# EVALUATION OF THE COURSE OF METEOROLOGICAL PHENOMENA IN THE DECADE OF 1993–2002 IN RELATION TO VINE GROWING IN THE SOUTHERN MORAVIA (THE CZECH REPUBLIC)

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**Abstract**

**Knowledge of vine growing has been changing throughout history. Viniculture and its branches have become separate scientific fields with a wide sphere of activities. Natural conditions do not allow vine growing in the whole territory of the Czech Republic. South Moravia is almost a synonym for this agriculture branch in our country. In the macroclimatic perspective, this part of the republic is quite a large continuous area with good conditions for vine growing. It is important to know that the basic climatological characteristics of specific localities are modified by various factors (inclination of terrain, orientation of slope, land use, anthropogenic activity). That is why local climate plays such an important role and particularly with specific vineyards it is also microclimate.**

**KEY WORDS:** vine growing, active temperatures sums, local climate, South Moravia, decade 1993–2002.

## 1. INTRODUCTION

### 1.1. Main goals

This article deals with results of the diploma dissertation called "The agro-climatic conditions of vine growing in the area of South Moravia" (researched in cooperation with the Department of Geography of the Natural Science Faculty of Palacký University in Olomouc CZ). The main part of this dissertation was the actual analysis of the agro-climatic conditions in specific locations in the chosen period of time (the decade 1993–2002).

In the branches of agroclimatology, viniculture and classification of potential areas for vine growing, the following publications were published in the Czech Republic:

Bláha, J. (1948): Katastr viničních tratí, Horniak, V. (1962): Organizace vinohradnictví, Klobáska, Z. (1987): Rajonizace révy vinné, Valachovič, A. (1990): Zhodnocení agroekologických podmínek vinohradů v ČSFR.

The most important project of this branch in the Czech Republic has been "Rajonizace vinohradnictví", which was finished for all vine–growing regions in 2003 – 2004. The main goal of this project has been in a long run to eliminate vine growing in the least favourable areas and to inform all possible vine growers about land which is recommended for vine growing. This project is consequent upon the activities of the Central Control and Test Institute in Agriculture in Brno CZ which is under Act No 321/2004 Coll., on vine growing, as amended (the Viniculture Act) responsible for the supervision of viniculture in the Czech Republic.

### 1.2. The territory in question

On the territory of the Czech Republic, there are two principal vine-growing regions: the Moravian Vine Region (situated in the Morava/March River basin and the Dyje/Thaya River basin) and the Bohemian Vine Region (only small areas along the Labe/Elbe, Vltava/Moldau and Ohře/Eger rivers). This article only deals with the Moravian Vine Region. Its southern boundary is marked by the Czech/Austrian frontier line, the western boundary lies on the touching line between the Dyje/Thaya-Svratka/Schwarzawa Lowlands and the Jevišovice Downs, i.e. the line between Znojmo, Moravsky Krumlov and Ivancice. The northernmost parts of vine growing in South Moravia spread as far as the Gully of Boskovice (Boskovická brázda), the southern slopes of the Drahany Uplands and the Chriby. The eastern boundary goes along the western slopes of the White Carpathians and the Czech-Slovak frontier line.

With regard to the characteristics of the researched topic, it is possible to use biogeographic regionalization (Culek 1996) for a more exact definition of the territory. Moravian vine sub-regions are parts of specific bioregions, situated mostly in the northern *Pannonicum* subprovince. The *Pannonicum* features very warm climate with continental influences from the east and Mediterranean ones from the south. The relief of *pannonicum* is not rugged in most parts except for the northern region – i.e. Moravia. On the slopes of downs there, there are well-located areas suitable for vine growing. In the Czech Republic the north *Pannonicum* subprovince consists of these bioregions: Lechovice, Mikulov, Hustopeče and Morava/March - Svratka/Schwarzawa. On the north-east borders of the Moravian Wine Region, influences of West-Carpathian subprovince (in north-east) are perceptible. Here the climate is more continental, influenced by warm and drier *Pannonicum* climate.

After the Czech Republic joined the EU in 2004, there have been changes to the titles and number of vine regions and sub-regions ( Regulation No 324/2004 Coll.). Currently, there are: "Čechy (Bohemia)" and "Morava (Moravia)". The Moravian Vine Region is divided into four sub-regions: Mikulov, Znojmo, Velké Pavlovice and Moravian Slovakia ("Slovácko"). Vine sub-regions are then divided into smaller districts (in Czech so called: „rajón"). And the smallest unit in this division is a wine community.


