

## Olive growing in Herzegovina

### Uzgoj masline u Hercegovini

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#### ABSTRACT

The cultivation of olive trees (*Olea europaea* L.) has been expanding in Herzegovina significantly in the last fifteen years. In the past olives were principally grown in the hinterland of Neum, while in recent years the olive groves have been spreading throughout other parts of Herzegovina, in particular in the vicinity of the town of Ljubuški. Most common are the small family plantations. However, in some cases, there are plantations of several to 50 hectares. In the past fifteen years approximately 300 hectares of olive groves were planted. Unfortunately, in some cases, not enough attention was paid to the selection of sites in terms of appropriate soil- and micro-ecological conditions, and to the selection of pollinators. The most common variety is Oblica, autochthonous Croatian variety, characterized by good tolerance to poor and shallow soil, drought and low temperatures. Oblica is followed by Istarska bjelica, Leccino and Pendolino, which together make up about 90% of varieties. Less commonly grown varieties include Carolea, Levantinka and Buža (approximately 10% of varieties). Several autochthonous Croatian varieties and some introduced varieties are being used as pollinators. Levantinka (that is commonly used as Oblica's pollinator in Croatia) proved to be sensitive to frost in Herzegovina, so it should be used only to a limited extent in appropriate sites, or it should be omitted. The situation is similar with the variety Pendolino which showed, compared to the Oblica, more sensitive to frost, and the growers have to be cautious if planning to use it as a pollinator. In the future it is necessary to: a) carry out professional monitoring and evaluation of varieties already planted in different agro-ecological conditions of Herzegovina, b) include new potentially valuable varieties in the pre-introduction variety testing, c) pay special attention to the issue of pollinator for Oblica, seeing that it is a valuable variety resistant to low temperatures, whose pollinators Levantinka and Lastovka are, on the contrary, sensitive to frost.

**Key words:** olive, *Olea europea*, growing, frost damage

#### SAŽETAK

U posljednjih petnaestak godina maslina (*Olea europaea* L.) se značajnije širi na području Hercegovine. Ranije se maslina intenzivnije uzgajala u zaleđu grada Neuma

dok se posljednjih godina širi u ostalim područjima Hercegovine, posebice području grada Ljubuškog. Najčešće se radi o manjim obiteljskim plantažama. Međutim, u pojedinim slučajevima, podižu se plantaže od nekoliko pa čak do 50 hektara. U posljednjih petnaestak godina podignuto je cca 300 ha nasada masline. Nažalost, u pojedinim slučajevima, nedovoljno pozornosti se posvećuje odabiru lokacije u pogledu pedoloških i mikroekoloških prilika, te odabiru oprašivača. Od sortimenata najzastupljenija je hrvatska autohtona sorta Oblica koja dobro podnosi škrta i plitka tla, sušu i niske temperature, zatim slijede Istarska bjelica, Leccino i Pendolino, koje zajedno s Oblicom čine 90% sortimenta, te sporadično Carolea, Levantinka i Buža (zajedno cca 10%). Od oprašivača koristi se više hrvatskih autohtonih ili uvedenih sorata. Levantinka koja se u Hrvatskoj dosta koristi kao oprašivač za Oblicu, potvrdila se osjetljivom na pozebe pa ju treba koristiti veoma ograničeno na posebno pogodnim položajima ili u potpunosti izostaviti. Slična situacija je i sa sortom Pendolino, koja se pokazala osjetljivijom na pozebe u odnosu na Oblicu, pa je potreban oprez kod planiranja ove sorte kao oprašivača. U budućim aktivnostima potrebno je: a) posvetiti se stručnom praćenju i ocijeni posađenih sorti u različitim agroekološkim uvjetima Hercegovine, b) uključivati u predintrodukcijske pokuse nove potencijalno vrijedne sorte, c) pozornost posvetiti pitanju oprašivača za sortu Oblicu, posebice što se radi o vrijednoj sorti otpornoj na niske temperature, čiji su oprašivači Levantinka i Lastovka osjetljivi na pozebe.

