

## CLIMATE OF THE VINEYARD ZONES AND THE ASSOCIATED VINE VARIETIES OF YUGOSLAVIA

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**Abstract:** According to general characteristics of the climate of vineyard zones in Yugoslavia in 1976, ten (10) vineyard zones were established. For better presentation of the climate conditions of the vineyard zones of Yugoslavia in this work the data of 12 representative meteorological stations for the period 1951-1995 were used. Meteorological parameters are presented in tab.1 and 2.

Taking into account the presented climate conditions in vineyard zones of Yugoslavia (Serbia and Montenegro), one can conclude that suitable temperature and another climate conditions exist for vine varieties growing from earliest to the late period of maturing.

**Key words:** vine, climate conditions of the vineyard districts, wine varieties.

### Introduction

According to general characteristics of the climate of vineyard zones in Yugoslavia, 10 vineyard zones with a certain number of subzones and vineyard districts were defined. In Serbia 9 zones were defined and in Montenegro only one zone was formed.

During the zoning in 1976, wine varieties, table varieties and rootstocks were recommended.

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## Materials and Methods

To better present the climate conditions of the vineyard zones of Yugoslavia in this work, the data of 12 representative meteorological stations for the period 1951-1955 were used (Tab. 1).

Tab. 1. - Mean air temperatures and precipitation in the vineyard areas of Yugoslavia

Numb.	Meteorological stations	$\varphi$ [°N]	H m	Mean air temperatures [°C]			Precipitation [mm]		
				I-XII	IV-X	IV-IX	I-XII	IV-X	IV-IX
							(1951-1995)		
1	Palić	46°06'	102	10.8	16.8	17.7	553	356	323
2	Vršac	45°09'	83	11.5	17.2	18.0	655	432	393
3	Šabac	44°46'	80	11.1	16.8	17.7	678	423	378
4	Beograd	44°45'	126	10.8	16.5	17.4	667	421	475
5	Negotin	44°14'	42	11.2	17.4	18.4	654	371	319
6	Čuprija	43°56'	123	10.8	16.5	17.4	651	412	371
7	Kruševac	43°34'	166	10.9	16.6	17.5	657	419	76
8	Niš	43°20'	202	11.5	17.3	18.2	585	351	311
9	Leskovac	42°59'	230	10.9	16.6	17.6	600	357	316
10	Vranje	42°33'	433	10.8	16.5	17.3	641	397	347
11	Prizren	42°13'	402	11.9	17.7	18.6	750	403	343
12	Podgorica	42°26'	42	15.6	21.1	21.6	1592	662	460

The climate indexes by Winkler, Huglin, Rio were used as well as the minimum night air temperature in September (Tab. 2).

In tab. 2 are presented data concerning Winkler index, rainless index (IS), Huglin heliothermic index (IH) and night fresh index (IF).

Tab. 2. - Climate indexes of 12 vineyard climate regions in Yugoslavia according Winkler, IS, IH and IF

Meteorological stations	Index after Winkler	Index of dryens IS	Heliothermal index		Index of night freshness IF			
			IH	IH				
(1951-1995)								
A. Serbia								
1 Subotica (Yusu)	1449	II-B	37	IS-1	2030	IH-3	11.1	IF-4
2 Vršac (Yuvš)	1525	II-B	93	IS-0	2090	IH-3	11.5	IF-4
3 Šabac (Yuša)	1458	II-B	148	IS-0	2107	IH-4	10.9	IF-4
4 Beograd (Yubg)	1394	II-B	104	IS-0	2012	IH-3	10.8	IF-4
5 Negotin (Yung)	1577	II-B	- 11	IS-1	2215	IH-4	11.2	IF-4
6 Čuprija (Yuću)	1403	II-B	121	IS-0	2045	IH-3	10.0	IF-4
7 Kruševac (Yukš)	1421	II-B	145	IS-0	2057	IH-3	10.3	IF-4
8 Niš (Yuni)	1559	II-B	- 49	IS-1	2031	IH-4	11.3	IF-4
9 Leskovac (Yule)	1406	II-B	105	IS-0	2132	IH-4	9.8	IF-4
10 Vranje (Yuvr)	1390	II-B	31	IS-1	1994	IH-3	10.5	IF-4
11 Prizren (Yupz)	1654	II-B	- 62	IS-1	2196	IH-4	12.1	IF-3
B. Montenegro								
12 Podgorica (Yupg)	2382	V-C-3	-	IS-2	2568	IH-5	19.2	IF-1

All values were determined by author's methodology, except IS value. In calculating IS value we had not values of Wo (water content in soil during the

determined period), so we took the value:  $W_0=200$  mm. Values TV and ES were taken from the data in meteorological stations concerning humidity shortage. For this index we obtained approximate but logical values. For all other indexes we used suitable data and calculation has been performed by authors' formulas.

