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OLIVE GROWING IN SLOVENIAN ISTRIA AND CLIMATIC LIMITATIONS TO ITS DEVELOPMENT

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Abstract:

In Slovenian Istria, olive trees grow at the northern climatic limit to this culture, so they are periodically endangered by severe frosts. In the 20th century, the average recurrent period of olive frosts was 20 years, and in the 18th century, which is considered to have been colder, it was 10-15 years. In spite of the risk of periodic frosts, olive growing in Slovenian Istria is an important and profitable economic activity, which is in steady progress, thanks to an ever greater demand for olive oil in the last few decades. An analysis of topoclimatic conditions for olive tree has shown that, within the existing area of olive tree growing, the capacities are sufficient at least to double the present-day olive groves. However, spreading the area beyond the borders of the traditional one could be questionable despite the forecasted warming of climate, since the same prognoses also forecast a greater possibility of weather disasters, including frosts.

Key words:

olive growing, topoclimate, frost, Slovenian Istria, Slovenia

KLIMATSKA OGRANIČENJA U MASLINARSTVU I NJEGOVU RAZVOJU U SLOVENSKOJ ISTRI

Izvadak:

U slovenskoj Istri maslina uspijeva na svojoj sjevernoj klimatskoj granici rasta, pa je povremeno ugrožena oštrim mrazom. U 20. stoljeću je prosječno povratno razdoblje smrzavanja maslina u maslinicima iznosilo 20 godina, a u 18. stoljeću, koje je bilo hladnije, masline su bile izložene smrzavanju svakih 10 do 15 godina. Usprkos riziku od mrazne štete, maslinarstvo je u slovenskoj Istri važna i isplativa gospodarska djelatnost koja je u stalnom razvoju, zahvaljujući sve većoj poražnji proteklih nekoliko desetljeća. Raščlamba topoklimatskih uvjeta za maslinarstvo pokazala je da je moguće barem udvostručiti sadašnje površine pod maslinama u slovenskoj Istri. Međutim, širenje masline izvan tradicionalnih područja uzgoja moglo bi biti upitno usprkos prognoziranom zatopljenju klime, s obzirom da iste prognoze predviđaju veću

mogućnost pojave vremenskih nepogoda, uključujući i oštar mraz.
Ključne riječi:
maslinarstvo, topoklimatski uvjeti, mraz, slovenska Istra, Slovenija

1. INTRODUCTION

Plantations of olive trees in the southwest part of Slovenia, in the littoral belt of the Gulf of Trieste as well as smaller plantations of this culture in the Goriška Brda and the Vipavska dolina valley and some growing areas in north Italy (the Treviso region, North-Italian lakes) fall within the northernmost areas up to which olive trees can still be grown and their growing is still profitable. The quality of olive oil at the northern climatic border is better so its market value is also greater. The disadvantage of these locations, however, is a greater threat of frost because of the advances of cold air. If frosts are too frequent, the growing of olives can become nonprofitable, due to high costs of the revitalization of plantations and the loss of income. A possible abandoning of olive growing or its decline, which already occurred after frosts in the past, would not only result in negative economic effects but would also cause great damage to the conservation of cultural landscape. A rather large percentage of agrarian areas that were restored and cultivated in the past two decades of intensive revitalization of olive groves would certainly be overgrown again, because this land is less suitable for other agrarian cultures and because vocational and social structure of olive growers is rather specific, since olive growing is only a supplementary activity for the majority of them.

During the recent few decades, particularly after 1980, olive growing in Slovenian Istria has undergone a rapid progress. Olive groves cover nearly 1200 hectares, more than 300.000 olive trees in total grow there, and the annual harvest is from 2000 to 2200 mt of olives, out of which about 400 mt of oil is pressed. Because of the increasing demand on the Slovenian market for qualitative home-produced olive oil (the current production meets less than a half of the demand), intensive spread of olive trees – further 30 to 50 hectares are planted with olives each year – and a gradual comeback of olive tree to the areas where it had already grown in the past but frosts "pushed" it towards the sea, a question occurs of what the general geo-ecological possibilities of its further spread are and, particularly, what limits the climate sets on it.