**Gljučne riječi:** maslina, *Olea europea*, uzgoj, štete od mraza

## INTRODUCTION

The cultivation of olive trees (*Olea europaea* L.) has been expanding in Herzegovina significantly in the last fifteen years. However, it should be noted that Herzegovina is the northern limit of olive growing area and certain risks of growing are more pronounced, especially in relation to the intensity and frequency of frost. Some severe frosts were recorded in the course of the last century: in 1929, 1941-42 and 1984-85 (Miljković, 2011). In Italy, in some important areas of olive cultivation, severe frost damage occurred in 1907, 1919, 1929, 1949, 1956, 1963 and 1958 (Sanzani et.al, 2012). This means that every 10 to 40 years a destructive drop in temperature can hit the crop. Frost damage is expected to increase its frequency in the future, considering the high worldwide demand for olive oil that encourages olive growing in marginal cold areas (Sanzani et.al, 2012). The winter 2011/2012 was the last very cold winter in Herzegovina, with temperatures that plunged to -16 °C and up to one meter of snow. At the beginning of February 2012, the highest snow cover levels were measured since the beginning of official measurement in Bosnia and Herzegovina (<http://fhmzbih.gov.ga>, Klimatološka analiza godine 2012.).

Taking into consideration these risks, as well as pedological- and ecological diversity of Herzegovina, and knowing that there is no tradition of olive growing in this area, it is necessary to pay special attention when planning, establishing and maintaining olive plantations. New olive groves are predominantly established on parcels that were previously not in agricultural use – marginal olive growing areas (about 95%). Climatic conditions are limiting factors in the distribution of olive throughout the world. Commercial olive-growing areas are not found above a latitude of 45° north and south as olive generally succumbs at -10 to -12°C (Mancuso, 2000). Temperature and other climatic factors have a range which maximizes growth, so that when they are outside this range, the different physiological processes are slowed down or suspended. For example, in the Mediterranean area, low temperatures from recurrent winter frost affect the northern border of olive-growing, whereas the southern border is determined by aridity (Sanzani et.al, 2012). Lacarte (2008) lists a number of factors that have an effect on olive growing in cold areas: cultivation area, exposure, orientation of rows, choice of variety, time of planting, use of plant protection products, fertilization and irrigation.

The paper presents current results of olive growing in Herzegovina and provides a critical review, including on variety selection (especially in respect to the risk of frost damage) and pedological, environmental and technological components of olive production.

## MATERIALS AND METHODS

The authors are well acquainted with olive plantations in Herzegovina and were involved in planning, establishment and maintenance of the majority of them. The analyses include the preparation, establishment and maintenance of plantations, production of olive fruit (data collected at processing sites for five years) and adaptability of olives to certain locations, particularly to frost (the winter 2011/2012). Special attention has been paid to assessing the condition of frost damage in two olive groves planted at different eco-physiological conditions, although spatially only 1 km away. Two times, in March and April 2012, olive trees were observed and low temperature damage was established according to the scale (0-none damage levels, 1-light damage levels, 2-moderate damage levels, 3-heavy damage levels, 4-complete defoliation and darkened of the bark of the branch; 5-death of the overhead part of the tree); modified scale Denney et al., 1993. The critical temperature parameters given here are based largely on field observations, not on experimentation. The situation in some plantations and the cumulative result of olive growing in Herzegovina are described. The spatial distribution of olive groves is shown in Picture 1.