## Results and Discussion

### Climate characteristics of the vineyard zones of Yugoslavia

The climate conditions of the investigated zones showed that all vineyard zones of Serbia belong to the continental vineyard area which is characterised by middle-continental climate and in some areas with the elements of hilly-mountain climate. Vineyards are mostly in hilly areas on the south exposition whose height above sea level varies from 80 to 550 m.

On the basis of the sum of effective temperatures and Winkler classification of vineyard zones, one can say that all vineyards' zones in Serbia belong to zone II according to Winkler i.e. to zone „B” according to EEC (EU). The vineyard region of Montenegro belongs to zone V i.e. to C-3.

Values IS indicate that in vineyard zones of Yugoslavia the existing climate classes are as follows:

The regions of Serbia, number: 2, 3, 4, 5, 7 and 9 are dominated by climate class IS-O-sub humid climate.

The regions of Serbia, number: 1, 5, 8, 9 and 11 are dominated by climate class IS-1 i.e. with presence of mild rainless, climate.

The vineyard region of Montenegro, number 12 is dominated by climate class IS-2 i.e. with strong rainless presence; vineyard irrigation is necessary in order to have regular and stable grape yield.

On the basis of heliothermic index IH (by Huglin), the climate of vineyard regions can be classified as follows:

In vineyard regions of Serbia, number: 1, 2, 4, 6, 7 and 10, the values of IH indexes from 1994 to 2094 place them into IH-3 „TEMPERE” climate class. In other regions, number: 3, 5, 8, 9 and 11, IH ranges from 2196 to 3210, which means IH-4 climate class, „tempere choud” i.e. temperate warm climate.

In the vineyard region of Montenegro number 12, IH is 2568, which means IH-5 class „choud” climate i.e. torrid- very hot climate.

On the basis of mean minimum temperatures in September, the IF values were calculated. Night moisture indexes have variations in Serbia from 9.8 to 12,1 C°. It means that in all vineyard areas IF-4 climate class dominates, when nights are very cool. Only in the Prizren district, IF-3 is 12,1, which means that nights are between the classes of very cool and cool.

In the Montenegro vineyard region, mean minimum temperatures in September are 19.2 C° and that means: the IF-1 class of climate with hot nights.

### List of associated vine varieties

Taking into account the presented climate conditions in vineyard zones of Serbia and Montenegro, it can be concluded that suitable temperature and other climate conditions exist for the growing of wine varieties from the earliest to the late period of maturing.

Suitable conditions for the quality of grape and wine are provided for the following associated famous international varieties:

a) Red wines: Burgundy black, Gamay black, Cabernet Sauvignon, Cabernet Franc, Merlot, Franconien, etc.

b) White wines: Burgunday white, Semillon, Sauvignon white, Chardonnay, Riesling italien; Riesling white, Müller Thurgau, Sylvaner green, Mouscat Frontignan, Mouscat ottonel, Traminer rose, Rkatziteli, etc.

Of the famous autochthonous varieties, suitable conditions for the table, quality and high quality wine are provided for the associated following varieties:

a) Red wines: Vranatz, Prokupaty, Skadarka, and new created Yugoslav varieties.

b) White wines: Žilavka, Bagrina rose, Smederevka, Plovdina, Kreatza and newly created Yugoslav varieties.

### Conclusion

Taking into account the general characteristics of climate of vineyard zones in 1976, 10 vineyards zones were established.

For the better presentation of climate conditions in vineyard zones of Yugoslavia, the data from 12 representative meteorological stations, for the period 1951-1995, were used.

By analyzing the presented climate conditions in vineyard zones of Yugoslavia (Serbia and Montenegro), it can be concluded that temperature and other conditions are suitable for the growing of international and autochthonous wine varieties of all maturing periods.

The list of identical varieties shows that in Yugoslavia a significant number of international and autochthonous varieties are raised in order to produce different quality categories of red and white wines.

