danube region's metropolitan area and carries a significant part of the problems listed (*Popović, Živanović Miljković, 2013.*).
Erosion in agricultural areas, associated with instability of terrain, could result in landslides. The biggest landslide zone of the southeast Pannonia basin is placed between Belgrade and Smederevo, and the largest landslide group covers the length of 700-800 m, width of 4,0 km and a total area of about 3,0 km^2 (*Miljković et al., 2009.*).

The canal network has been built on an area of 8.7 ha, of which is in operation at 4.5 ha, and pipe drainage at 600 ha, but it is not functional *(OG of the City of Smederevo, no. 3/2015b).* The rehabilitation and upgrading of drainage systems is of particular importance in areas with high groundwater levels (such as Godominsko polje, under the influence of Danube River slow down, caused by the construction of HPP "Đerdap").

Fruit growing and viticulture

Serbia has many natural advantages for ***fruit growing***, especially in hilly and mountainous regions where fruit production far exceeds the profitability of other crops because natural conditions are in favour of this production (*Keserović, 2004.*). A considerable interest among fruit farmers, steady government support through incentives and integration through cooperatives could translate into significant results (*Milić et al., 2011.*).

Due to its mild continental climate, the region of Smederevo has favourable conditions for growing almost all fruit species and grape vines. Fruit production in the region of Smederevo is carried out on 16,6% of the KPZ, a total of 4.412 hectares (4.234 ha of plantations and 178 hectares of extensive plantations), of which peaches on 1.961 ha, apples on 1.340 ha, plums on 333 ha, apricots on 234 ha, sour cherries on 183 ha, pears on 87 ha, while strawberry, cherry, blackberry, walnut, quince, medlar, hazelnut and almond are grown on smaller areas (*SORS, 2013.*).

The economic importance of ***viticulture*** is determined, among other things, by the circumstance that grapevine can be successfully grown in areas that are not suitable for profitable production of other crops, including a variety of light, loose, sandy or gravelly soil, brown forest soil, alluvium and diluvium, soil on mild slopes up to 240 m above sea level, and in river valleys, where there is abundance of sunlight from the water surface. In Serbia, the traditional vineyards are typically located in such terrains with good water drainage, and in most cases on soil rich in minerals that contribute to the better taste of wine (phosphorus, iron, potassium, magnesium and calcium) (*Popović et al., 2011.*).

Smederevo wine-growing region encompasses hilly terrain of the Danube basin near Smederevo and its hinterland and consists of three parts, separated by the river valleys of Ralja and Konjska reka (Official Gazette of RS, no. 45/2015). Agricultural census records vineyard holdings in Smederevo viticultural area in a total area of 381 ha (1,4% of UAA), of which only 27 ha of varieties with geographical indications, 150 ha of table varieties and 204 ha of other grape varieties (*SORS, 2013a*). The main grape variety is „*smederevka*" which has been grown there since ancient times. Besides smederevka there are other quality wines that are obtained from varieties such as Italian Riesling, Sauvignon Blanc, Semillon and Gewurztraminer. With regards to quality red varieties there are varietal wine Game and rose variety Prokupac. Although they have favorable climate and soil predispositions for the development of diversified fruit and grape production, producers from Smederevo lag behind the national average, at least when it comes to yields of apples, plums and grapes (Table 3 and Table 4).