Fig. 1.2.1. Vine sub-regions – The Moravian Vine Region

## 2. AGROCLIMATIC CONDITIONS OF VINE – GROWING IN SOUTH MORAVIA

### 2.1. Methods and data

For analysis two main characteristics were used: air temperature and precipitation sums. These characteristics were elaborated for selected meteorological stations in southern Moravia: Znojmo – Kuchařovice, Dyjákovice, Brno – Tuřany, Velké Pavlovice and Strážnice na Moravě.

For these stations, graphs of the course of meteorological characteristics during the decade 1993 – 2002 were created and from these basic characteristics other meteorological parameters (mainly active temperatures sums) were consequently derived.

Very important and inseparable part of the paper is the chapter called "Local air currents", which describes the most typical air-currents in the area of South Moravia affecting vine-growing. This information about air-currents was taken from Blaha (1940).

Table 2.1.1. Selected meteorological stations in South Moravia (CHMI, 2003)

| Name of station | Altitude (m) | Geographical location |
|---|---|---|
| Znojmo - Kuchařovice | 334 | 48° 52‘ 57“ N, 16° 05‘ 11“ E |
| Dyjákovice | 201 | 48° 46‘ 24“ N, 16° 17‘ 51“ E |
| Brno - Tuřany | 241 | 49° 09‘ 35“ N, 16° 41‘ 44“ E |
| Velké Pavlovice | 196 | 48° 53‘ 57“ N, 16° 49‘ 28“ E |
| Strážnice na Moravě | 176 | 48° 46‘ 24“ N, 17° 20‘ 17“ E |

## 2.2. Air temperature as determinative factor for vine growing

This chapter describes elementary air temperature characteristics in the decade 1993–2002 (active temperatures sums, average air temperature IV – IX, average monthly temperature in June, July and September).

If we count up all average daily temperatures higher than 10 °C (from the beginning of vine growing season to its end), we shall get the active temperatures sum (SAT). It is one of the main factors affecting vine growing. In our geographical location, SAT is around 2200 °C (for earliest cultivars) and about 3000 °C (for very late cultivars). However, in southern vine regions SAT is often much higher, e.g. in the Republic of South Africa 6000 °C, in the Crimea 4100 °C. In northern vine regions (including the Czech Republic) the growing season is made shorter by using early and semi-early cultivars, so under identical conditions the quality of wine is better.

Table 2.2.1. Wine cultivar classification according to the mature period (Valachovič 1990)

| Groups of wine cultivars | Necessary SAT (°C) | Examples of wine cultivars |
|---|---|---|
| early | 2 200 | Čabianska perla |
| middle – early | 2 500 | Irsai Oliver, Muškát moravský |
| middle | 2 700 | Veltínské červ. rané, Műller Thurgau, Rulandské šedé |
| middle – late | 2 800 | Pálava, Neuburské, Sauvignon, Sylvánske zel., Rulandské bílé, Rulandské modré, André, Tramín červený, Chardonnay, Modrý Portugal,Zweigeltrebe |
| late | 2 900 | Ryzlink rýnsky, Ryzlink vlašský, Veltlínské zel., Svatovavřinecké, Frankovka |
| very late | over 2 900 | Ezerjó, Furmint |

Table 2.2.2. Active temperatures sums (°C) in selected stations in South Moravia in the decade 1993–2002

| Station / Year | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 1993-2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Velké Pavlovice | 2845.1 | 3068.3 | 2843 | 2714.7 | 2785.5 | 3022.4 | 3104.4 | 3149.2 | 2784.3 | 2993.7 | 2931.06 |
| Brno - Tuřany | 2806.3 | 2995.3 | 2776.9 | 2541.7 | 2667.8 | 2885.6 | 3014.5 | 3078.7 | 2712.7 | 2936.3 | 2841.58 |
| Strážnice | 2795.7 | 2922.2 | 2719.8 | 2554.7 | 2571.9 | 2910.2 | 2898.2 | 2936.4 | 2657.1 | 2847.2 | 2781.34 |
| Kuchařovice | 2694.5 | 2870.1 | 2641.3 | 2351 | 2539.9 | 2720.8 | 2793.4 | 2900.7 | 2592.9 | 2847.7 | 2695.23 |
| Dyjákovice | 2881.8 | 3021.8 | 2869.1 | 2652.7 | 2756.1 | 2976.5 | 3019.4 | 3112.2 | 2830.9 | 2999.1 | 2911.96 |
| average | 2804.68 | 2975.54 | 2770.02 | 2562.96 | 2664.24 | 2903.1 | 2965.98 | 3035.44 | 2715.58 | 2924.8 | 2832.234 |