By analyzing climate characteristics in vineyard zones of Yugoslavia, it can be noticed that conditions are suitable for the growing of most important wine varieties, and that zones can be compared not only with the vineyard conditions in neighboring countries (Bulgaria, Rumania, Hungary, Croatia), but with other famous vineyard zones in France, Italy, etc.

## REFERENCES

1. Avramov, L., Nakalamić, A., Cindrić, P., Kovač, V., Vuksanović, P. (1998): Zoning of Viticulture in Yugoslavia. *Territorio e Vino. Simposio Internazionale, Siena, Italia.*
2. Avramov, L. (1999): State and applied method of zoning in Viticulture in Yugoslavia. Grouped Experts, OIV., „Zonage Vitivinicole“, 8<sup>th</sup> March, Paris.
3. Boubals, D. (1999): L'Adaptation des cépages internationaux ou universels. Groupe d'Experts, OIV., „Zonage vitivinicole“, 8<sup>th</sup> Mardi, Paris.
4. Borsiquot, J. M. (1999): Adaptation des cépages internationaux: Chardonnay, Syrah, Merlot et Cabernet Sauvignon. Groupe d'Experts, OIV., „Zonage vitivinicole“, 8<sup>th</sup> Mardi, Paris.
5. Carboneau, A. (1999): Adaptation des cépages internationaux: Chardonnay, Merlot, Cabernet Sauvignon. Groupe d'Experts, OIV., „Zonage vitivinicole“, 8<sup>th</sup> Mardi, Paris.
6. Fregoni, M., Zamboni, M., Venturi, A. (1999): Le zonage en deux zones viticoles de l'Emilia-Romagna. Groupe d'Experts, OIV., „Zonage vitivinicole“, 8<sup>th</sup> March, Paris.
7. Huglin, P. (1978): Nouveau mode d'évaluation des possibilités héliothermiques d'un milieu viticole. In. *Symposium international sur l'écologie de la vigne*, 1, 1978. p. 89-98, Constanca.
8. Kolektiv autora (1976, 1977): Rejonizacija vinogradarstva Srbije, Vojvodine, Kosova i Metohije i Crne Gore.
9. Meredith, C. (1999): Area planted to international varieties in California. OIV Viticultural Zoning Group. 8<sup>th</sup> March, Paris.
10. Riou, C., Morlat, R., Asselin, C. (1995): Une approche intégrée des terroirs viticole: discussions sur les critères de caractérisation accessibles. *Bulletin d' O.I.V.*, 767-768, p. 93-106. Paris.
11. Tonietto, J., Caronneau, A. (1998): Macroclimat viticole et groupes climatiques de la vitiviniculture mondiale. In. *Symposio internazionale territorio e vino, Siena*, p. 71. (abstract degli interventi). Siena.
12. Tonietto, J. (1999): Les macroclimats viticoles mondiaux et l'influence du mésoclimat sur la typicité de la Syrah et du Muscat de Hambourg dans le sud de la France: méthodologie de caractérisation. Montpellier. Ecole Nationale Supérieure de Agronomie - ENSA-M 233 p. (These Doctorat).
13. Tonietto, J., Carboneau, A. (2000): Le climat mondial de la viticulture et la liste des cépages associés. Office International de la Vigne et du vin. Groupe d'experts „Zonage vitivinicole“, 6 mars 2000., Paris.
14. Winkler, A. J. (1962): *General Viticulture*, 633 p., Berkly and Los Angeles. California.

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## KLIMA VINOGRADARSKIH PODRUČJA SR JUGOSLAVIJE I LISTA PODUDARNIH SORTI VINOVE LOZE

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### Rezime

U cilju uporednih ispitivanja opštih karakteristika klime najznačajnijih vinogradarskih područja u svetu, Medjunarodni ured za vinovu lozu i vino (O.I.V. - Paris) je preporučio da se za karakterizaciju vinogradarske klime (parcele jednog vinograda, lokaliteta ili vinogradarskog regiona) koriste pored osnovnih meteoroloških podataka i sledeći klimatski indeksi koji obuhvataju 2 ili više meteoroloških činilaca:

- IW, indeks Vinklera (Winkler, 1962)
- IH, heliotermički indeks Iglena (Huglen, 1978)
- IS, indeks suše (Riou et al. 1994)
- IF, indeks svežine noći u periodu sazrevanja grožđa (Tonnetto, 1999)

U ovom radu su prikazani podaci 12 reprezentativnih meteoroloških stanica u Jugoslaviji (1951-1995. god.) na osnovu kojih se može izvršiti karakterizacija klime u najznačajnijim vinogradarskim područjima naše zemlje (tab. 1 i 2). U radu je data i lista podudarnih - adaptivnih vinskih sorti za čije gajenje postoje povoljni uslovi u vinogradarskim područjima Srbije i Crne Gore.