2. THE STATE OF OLIVE GROWING IN SLOVENIAN ISTRIA

In Slovenia, olive trees are grown in the area of about 1200 hectares of which 10 hectares, approximately, are located in the Goriška Brda and the lower section of the Vipavska dolina valley, where olive tree has gradually returned after the frost of 1929, and the rest of these hectares are located in Slovenian Istria. Olive as a typical Mediterranean culture does not grow in the whole of Slovenian Istria but only in its

coastal belt and on the hills up to the height of 250 m, rarely even to 300 m. Neither does it grow on the alluvium of streams because of the unsuitable soil and climate conditions (occurrence of temperature inversion). It reaches into the hinterland only to the sunny slopes along the streams of the Rižana, Osapska reka, Badaševica, Drnica, Dragonja and Rokava. Most of the olive groves occur in the western, slightly lower part of Slovenian Istria, west of Škofije–Marezige–Koštabona line. According to the statistical data of the 1991 Census, nearly 75% of all olive trees grew in the local communities of this area, with urban local communities not included, and more than 20% of them in the local communities of Lucija and Šmarje.

Olive growing in Istria gained importance in the time of the Roman Rule. It was in full swing in the period of the Venetian Republic, which systematically fostered this culture to satisfy the needs of its own market. A rather great number of olive trees grew also in the initial period of the Austrian Rule over Istria, when a law was put in force of compulsory planting of a certain number of olive trees for each of the new weds. In this way, the number of olive trees remained in proportion with the growth of the population (RAZVOJ PRIDELOVANJA..., 1985).

The development of viniculture in the second half of the 19th cent. marked the beginning of the decline of olive growing. The frost of 1929 was a serious shock to it because the number of trees dropped from

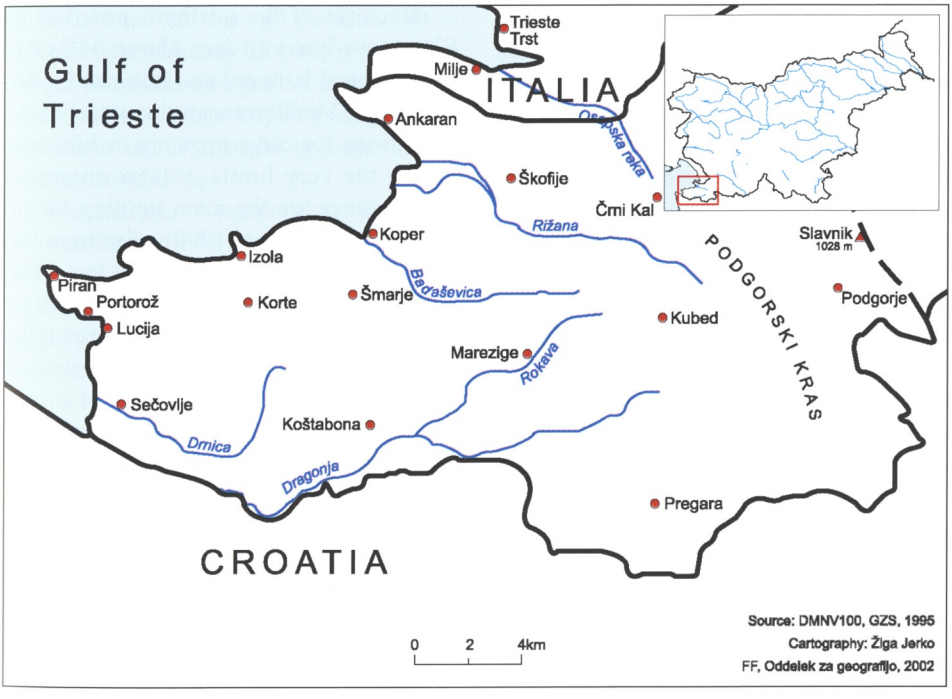

Fig. 1: Geographical position of the area discussed
Sl. 1: Geografski položaj istraživanog područja