**Picture 1 The spatial distribution of olive groves**

**Slika 1. Prostorna raspodjela maslinika**

The area of growing olives in Herzegovina



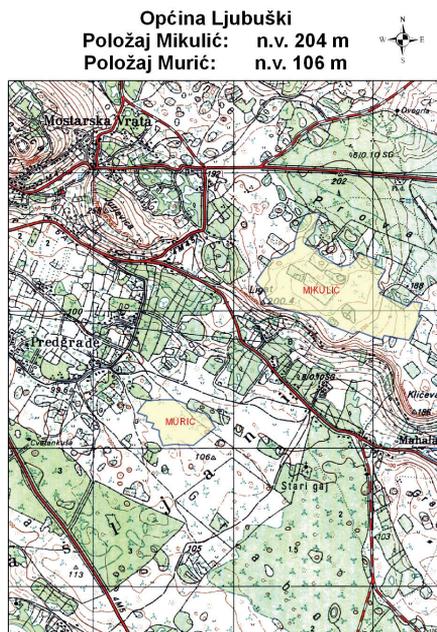
**RESULTS AND DISCUSSION**

**Site selection and soil preparation**

Site selection is a key moment in the planning of a new olive grove, especially seeing that Herzegovina is the northern limit of olive cultivation. Practice shows that the site selection is good when done by professionals. Avoiding depressions and planting on sunny sides protected from cold northern winds, results in a favorable response of olive trees. However, in some cases the site selection was not properly done (a total of 9 ha), which resulted in a significant frost damage in young olive groves in winter 2011/2012. (plantation “Murić”, Pictures 2 and 3). This has in practice confirmed the importance of paying attention to the choice of position, as pointed out by other researchers (Denney et al., 1993; Sanzani et al., 2012). New olive groves are predominantly established on parcels that were previously not used for agriculture – marginal olive growing areas (about 95%). These are marginal fields largely covered with shrubs. Shrubs were initially grubbed up by bulldozers, large rocks removed (usually stored in micro-depressions in the fields), the soil leveled roughly and then cultivated using a special stone burying rotary cultivator. Planting holes were dug and filled with approximately 0.5 m<sup>3</sup> of soil, before planting the young trees. In this way, more favorable conditions for the growth of young plants were provided. The irrigation of olive groves was provided in most cases.

**Picture 2 Plantations “Mikulić” and “Murić”**

**Slika 2. Plantaže “Mikulić” i “Murić”**



**Picture 3 Plantation “Murić” /29<sup>th</sup> April 2012/**

**Slika 3 Plantaža “Murić” /29 travnja 2012/**



## Varieties

The choice of olive varieties to be grown in Herzegovina was particularly challenging, since there were no reference data on response of olives to environmental and pedological conditions in this area. The importance of proper selection of varieties, particularly in relation to frost tolerance, was also pointed out by other authors (Denney et al., 1993; Bartolozzi and Fontanazza, 1999; Barranco et al., 2005; Sanzani et al., 2012; Lodolini et al., 2016). The leading variety in Herzegovina is Oblica, autochthonous Croatian variety that tolerates well the shallow and meagre soils, drought, low temperatures and strong winds (Strikić, 2011). Oblica is grown all over the olive growing area in the Republic of Croatia and Montenegro and in a significant part of Californian olive-growing areas (Miljkovic, 2011). It makes approximately 80% of olive trees planted in Herzegovina, followed by Istarska bijelica, Leccino and Pendolino (which together make up for 10%), then Buža, Levantinka, Carolea, Lastovka and other minor varieties (a total of 10%). Several autochthonous Croatian varieties are used as pollinators: Levantinka, Buža, Istarska bijelica, Lastovka, as well as two introduced varieties: Leccino and Pendolino.

Later entry into the productive phase, irregular yield, problems with the pollinators (especially in Herzegovina compared to Croatia) indicate the need to reduce the share of Oblica in the future olive groves with the increase of Istarska bijelica, Leccino (and Pendolino) shares, and other varieties showing positive results in existing plantations, as well as some future varieties from (pre)introduction.

## Production and processing of olive fruit

In the five-year period (2014-2018) 1,133 tons of olives were produced and processed in three modern oil mills, evenly distributed in growing areas. The yield of olives amounted to about 70 tons (2014), 120 tons (2015), 346 tons (2016), 229 tons (2017) and 368 tons (2018).

## Frost damage

Most olive-growing countries in some olive groves periodically record frost damage. Frequency, time of occurrence, intensity and duration in combination with the cultivar result in greater or lesser damage (Denney et al., 1993; Sanzani et al., 2012). Significant differences between the cultivars in terms of sensitivity to freezing were found (Denney et al., 1993; Bartolozzi and Fontanazza, 1999; Barranco et al., 2005; Sanzani et al., 2012; Lodolini et al., 2016). In Herzegovina there are periodically - usually every 15 to 20 years – extremely