Table 3. *City of Smederevo: Production and yields of fruits and grapes, 1997-2013*

Year	Apples		Plums		Grapevine	
	ton	kg/per tree	ton	kg/per tree	ton	kg/per vine
1997	16.350	13,6	1.054	6,4	7.955	1,2
1998	11.435	7,7	1.023	6,7	6.510	1,0
1999	18.259	11,0	572	3,5	1.944	0,3
2000	11.899	7,2	838	4,8	4.846	0,8
2001	11.807	7,0	1.284	7,2	4.188	0,7
2002	4.753	2,7	405	2,2	6.053	1,1
2003	16.483	9,3	1.281	7,1	8.395	1,4
2004	10.755	5,9	1.483	7,6	7.522	1,3
2005	12.719	7,4	1.531	7,7	3.911	0,7
2006	19.339	10,4	1.826	9,1	4.980	0,9
2007	15.548	8,1	2.269	10,9	5.170	1,0
2008	18.726	9,6	2.928	12,4	7.163	1,3
2009	20.121	9,8	4.154	16,0	5.823	1,1
2010	21.204	10,2	2.803	10,6	3.844	0,7
2011	24.187	11,3	3.916	14,9	4.222	0,8
2012	15.686	7,3	2.767	10,3	3.743	0,8
2013	26.755	13,5	4.498	15,9	4.236	1,2
Average	16.237	8,9	2.037	9,0	5.324	1,0

Source: *Statistical Office of the Republic of Serbia, Municipalities in Serbia, 1997-2014.*

Table 4. *Republic of Serbia: Production and yields of fruits and grapes, 1997-2013*

Year	Apples		Plums		Grapevine	
	ton	kg/per tree	ton	kg/per tree	ton	kg/pe r vine
1997	230.074	7,5	462.116	17,6	541.661	2,0
1998	189.491	8,1	477.537	20,5	449.587	1,7
1999	196.474	8,7	379.569	12,2	182.939	1,0
2000	197.490	13,8	351.307	8,2	326.658	0,8
2001	135.374	9,5	333.106	7,8	380.818	1,0
2002	95.584	6,6	197.486	4,7	394.811	1,0
2003	246.138	16,8	570.913	13,4	450.166	1,2
2004	183.571	12,3	561.199	13,2	424.511	1,2
2005	198.030	13,4	304.351	7,1	240.643	0,7
2006	240.320	16,4	556.227	13,3	359.454	1,1
2007	245.228	16,3	680.566	16,2	353.315	1,1
2008	235.601	15,5	606.767	14,5	372.967	1,2
2009	281.868	18,1	662.631	15,9	431.306	1,5
2010	239.945	15,1	426.846	10,4	330.070	1,1
2011	265.676	16,6	581.874	14,3	324.919	1,2
2012	178.713	10,6	391.485	9,7	263.419	1,0
2013	332.255	18,2	738.278	18,7	320.329	1,3
Average	217.167	13,1	487.192	12,8	361.622	1,2

Source: *Statistical Office of the Republic of Serbia, Municipalities in Serbia, 1997-2014.*

The average **apple** production in the period 1997-2013 amounted to 16.237 tons, or 8,9 kg per tree. The highest production was achieved in 2011 (24.187 tons) and the lowest in 2002 (4.753 tonnes). Yield per tree in the Republic during the same period amounted to 13,1 kg.

The average production of **plums** amounted to 2.037 tons, or 9,0 kg per tree (compared with 12,8 kg per tree at national level). The highest production was achieved in 2013 (4.498 tons) and the lowest in 2002 (405 tons).

As for the **grapes**, the maximum production was achieved in 2003 (8.395 tons) with 1,4 kg per vine and the lowest in 1999 (1.944 tons) with 0,3 kg per vine. The average production of grapevines in the period 1997-2013 amounted to 5.324 tons, or 1,0 kg per vine. These yields are more than twice lower than the maximum permitted yield per vine for recommended/approved varieties of grapevines in Smederevo wine-growing area *(Official Gazette of RS, no. 45/2015)*.

Measures for improvement of fruit production and viticulture

In order to achieve a higher level of product finalization, and thus raise the competitiveness on the market, it is necessary to intensify fruit production and fruit processing by using new technologies, healthy planting material, modern machinery and irrigation, as well as organized forecasting and reporting services for plant protection.

The improvement of assortment, as well as thr proper preparation of fruit for the market represent an important basis for the improvement and development of fruit production in general.