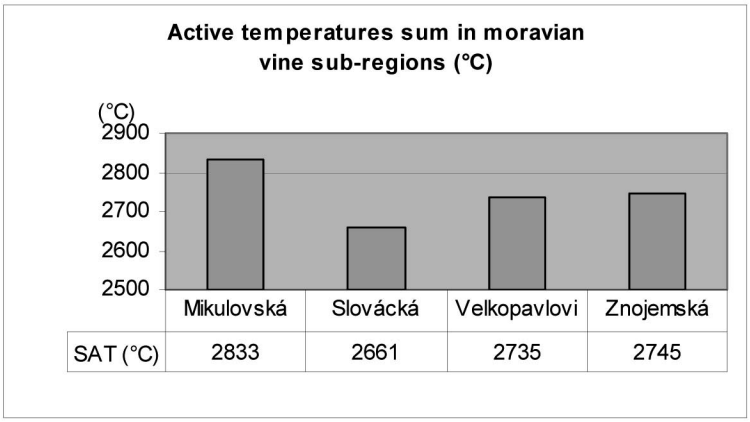



Fig. 2.2.1. Long-term SAT (°C) in moravian vine sub-regions (by Litschmann 2005)

From a long-term perspective, Moravian Slovakia (Slovácko) is the coldest sub-region (but it includes also the former vine region named „Podluží", which is classified as the warmest locality in the Czech Republic). In this paper, Strážnice is the sample meteorological station for the vine sub-region of Moravian Slovakia. In the decade in question, the highest temperatures were measured in 1994 (in that year temperatures were so high because of an extremely long hot wave – cf. Kyselý 2003) and in 2000. The average SAT figure – 2781,34 (in the decade 1993–2002) corresponds to the wine cultivars with middle period of mature and also certainly to earlier wine cultivars.

The Znojmo vine sub-region has a really good net of meteorological stations, which cover the whole territory. Each of the stations (Kuchařovice, Dyjákovice and in northern part also Brno - Tuřany) observe quite different values. The Dyjákovice station observed the highest values (which were as high as over 3000 °C – in 1994, 1999, 2000). On the other hand, Kuchařovice was the coldest meteorological station in the decade. In the coldest year of the decade (1996), SAT was only 2351 °C.

In a long-term perspective, the sub-region of Velké Pavlovice is the warmest in Moravia. This fact was confirmed in the decade researched, too (2931.06 °C on average in the decade, Table 2.2.2.). The values over 3000 °C occurred four times. In the coldest year of the decade (1996) SAT was still over 2700 °C.

Another factor affecting vine growing is average temperature during the growing season (Apr – Sept) or average monthly temperature in June, July and September.

In Table 2.2.3. we can see that the highest average air temperatures were observed in two stations – Velké Pavlovice and Dyjákovice. The lowest values were reached in the Kuchařovice station. As for long-term values, Moravian Slovakia is the coldest sub-region. The average air temperature in the growing season is only an orientational characteristic and in vine growing regions it ought not to drop under 14 °C. In the decade in question, this limit was achieved in all stations.

The average temperature of the warmest month (i.e. July – this has been proved by the research) ought not to drop under 17 °C in all vine growing regions. It is apparent that this limit was achieved in all stations in the decade in question. With some cultivars, it is possible to reach high quality wine at the temperature of 19 °C (Hubáček, Kraus 1982), if over 19 °C, the quality is excellent. In this perspective, the Dyjákovice and Velké Pavlovice stations have the best conditions.