300.000 to 120.000. Political and social changes after the 2nd World War, and the resulting partial changes in the population as well as intense abandoning of agrarian activities and depopulation in the hinterlands of Slovenian Istria caused the decline in the number of olive trees down to 50.000 – 60.000. In addition, olives were heavily affected by the frost of 1956. In the 1980s, a revitalization of olive groves began but was partly impeded by the frost of 1985. In spite of this, the number of olive trees increased to about 126.000 by 1990, of which 90.000 grew in extensive and 36.000 in intensive groves (Vesel, Sedmak, 1990). A slight impeding in the development was also caused by the latest frost, in 1996, which mainly affected young trees (Ogrin, 1997), but it did not stop the spreading trend, so that the olive with more than 300.000 trees has already reached the fourth place in Slovenia, following the apple, peach and pear.

Olive groves in Slovenian Istria are private. Individual owners have smaller areas only (from 0,2 to 3 hectares). Even greater complexes with olive trees are but smaller; the largest one covers about 14 hectares. In the new plantations the autochtonous sort called Istrska belica prevails (50 – 70%). It yields abundant harvest and is rich in oil and rather well resistant to frost. To obtain a better harmony of olive oil, several sorts are required, so also leccino is planted (20 – 30%), and other sorts too grow in older groves, e.g. pendolino, frantoio, moraiolo, štorta, buga, črnica, drobnica, mata, etc. (Vesel, 1996).

3. CLIMATIC SUITABILITY OF SLOVENIAN ISTRIA FOR OLIVE GROWING

Olive groves in Europe occur in the littoral zone of the Mediterranean and its adjacent seas; they are mainly located between 30 and 35° of N geographical latitude. They grow most fruitfully in the Mediterranean climate, with mild winters and not too hot summers. Dangerous for olives is winter when air temperature drops below -8°C. Olive tree is a xerophyte, well adapted to droughts. It also grows in the areas with 300–500 mm of annual precipitation; for average harvest, the minimum of 130 mm of precipitation must fall from February to May, and 50–70 mm from July to September. A greater amount of precipitation (over 1000 mm) is not harmful to it provided that the ground is sufficiently permeable. As to soil conditions, it is not demanding at all. It grows in dry, sandy and stony grounds which must be permeable and contain enough Calcium (Sancin, 1990).

Because of the northern position of Slovenian Istria (it lies above 45° of N geographical latitude) and mitigated influence of the Mediterranean climate, climatic conditions for olive growing in Slovenia are on the very limits. Winter minimum temperatures are the main limiting factor. According to Sancin (1990), olive trees can even stand the temperatures of -13 to -15°C during winter dormancy; this depends on air humidity, sort of olive, nutrition level of the plant, its age, etc. The longer the duration of cold and the greater the humidity of air, the sooner the frost occurs. It is easer for olives to endure shorter spells of cold, dry weather with temperatures from -13 to -15°C than longer spells of cooling with temperatures from -5 to -8°C but with great air humidity. Sensitivity to cold is considerably greater with young plants.

The threat of damagae caused by cold is greater when the vegetation season has already begun or still lasts. In such a case, even the temperatures of -2 to -3°C can be

destructive. Particularly dangerous is a fast and intense cooling after an early spring warming when the assimilation processes in plants have already begun. In general, damage first occurs on leaves and twigs at -8°C, on thicker branches and the trunk at -10 to -12°C. If cold lasts longer, the trunk freezes at -14 to -16°C. But even at such low temperatures, the roots never get damaged so that in spring new olive sprouts again from them (SANCIN, 1990).