Improvement of varieties and fruit growing technology has been for many years one of the priorities in the development of agriculture in Smederevo. Agricultural Development Strategy in the city of Smederevo in the period 2008-2013 recommended the increase of the areas under orchards for about 1.000 hectares, by increasing the number of trees of: apples, from the current 5.438.400 to 6.000.000; peaches, from 982.940 to 1.500.000; plums, from 382.500 to 500.000; and sour cherries, from 345.600 to 500.000 trees.

Land consolidation, specializing in production, construction of irrigation systems, professional training of producers, strengthening producer associations and regional branding for better production and sales, are the measures to improving fruit production which should be focussed on in the future.

Priority should be given to plantations with integrated production of grapes, with reduced application of pesticides, in order to meet the strict standards of quality and safety, required by large trade chains for fruit import and to respond to the growing international demand for quality wines obtained from integrated production.

The tradition of grape growing in the city of Smederevo is almost two millennia long. When PK Godomin went bankrupt in 2005, the capacities for grape processing and wine production were lost.

Due to problems with placement of grapes, the private sector has rooted out significant areas of vineyards, primarily cultivated with „smederevka“ variety - the basic raw material for the production of wine.

Agricultural Development Strategy in the city of Smederevo in the period 2008-2013 recommended an increase of production or expansion of vineyards from 1.477 ha at the time, as recorded in the Real Estate Cadastre, to 1.700 hectares in 2013.

The real estate cadastre in 2015 records 1.824 hectares of vineyards (*OG of the City of Smederevo, no. 3/2015b*). It was also recommended to improve the varieties, primarily to renew the brand "Smederevka" by forcing its cultivation in the new plantations.

A more significant place in the new plantations should be given to varieties "Rhine Riesling", "Chardonnay", "Cabernet Sauvignon" and other recommended / approved international varieties, as well as domestic varieties and indigenous and regional varieties of quality white, rosé and red wines with geographical indications as well as for table use of grapes, regulated by the Rulebook on the Viticultural Zoning in Serbia *(OG RS, no. 45/2015)*.

Growing number of successful private wineries primarily oriented towards production of limited quantities of terroir-driven high quality and quality wines with geographical indications will in the future be the mainstay of the development of viticulture and wine production and wine routes of the Danube basin *(Popović, Živanović Miljković, 2012.)*.

Smederevo Wine Route ***Golden Hill*** includes Smederevo vineyard area of Belgrade wine-growing region, Braničevo vineyard areas of Mlava wine-growing region, and Krnjevo vineyard area of Sumadija wine-growing region *(TOS, 2011.)*.

Conclusion

Smederevo area has favourable climate conditions, physico-mechanical and moisture-air soil properties and favourable hydrologic conditions for irrigation and achieving high production yields. All of this makes the area very suitable for development of all branches of agriculture, including fruit growing and viticulture.These branches have long tradition in this area and significant export potentials.

The climate is mild continental with an average annual temperature of 10,4 ° C. On average there are 205 days during a year with mean daily temperatures of over 10 °C, which provides suitable conditions for long vegetation period for many cultures. The sum of active temperatures during this period is about 3.500 °C - sufficient for successful cultivation of grains, fruits, grapes and vegetables from the agro-technical aspect.

All soil types are generally of deep and powerful horizon, good structure and good production capacity, and may be suitable for intensive crop production. Hydrologic conditions are generally favourable for irrigation of large areas, due to the presence of large water resources and groundwater, but have been poorly utilized so far.

Some of the limitations of fruit growing are: land fragmentation, non-existing irrigation systems, inadequate assortment, lack of legislation and unwillingness to accept new ideas and technologies, such as integrated production.

A strategic approach to sustainable use of land and water resources in agriculture and the improvement of fruit growing and viticulture as well as fruit and grape processing needs to be taken, in order to achieve the required quality and safety level of export food and to ensure the development of wine tourism and overall regional development.

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