U vinogradarskim područjima Srbije (tab. 1) srednja godišnja temperatura vazduha varira od 10.8 do 11.9 °C, a srednja vegetaciona 16.5 do 17.7 °C. Godišnja suma padavina iznosi 553-750 mm, a u periodu vegetacije padne 351-451 mm. U vinogradarskoj zoni Crne Gore srednja godišnja temperatura iznosi 15.6 °C, a srednja vegetaciona 21.1 °C. Godišnja suma padavina iznosi 1592 mm, a za period vegetacije 662 mm.

Prema vrednostima indeksa po Vinkleru sva vinogradarska područja Srbije pripadaju klimatskoj zoni II, odnosno zoni B po EU. Suma efektivnih temperatura varira od 1390 °C u Vranju, do 1577 °C u Negotinu. U Crnoj Gori, suma efektivnih temperatura iznosi 2382 °C, što ovo vinogradarsko područje svrstava u zonu V po Vinkleru, odnosno, C-3 po EU.

Na osnovu heliotermičkog indeksa (IH po Huglenu) klima vinogradarskih područja naše zemlje se može okarakterisati na sledeći način:

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- U vinogradarskim područjima Srbije oko Subotice, Vršca, Beograda, Čuprije, Kruševca i Vranja vlada umerena klima ( $IH_3 = 1994$  do  $2090$ ), a u područjima oko Šapca, Negotina, Niša, Leskovca i Prizrena vlada umereno - topla klima ( $IH_4 = 2100 - 2196$ ).

- U području Podgorice vlada topla klima ( $IH_5 = 2568$ ).

Na osnovu vrednosti Indeksa suše (IS po Riou) proizilazi da u našim vinogradarskim područjima vladaju sledeće klase klima:

- U području oko Vršca, Šapca, Beograda, Čuprije, Kruševca i Leskovca vlada subhumidna klima ( $IS_0$  ukazuje da u zemljištu ima od 50 do 150 mm pristupačne vlage više nego što je neophodno za vinovu lozu), pa nema izražene suše. Navodnjavanje vinograda nije potrebno.

- U područjima oko Subotice, Negotina, Niša, Leskovca i Prizrena vlada klasa klime  $IS_1$ , umereno suva klima, sa viškom vode u zemljištu 50 mm, odnosno sa manjkom pristupačne vlage u zemljištu do 100 mm. Navodnjavanje vinograda je korisno.

- U području Podgorice vlada klasa klime  $IS_2$ , u kojoj se javlja suša sa manjkom pristupačne vode u zemljištu između 100 i 200 mm, pa je neophodno redovno navodnjavanje vinograda.

Na osnovu indeksa svežine noći (IF), koji reprezentuje srednje minimalne temperature vazduha u septembru, proizilazi da vrednosti IF variraju od  $9.8-12.1^{\circ}C$ . To znači, da u svim vinogradarskim područjima Srbije vlada klasa klime  $IF_4$ , u kojoj su noći veoma sveže, što pogoduje dobrom sazrevanju grožđa, nagomilavanju dovoljnih količina bojnih i aromatičnih materija u grožđu. Samo u području Prizrena,  $IF_3 = 12.1$ , što znači da su noći između klase „veoma svežih” i „svežih”, koje pogoduju veoma dobrom sazrevanju grožđa. U vinogradarskom području oko Podgorice,  $IF_1 = 19.2$ , što znači da su u periodu sazrevanja grožđa noći tople, iznad neophodnih temperatura za sazrevanje grožđa većine gajenih sorti vinove loze.

Na osnovu klimatskih uslova u vinogradarskim područjima Srbije i Crne Gore, daje se sortna lista internacionalnih i autohtonih vinskih sorti, koje su rejonirane i zauzimaju najznačajnije mesto u vinogradarstvu naše zemlje.

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