In general, temperatures in Slovenian Istria drop from the coast towards the higher altitudes of the inland, therefore a greater danger of frost for olive trees occurs in the inland area. Along the coast, the average January temperature is around 4°C and in the higher inland areas between 2 and 4°C. The average minimum January temperatures in the coastal belt are still positive, but in the inland they already drop below 0°C. The danger of frost is also greater at the bottom of the valleys where explicit temperature inversions occur at night in anticyclonic weather conditions.

The analysis of temperature data from two weather stations, one at Portorož (92 m) by the sea and another in the inland of Slovenian Istria, at Kubed (262 m), up to which height olives still grow, showed that during the frost of January and February of 1985 two days only had the minimum temperature below -8°C at Portorož, whereas there were as many as 11 such days at Kubed. While temperatures at Portorož did not drop below -10°C, there were six such days at Kubed. The absolute minimum temperature during this frost was -9,3°C at Portorož, on 8 January 1985, and that same day the temperature at Kubed dropped to - 16°C. It was so cold at Kubed because of its position in the valley system, where temperature inversion developed. Comparison with the latest frost of 1996 is not possible because no weather station has operated in the inland since 1991.

According to the data of the 1961-90 period, the probability of cold days (minimum temperature below 0°C) and very cold days (minimum temperature below -10°C) differs greatly in the coastal zone and in the higher inland. On average, there is not a single very cold day by the sea in 30 years, but there is at least one in the inland. On average, 8 cold days occur annually in the coastal belt and about 30 in the inland. There is a great possibility in the inland of temperature dropping below -8°C, when first damages of olives occur. On the average, such temperatures occur every second year, while in the coastal belt, once in 15 years, which is within tolerable (current) limits of profitable olive growing.

Tab. 1: Temperature tresholds for olive damages and their occurence in Slovenian Istria in the 1961-90 reference period

Tab. 1: Temperaturni pragovi za mrazne štete na maslini i njihova pojava u slovenskoj Istri u standardnom razdoblju 1961.-1990.

Temperature	Type of damage	No. of days with specified temp. in 30 years	
		Portorož (92 m)	Kubed (262 m)
> -6 0C	Undamaged	8	30
-7 to -9°C	Damaged leaves and young sprouts	2	15
< -10°C	Damaged twigs	0	2
< -15°C	Frosted main branches and trunk	0	1
> +40/50°C	Fertility ceases	0	0

However, a question is posed, of what the issue will be in the future when the production of oil will increase, due to the spread of olive groves and ever richer fertility of the nowadays young plantations, and its price will most probably drop also because of an ever greater import. The danger of frost can be slightly reduced by a proper, carefully chosen microlocation of plantation (sunny position in the lee from bora in the thermal belt) and a proper selection of sorts.

Other climatic elements, except for bora which can break branches and contribute to temperature drop, do not impede olive growing. On average, it happens once in 30 years (theoretically) that olive trees suffer drought in summer months, when the quantity of precipitation does not exceed 50 to 70 mm, which is the lowest limit for sufficient fertility. Young trees are more sensitive to drought because their root system has not been completely developed, therefore, during the first few years, they need watering in summer if more severe droughts occur.

3.1. Frosts of olives in the past

Frost of olives in the Trieste Gulf is a recurrent phenomenon which must be taken into account in this economic branch. According to the chronicle of exceptional weather phenomena composed by Braun (1935) for Trieste, Istria and east Friuli in the period after the 7th cent. and supplemented with additional sources by Ogrin (1994, 1995), there are 20 records which directly report on frosts of olives, including the frosts in the 20th cent. (Table 2). In the last 300 years, there were 16 such cases, which means one per 18 years on average.

Frosts were most frequent in the 18th cent. (seven; one per 14 years), particularly in its second half. Together with the frosts in the first half of the 19th cent. they belong to the end of the so-called "little ice age", i.e. a rather cold period which began in Europe in the mid-15th cent. and had several cold climaxes, one of them at the end of this period.

According to the analogy with the second half of the 19th cent. and the 20th cent., for which concurrent climatic measurements and descriptions of effects of low winter temperatures are available, it can be presumed that frosts of olives were even more frequent in the past. It is highly likely that olives froze, partly at least, also in the years when chronicle writers reported ice in Venetian lagunas, at the mouth of the Isonzo river or by the coast of the Trieste Gulf.