Table 2.2.3. Average temperature (°C) during the growing season, average monthly temperature in June, July and September in the decade 1993–2002 in selected stations of South Moravia

| Station | t IV–IX | t VI | t VII | t IX |
|---|---|---|---|---|
| Brno - Tuřany | 16.3 | 18.0 | 19.9 | 14.3 |
| Dyjákovice | 16.6 | 18.4 | 20.2 | 14.5 |
| Kuchařovice | 15.6 | 17.2 | 19.3 | 13.8 |
| Velké Pavlovice | 16.7 | 18.5 | 20.2 | 14.7 |
| Strážnice | 16.0 | 17.7 | 19.4 | 14.2 |

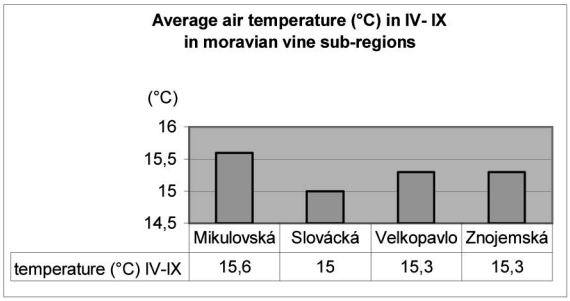



Fig. 2.2.2. Long-term average air temperature (°C) from April to September in Moravian vine sub-regions (Litschmann 2005)

## 2.3. Precipitation

Precipitation amount belongs among other agro-climatic characteristics for vine growing. Results for the season from April to September in the decade 1993–2002 are shown in Table 2.3.1.

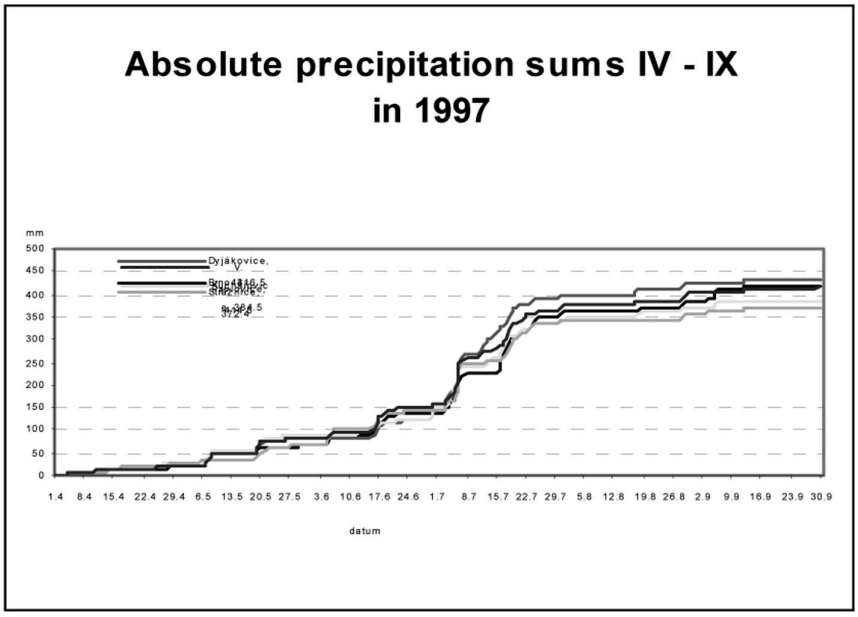
Table 2.3.1. Absolute precipitation sums (mm) in selected stations in the season Apr – Sept in 1993–2002

| Station / Year | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 1993-2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Velké Pavlovice | 285.9 | 265.4 | 466.8 | 361.3 | 414.5 | 374.0 | 334.2 | 283.5 | 389.3 | 360.6 | **353.6** |
| Brno - Tuřany | 290.0 | 310.1 | 365.2 | 354.6 | 416.5 | 383.1 | 306.8 | 245.6 | 408.5 | 344.5 | **342.5** |
| Strážnice | 244.1 | 343.1 | 344.0 | 378.9 | 372.4 | 350.9 | 327.9 | 283.4 | 353.6 | 301.9 | **330.0** |
| Kuchařovice | 295.4 | 252.4 | 429.6 | 411.4 | 384.5 | 320.8 | 356.4 | 297.2 | 314.5 | 471.9 | **353.4** |
| Dyjákovice | 312.3 | 235.4 | 434.7 | 363.8 | 431.0 | 302.1 | 364.0 | 250.2 | 333.5 | 392.7 | **342.0** |
| average | **285.5** | **281.3** | **408.1** | **374.0** | **403.8** | **346.2** | **337.9** | **272.0** | **359.9** | **374.3** | **344.3** |

In the decade in question we may notice the untypical year 1997. From the Fig. 2.3.1. it is evident that the precipitation sums were evenly placed until June and did not reach extremes. However, after that (from the first decade in July on) it rained a lot during a very short period of time. These precipitation sums were essential in terms of water supplies for flora/vegetation in that year. The raining period was short and lasted only around 14

days. It influenced the crop per hectare in that year (on average only 3.2 t/ha for the districts Brno, Brno – the town, Břeclav, Hodonín, Uherské Hradiště, Znojmo, Vyškov and Kroměříž).