low winter temperatures, that cause significant frost damage to Mediterranean species (fig, almond, pomegranate, olive, etc.). These extremely negative temperatures occur in the time of plant dormancy and cause the damage on annual- and perennial branches and on the young trunk. The last incident of extremely low temperature was recorded in the winter 2011/12, resulting in a significant damage, since the temperature dropped to  $-16\text{ }^{\circ}\text{C}$  with up to 1 meter of snow. Most olive trees were young (few years old, up to seven to eight years), with the exception of Neum trees. The degree of frost damage the most depended on micro-location, then variety and maintenance of a plantation. In unfavourable locations (micro-depressions) all trees were frozen, including the young trunk (plantation "Murić"-Picture 3 /29<sup>th</sup> April 2012/ 2.5 months after event; the greatest damage to the observation scale: 5-death of the overhead part of the tree). Frost-induced bark cracking was recorded on south-east side of trunks of some Oblica trees and other olive varieties. However, new shots emerged on the basis of the trunk in the following vegetation, regenerating the tree, which continued to develop properly in the next years. On the plantation "Mikulić" (the largest olive plantation in Herzegovina), which is only one kilometer away from the "Murić" plantation and has a higher altitude of 100 m (Picture 2), the damage was not or was negligible: ratings 0- none damage levels, 1-light damage levels (Picture 4 /29<sup>th</sup> April 2012/ 2.5 months after event). In other locations, which were well selected and prepared, the damage was significantly lower, compared to the plantation "Murić", (2-moderate damage levels, 3-heavy damage levels). The annual and (rarely-) biennial branches of Oblica were damaged by frost, and afterwards removed at pruning, which provided for a simpler and faster crown regeneration. Some varieties used as pollinators of Oblica sustained significant frost damage. Levantinka (grafted on Oblica) was completely damaged by frost in most cases. Pendolino and Lastovka were also significantly damaged (including young trunk). Increased sensitivity to frost of varieties used as pollinators provides an argument for further research on high-quality pollinators for Oblica, with greater tolerance to frost (at least to the extent demonstrated by Oblica).

Also, it was found that higher altitude positions (150-300 m) exposed to moderate winds (circulation of air), where cold air drifts towards lower positions are more favourable for olive growing than lower altitude sites where cold air remains for a long time (closed fields).

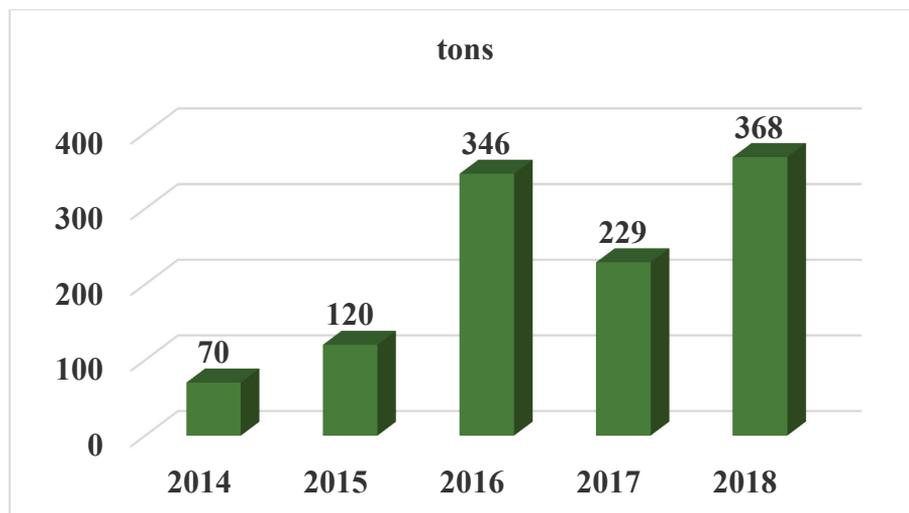
Picture 4 Plantation “Mikulić” /29<sup>th</sup> April 2012/

Slika 4. Plantaža “Mikulić” /29 travnja 2012/



Picture 5 Olive fruit production in Herzegovina (t) for the period 2014-2018 years

Slika 5. Proizvodnja ploda masline u Hercegovini (t) za razdoblje 2014.-2018. godine



## CONCLUSIONS

1. The cultivation of olive trees has been expanding in Herzegovina significantly in the last fifteen years. Parcels with newly established olive groves are usually marginal karst terrains that were previously not in agricultural use.
2. About 300 ha of olive groves has been established. Leading variety is Oblica, autochthonous Croatian variety which makes up about 80% of the olive groves; followed by Istarska bjelica, Leccino, Pendolino, Levantinka, Carolea, Buža (and other varieties to a lesser degree).
3. The yield of olives (t / year: 2014-2018) was 70, 120, 346, 229 and 368 tons.
4. The first results of intensive olive growing in Herzegovina and the experience of olive growers are mostly positive.
5. In the future it is necessary to: a) provide a professional monitoring and evaluation of planted varieties in different agro-ecological conditions of Herzegovina, b) include new potentially valuable varieties into the pre-introduction variety testing, c) pay special attention to the issue of pollinators for Oblica, especially as it is a valuable variety resistant to low temperatures, whose pollinators are more sensitive to frost.
6. When raising and maintaining olive groves: avoid orchard sites prone to damaging freezes; choose the right cultivar(s), maintain healthy trees; avoid practices that lead to late vegetative growth.

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