Tab. 2: Frosts of olives in Slovenian Istria in the past
Tab. 2: Smrzavanje maslina u slovenskoj Istri u prošlosti

Century	No. of frosts	Year of frost	Recurrence period
15th	1	1441	
16th	0		
17th	2	1684, 1685	
18th	7	1704, 1709, 1738, 1763, 1782, 1789, 1795	15 years
19th	4	1820, 1829, 1847, 1885	25 years
20th	5	1901, 1929, 1956, 1985, 1996	20 years
15th-20th	19		30 years

Tab. 3: Frost damaged olives in Slovenian Istria in the 20th century
Tab. 3: Smrzavanje maslina u maslinicima u slovenskoj Istri u 20. stoljeću

Frost	Absolute minimum temperature		Damage
1929	Trieste (Feb. 11)	-14.3°C	90% of trees destroyed.
1956	Kubed (Feb. 10) Kubed (Feb. 16)	-12.8°C -14.6°C	30% of trees frosted to the ground. Revitalization prevented by frost.
1985	Portorož (Jan. 8) Kubed (Jan. 8)	-9.3°C -16.0°C	60% of trees damaged. Harvest reduced by 80%.
1996	Portorož (Dec. 29) Korte (Dec. 29)	-8.5°C -10.0°C	Nearly completely damaged one-year plantations.

Taking account of this possibility, the recurrence period of frost in the past 300 years shortens to 14 years, and even to 9 years in the 18th cent.

The 20th cent. is believed to be a rather warm period in the history of climatic conditions, with a gradual rise of temperatures, the winter ones in particular. There were five major frosts of olives (Table 3) in this century, the latest one of 1996 included. Their recurrence period was 20 years on average.

4. GENERAL TOPOCLIMATIC CONDITIONS FOR THE DEVELOPMENT OF OLIVE GROWING IN SLOVENIAN ISTRIA

The intensive spread of olive groves in Slovenian Istria in the past decade and great demand for olive oil pose a question about the possibility of further spread of this branch. It depends on a number of factors, e.g. the social and economic ones, the owners structure, etc., and among the physicogeographical factors there are also the limitations that are set within the general climatic conditions by the so-called topoclimatic conditions. These primarily depend on the characteristics of landforms, mainly the altitude structure, concave landforms, inclination and exposure of surface.

Height in Slovenian Istria is an important topoclimatic factor in olive growing because temperatures drop with the increasing altitude. Temperatures in the coastal belt are by 2 to 3°C higher than on the flysch hills and by about 4°C higher than on the 400-500 m high Podgorski Kras plateau. The uppermost limit for olive growing, established during several centuries of tradition of olive growing in Slovenian Istria, is at about 250 m. The majority of olive groves lie up to this height, while a smaller percentage of them also occur in favourable microlocations up to the height of 350 m.

Exposure is important from the aspect of the energy received from solar radiation and duration of insolation and, accordingly, higher temperatures. Because of the shade cast by the surrounding slopes, bottoms of the valleys in Slovenian Istria receive the insolation which is even more than 4 hours shorter at the winter solstice than on the south-oriented slopes. According to the calculations by Ogrin (1995), the sunniest slopes receive yearly even up to 50% more energy from solar radiation than the shadiest ones. Besides, south positions are well protected against the bora. Thus Vesel (1998) is of the

opinion that most suitable for olive groves are the south, south-west and west locations.

Surface inclination is decisive for the energy received from solar radiation and the amount of moisture in the soil. According to the calculations by Hočevar (1980), the most favourable locations from the aspect of received energy are the south ones, with the inclination of about 40°. Such steep slopes are very rare in Slovenian Istria, since only a little more than 2% of its surface is steeper than 20°. This aspect of surface inclination does not belong to relevant limiting topoclimatic factors for olive growing. More important is the aspect of water drainage which is faster on steeper slopes; therefore, terraced olive groves are arranged there. This method grants sufficient moisture in soil even in droughty summer months when precipitation is scarce.