On the other hand, the year 1996 was typical for even course of precipitation during the whole growing season (Fig. 2.3.1.) The crop per hectare in 1996 was the highest (6.2 t/ha) of the decade in question.



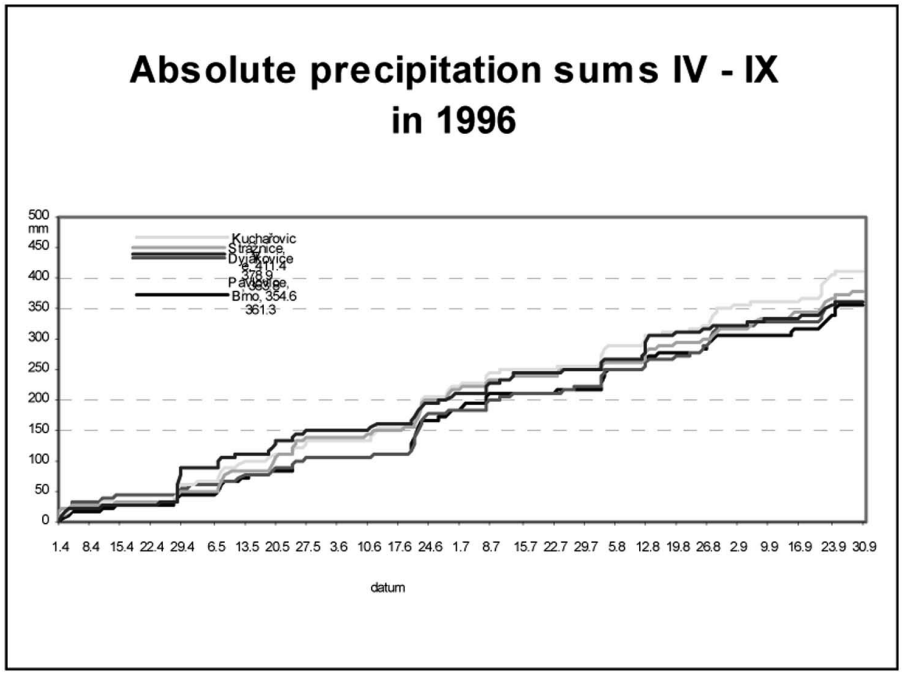



Fig. 2.3.2. Absolute precipitation sums (mm) Apr – Sept in 1997 and 1996 in selected stations of South Moravia

## 2.4. Local air currents

This chapter describes the most typical air-currents in the area of South Moravia affecting vine-growing. This information about air-currents were taken from Blaha (1940).

In South Moravia, georelief and its active surface affect vine growing in an essential way. There are two basic air-currents in South Moravia: retarding (a negative actuator for vine growing) and accelerating (a positive actuator).

The retarding air-currents have an impact on vine during the whole growing season. They make the air very cold, which may strain the sensitive organism of vine in a significant way. However their influence on vine is unstable. Among the cold air currents, the north ones prevail in South Moravia. These come through depressions to the south (mainly through the Lower Moravian Lowlands). Their impact is often a critical factor for vine growing particularly in the spring months. In South Moravia we can observe three basic cold winds: Židlochovice – Drnholec (N – S), Šakvice – Břeclav (NW – SE), Kyjov – Mutěnice – Lanžhot (along the Kyjovka and Morava/March rivers) and Polešovice – Blatnice pod Sv. Antonínkem – Strážnice – Hodonín.

The next possible negative factor may be inversion. Inversion develop mainly in the Znojmo sub-region (along the Dyje/Thaya River). Another area where inversion takes

often place is around Lednice (in the spring) and Svatobořice – Mistřín (in the spring as well).