Concave landforms (valleys, basins, karst depressions) offer favourable conditions for the occurrence of temperature inversions, which means a greater danger of frost, more frequent white frost, and greater air humidity which is not favourable for olives either. Despite their location near the sea, temperature inversion is frequent in the depression landforms in Slovenian Istria, which coincides with 50 to 75% frequency of anticyclonic type of weather. Inversions are explicit in fluviokarstic valley systems, on the transition of the karstic into the flysch area of Slovenian Istria (Movraška vala, Gračiška vala) and in the valleys of the Rižana, the Dragonja, the Rokava and the Drnica in the heart of the hills. Here, the differences in temperatures between the inversion air layer and the thermal belt, which begins a few tens of meters above the bottom, can amount up to 8°C or even more. Inversions are slightly weaker in the valleys by the sea, where the differences amount 3.5 to 5°C. The bottoms of fluviokarstic valleys and valley systems are not favourable for olives also due to alluvial accumulations where heavier and wetter soils were generated.

In order to establish the areas that are suitable for olive growing and to calculate the percentage of suitable areas we first made a partial analysis of suitability by individual topoclimatic elements. Considered as favourable were the heights up to 250 m, inclinations up to 37°, to where terraces have traditionally been made, and exposures from SE to NW, excluded as unfavourable were the bottoms of the valleys and fluviokarstic valley systems because of greater danger of frosts, greater air humidity and less favourable soil conditions. By overlaying individual layers the areas in Slovenian Istria were established in the final

Tab. 4: Suitability of Slovenian Istria for olive growing as to topoclimatic factors
Tab. 4: Prikladna područja za uzgoj masline u slovenskoj Istri prema odgovarajućim topoklimatskim čimbenicima

	Suitable		Less suitable	
	Area (sq km)	Percentage (%)	Area (sq km)	Percentage (%)
Height (up to 250 m)	226	54	193	46
Concave forms	345	83	73	17
Inclination (up to 37°)	397	95	22	5
Exposure (135–310°)	226	54	193	46
Outcome	83	20	335	80