There are two basic accelerating air-currents in South Moravia: cold and dry currents, "boreal" as Blaha called them, and relatively warm currents, labelled (not precisely) as "föhn". Boreal currents occur in the Znojmo sub-region (north and north-west course), in the areas of Podmolí – Znojmo, Suchohrdly – Tasovice, Znojmo – Konice – Popice – Havraníky – Hnanice. The "fohn" currents are typical for the area of the White Carpathians, having an impact on vine-growing in Moravian Slovakia, blowing from the south, south-east or east. As e.g. Prošek (1998) claims, those are not typical fohn because there are no conditions for their formation due to the morphology (shape) of the main ridge. The most distinct impact of fohn on vine takes place at the period of maturation. There are three basic areas in the region of South Moravia where these currents blow:
on the southern slopes of Ždánické vrchy (the Ždánice Hills), the southern foothills of Chřiby and the Bzenec Region, in the foothills of the White Carpathians (Strážnice – Blatnice) and the Hills of Dunajovice (Valtice – Sedlec – Novosedly).

## 3. CONCLUSIONS

When elaborating this paper, author has placed greatest emphasis on the behaviour of the two most important meteorological factors related to vine-growing – temperature and precipitation. The results from the decade 1993–2002 (compared with long-term values) have been crucial for evaluation and answering the question which cultivars are fit for vine-growing in the area of South Moravia. The characteristics of temperature are very different in each of the Moravian wine sub-regions. The warmest locality is Velké Pavlovice where SAT did not drop under 2700 °C in the decade reseached. The lowest values were measured in the Kuchařovice station (average SAT was 2695.23 °C in the decade). Apart from the meteorological characteristics researched herein, there are other ecological factors for vine-growing but those were not subject of this research. Therefore, the chapter called "Local air currents" is an important part of this paper. It describes the most typical air-currents in South Moravia affecting vine-growing. That information, published over 60 years ago (see Blaha J. – Mrkos J. 1940), has been very precious for the present research. The resultant air temperature characteristics values show (compared with long-term values) that there were several very warm years (1994, 1999, 2000, 2002) in the decade 1993–2002 (Table 2.2.2., Table 2.2.3.)

The results may arouse a question whether cultivar structure of our vineyards should be changed towards later cultivars, or whether the vine growing region boundaries should be pushed further to the north. This is, however, a cue for another detailed research which could prove the current trend of climatic changes in South Moravia and thus show the way for new vine planting.

## 4. SOUHRN

**Zhodnocení průběhu meteorologických prvků v dekádě 1993–2002 ve vztahu k pěstování révy vinné na jižní Moravě**

Hlavní pozornost byla věnována především dvěma zásadním klimatickým charakteristikám ve vztahu k pěstování révy vinné, teplotě vzduchu ve vegetačním období a úhrnu srážek. Získané výsledky z dekády 1993–2002 v porovnání s dlouhodobými údaji sloužily k posouzení vhodnosti pěstovaných odrůd révy vinné na jižní Moravě. Teplotní poměry jednotlivých podoblastí moravské vinařské oblasti jsou velmi rozdílné. Jako nejteplejší se ukázala lokalita Velké Pavlovice, pro kterou SAT neklesla ve zvolené dekádě pod 2700 °C. Nejnižší hodnoty vykazovala pak lokalita Kuchařovice s průměrnou hodnotou SAT 2695.23 °C ve zvolené dekádě. Naznačená analýza vhodnosti pěstování jednotlivých odrůd révy má zcela určitě význam, a to i přesto, že výběr pěstovaných odrůd závisí samozřejmě na více ekologických faktorech. Proto je vhodným doplněním uvedeného příspěvku kapitola Místní proudění vzduchu shrnující hlavní poznatky o klimatických poměrech jihomoravských vinařských oblastí. Tyto poznatky, byť publikované před více než 60 lety (viz Blaha J – Mrkos, J. 1940), jsou jistě i pro dnešní výzkum velmi cenné. Výsledné hodnoty teplotních charakteristik v dekádě 1993–2002 naznačují v porovnání s dlouhodobými údaji, že v této dekádě se vyskytlo několik velmi teplých roků (1994, 1999, 2000, 2002) a to jak podle SAT, tak dalších teplotních ukazatelů. Vzhledem k pěstování révy vinné se logicky nabízí otázka možnosti změny odrůdové skladby našich vinic směrem k pozdnějším odrůdám, resp. celkový posun hranice pěstování révy na sever. To je však již otázka k podrobnějšímu výzkumu, který by prokázal v prostoru jižní Moravy trend dlouhodobého oteplování a tím naznačil cestu pro nové uskutečňované výsadby.

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