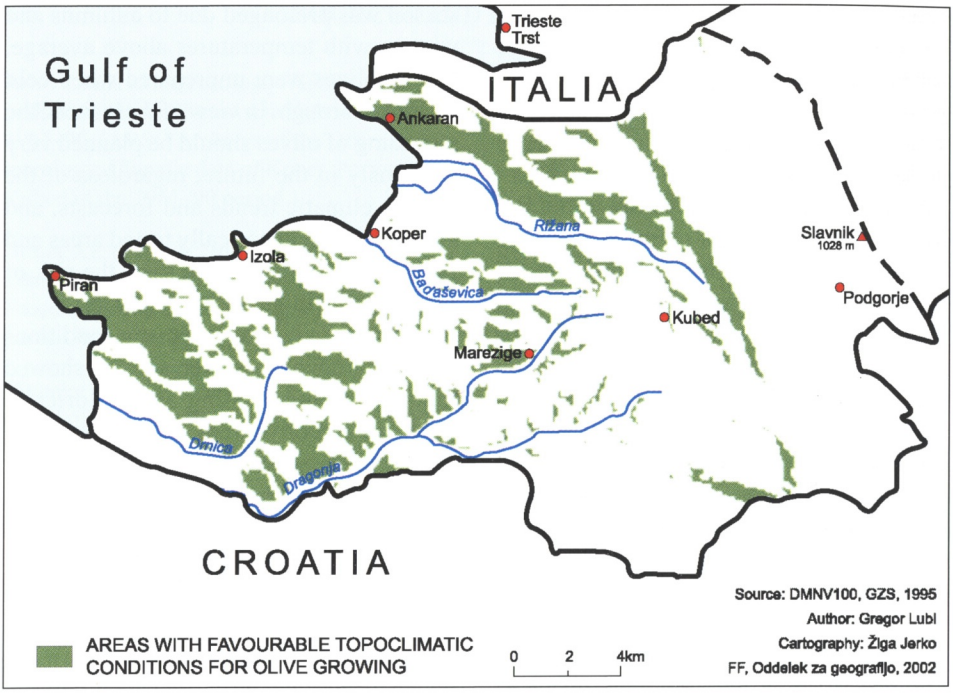

Fig. 2: Suitability of Slovenian Istria for olive growing as to topoclimatic factors
Sl. 2: Područja u slovenskoj Istri s primjerenim topoklimatskim uvjetima za uzgoj masline

stage which are suitable for arranging olive groves from the aspect of topoclimate. The basis for calculations and map presentations was a digital elevation model of 100 x 100 meters. The operations were performed by means of the IDRISI programme package (EASTMAN, 2001).

The analysis showed that 20% or 83 sq km of the whole of Slovenian Istria (419 sq km) are suitable for arranging olive groves from the aspect of topoclimatic factors (Table 4; Fig. 2). The height and exposure stand out as the major limiting factors. Larger continuous areas which are suitable for olive growing are as follows: the littoral hills in the hinterlands of Izola and Piran, where olives are indeed most numerous today, the Muggia peninsula, the slopes above the right banks of the Rižana, the Badaševica and the Dragonja, and the sunny slopes under the karstic step of Črni Kal.

5. CONCLUSIONS

Olive growing in Slovenian Istria is a traditional branch of economy which strongly depends on climatic conditions, primarily on periodical frosts. Olive growers are sometimes insufficiently aware of the benefits and prospects and even less of the risks of growing this culture. Therefore, it is not needless to emphasize again the danger of frosts, especially because it is traditionally said that the recurrence period of stronger frosts is 25 – 30 years. However, the data for the 20th cent., which is considered to have

been relatively warm, prove that frosts can be more frequent. Namely, their average recurrent period was 20 years. In colder periods, such as the 18th cent. was, frosts were even more frequent: their recurrence period was as short as 10–15 years.

At first sight, olive growing in the last decades has also been stimulated by the climatic trends and also the forecasts for the 21st cent. are favourable. According to several prognoses the climate in our area is expected to warm up, especially in winter, by 1 – 2.5 °C. This means theoretically that the vegetation season will be longer and temperature conditions for more demanding cultures, including olives, will be more favourable. But the same prognoses also foretell that the possibility of extreme weather events, including frosts, will increase. A combination of both might be unfavourable for olive trees because the severest frosts in the 20th cent. occurred precisely in those years when the vegetation season was prolonged due to autumns and winters with temperatures above average, so that olives were unprepared when cold air broke through. In view of these facts, the spreading of olives should be planned very cautiously in the future, regardless of the current climatic trends and forecasts, and should keep to historically tested areas and locations. In the opposite case, the risk of frost damage might be even greater.

The analysis of topoclimatic conditions for olive growing in Slovenian Istria showed that, within the existing and historically tested area of olive trees, there still remain enough areas suitable for spreading this culture. About 8000 hectares were established as suitable for olive trees. If urbanized areas and those areas which are occupied by other cultures, then protective forests, protected areas, etc. are deduced, more than 3000 hectares remain available for olive growing, which means that the current areas could at least double.

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Sažetak

KLIMATSKA OGRANIČENJA U MASLINARSTVU I NJEGOVU RAZVOJU U SLOVENSKOJ ISTRI

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Jugozapadni dio Slovenije, reljefno otvoren prema Tršćanskom zaljevu i Sredozemlju, ima znatno blažu klimu u odnosu na unutrašnjost Slovenije. Glede uzgoja klimatski zahtjevnijih kultura, najvažnije su razmjerno visoke temperature (posebno zimske i jesenske) i najdulje trajanje sijanja sunca u Sloveniji. Klimatske prilike bliske su onima u sredozemnoj klimi pa u obalnom pojasu slovenske Istre i u ograničenim područjima u Goriškim brdima i Vipavskoj dolini uspijevaju neke kulture tipične za središnje Sredozemlje, među njima i maslina. Sada je pod maslinama oko 1200 ha, na kojima je više od 300000 stabala. Maslinari godišnje proizvedu 2000 do 2200 t plodova iz kojih dobivaju oko 400 t maslinova ulja. Zbog velike potražnje za domaćim maslinovim uljem sadašnja proizvodnja pokriva nepunu polovicu slovenskih potreba. Povoljan gospodarski položaj maslinarsva u posljednjih nekoliko desetljeća potiče daljnji razvoj ove grane poljoprivrede, pred kojom su pak određena ograničenja zbog općih i lokalnih klimatskih uvjeta. Pritom su vrlo važni povremeni prodori hladnoga zraka, koji mogu nanijeti manje ili veće mrazne štete. Tomu su više izloženi nasadi u unutrašnjosti, nego oni uz more. Za lokaciju maslinika važni su i lokalni topoklimatski uvjeti.

Raščlamba povijesnih zapisa o mraznim stradavanjima u maslinicima od 15. do kraja 20. stoljeća pokazala je da je mrazna šteta u slovenskoj Istri stalno moguća, jer se pojavljuje bez obzira na opće klimatske prilike. U 20. stoljeću, koje je jedno od najtoplijih od ledenoga doba, smrzavanje maslina se događalo prosječno svakih 20 godina. U 19. stoljeću, u kojem je završilo tzv. malo ledeno doba, takvo mrazno stradavanje maslinika događalo se svakih 25 godina. U 18. stoljeću događalo se približno svakih 15 godina. U prosjeku se u zadnjih 500 godina smrzavanje maslina pojavljivalo svakih 30 godina. Svako smrzavanje maslina prouzroči znatnu materijalnu štetu, a utječe i na raširenost masline. Tako je, primjerice, nakon stradavanja od mraza 1929. maslina praktično nestala iz Goriških brda, da bi se nasadi obnovili tek u zadnjem desetljeću. Isto tako se maslina u većoj mjeri opet vraća u više predjele slovenske Istre.

Klimatski trendovi potkraj 20. stoljeća i predviđanja za 21. stoljeće na prvi pogled idu u prilog razvoju maslinarstva. Po nekim scenarijima u 21. stoljeću se očekuje zatopljenje od 1 do 2,5° C, ponajviše zimi. To teorijski znači dulje vegetacijsko razdoblje i povoljnije temperaturne uvjete za zahtjevnije kulture. Međutim, scenariji zatopljenja istodobno predviđaju povećanu vjerojatnost ekstremnih vremenskih događanja pa i češću pojavu mraza. Kombinacija općega zatopljenja i mraza nepogodna je za masline. Maslinici su u slovenskoj Istri u 20. stoljeću najviše stradali upravo tada kada se je zbog natprosječno tople jeseni i rane zime vegetacijsko razdoblje produljilo te su masline nespremne dočekale zimske prodore hladnoga zraka. Stoga treba opreza pri budućem širenju nasada maslina i držati se povijesno provjerenih areala i lokacija. U suprotnome, riskiramo još veće štete od mraznih stradavanja nego do sada.

Raščlamba topoklimatskih uvjeta unutar tradicionalnog areala maslinarstva u slovenskoj Istri, koja je provedena pomoću GIS programskoga paketa Idrisi i uključila elemente nadmorske visine, konkavnosti reljefa te nagibe i ekspozicije padina, pokazala je da je s obzirom na topoklimatske uvjete za maslinarstvo

pogodno oko 20 % slovenske Istre, ili oko 8000 ha. Ako se od toga odbiju urbanizirane površine, površine pod drugim kulturama, zaštićene šume, zaštićena područja i dr., ostaje na raspolaganju oko 3000 ha, što omogućuje barem udvostručenje sadašnjih površina pod maslinom.

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