

## Characteristics of Raspberry Production in Bosnia and Herzegovina

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### Abstract

This paper presents information on the main characteristics of the raspberry production in Bosnia and Herzegovina. During the 2012 – 2017 period, raspberry production has become a significant segment of agricultural production and rural development. The export of frozen raspberry comprises more than 50% of the total fruit and vegetables exports from B&H. The raspberry production is accompanied by the increase in the construction of processing facilities (cold storage capacities). In the overall structure of the raspberry production, floricanne cultivars prevail ('Willamette'). Primocane cultivars such as 'Polka' have been introduced in the production recently. Due to the lack of knowledge in cultivation specifics and the biology of this fruit species, yields achieved in the raspberry production are generally lower than actual fruiting potential. Fluctuation of raspberry prices on the global market may have long-term negative effects on the raspberry production in B&H.

*Key words:* production, price, cultivar, biology, cultivation technology

## Introduction

Raspberry production has become an important segment of agricultural production and rural development in Bosnia and Herzegovina (B&H). Bearing in mind the land ownership fragmentation and high unemployment, cultivation of raspberry and other berry fruit is a profitable aspect of the agricultural production in B&H. Raspberry export is very significant in the overall structure of the fruit and vegetables exports from B&H, considering both exported quantities and realized revenues. In the overall cultivar structure, floricane cultivars such as 'Willamette' prevail, while the primocane cultivars such as 'Polka' have seen an increase in production in the recent years. The level of applied pomotechnics (for the floricane cultivars) is generally satisfactory, even though the producers encounter difficulties as a result of the lack of knowledge which also affects the intensity of the production. A prominent problem in raspberry cultivation is the lack of knowledge among producers considering the growth and development of raspberry and the necessity of planning the application of agrotechnical and pomotechnical treatments according to the biological specifics of this fruit species. Raspberry production in B&H is highly sensible to the prices fluctuation, which is partially affected by the global raspberry market. High expectations by the producers often lead to the abandoning of the production in a very short period.

## Literature review

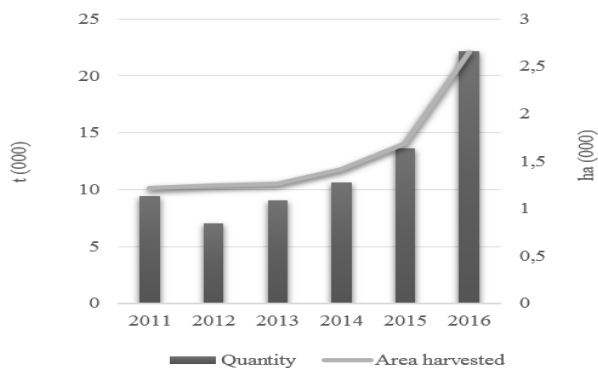
Development in the fruit freezing technology has enabled expansion of berry fruit in the agricultural production. Standard floricane raspberry cultivars significantly expanded their share in production due to the suitability for freezing and demand on the global market (Petrović and Leposavić, 2004). A number of factors such as product placement, raspberry trade and prices affect raspberry global market, thus directly affecting raspberry production in B&H (Dulić-Marković and Teofilović, 2017; FARMA II, 2018). Raspberry export is very significant in the overall structure of the fruit and vegetables exports from B&H. The development of modern agrotechnical and pomotechnical approaches in the trellis system cultivation of the floricane cultivars defined in Serbia during 1970s (Nenadić, 1986; Mičić et al., 2000; Petrović and Milošević, 2002), is a dominant cultivation system in B&H as well (Kurtović et al., 2012; Maličević et al., 2013). Most raspberry producers in B&H lack the complete knowledge about the biology of raspberry growth and development (Mičić et al., 2015), which has to be the basis for the application of the defined agrotechnical (Mičić and Cvetković, 2002; Mičić and Cvetković, 2003a) and pomotechnical treatments (Mičić and Cvetković, 2003b), if the goal is realization of high yields and regular production.

Due to the fact that certain differences between the shoots exist (Cvetković et al., 2016) as well as differences in the application of specific procedures (Mičić et al., 2015) that affect the realization of continuity of high fruiting potential, monitoring and the understanding of growth and development processes is especially important for determination of the type and quality of the aboveground shoots. A relatively small number of raspberry producers, who permanently work on the intensification of cultivation technology, apply acquired knowledge in the field. Experience with the other berry fruit species in the previous period (Mičić et al., 1998; Mičić et al., 2007; Cvetković et al., 2015) merely confirms the necessity to apply the procedures defined in raspberry plantations. In recent years, there has been an increasing emphasis in B&H on the standardization of the raspberry production (Trkulja et al., 2015), so the attractiveness of the production and export to the EU market could be assured, thus creating new challenges for the producers. This paper reviews the characteristics of the raspberry production in B&H by using the data on realized production and export, cultivar assortment and characteristics of the planting material, as well as the most significant aspects of the cultivation technology of the florican raspberry cultivars, based on the growth and development biology of this fruit species.

## Discussion

### Raspberry production in B&H

Raspberry production in B&H has increased from 9.000 t in 2013 to 22.100 t in 2017 (FARMA II, 2018). It is estimated that around 23.400 t were produced in 2018 (FARMA II, unpublished data). For the same period there was also a significant increase in the harvested area of this fruit species (Graph 1).



Graph 1. Raspberry production (quantity and area harvested) in B&H  
(Source: FAOSTAT, FARMA II, 2018)

Most of the raspberry produced in B&H is intended for the freezing and export. Total value of fruit and vegetables export from B&H peaked in 2017 (about €70 million), for the same season total value of raspberry export also peaked with about €36 million. Constant growth of the fruit and vegetables export was recorded for the period of 2014-2017 (Table 1), while there was a decrease in export for the season 2018.

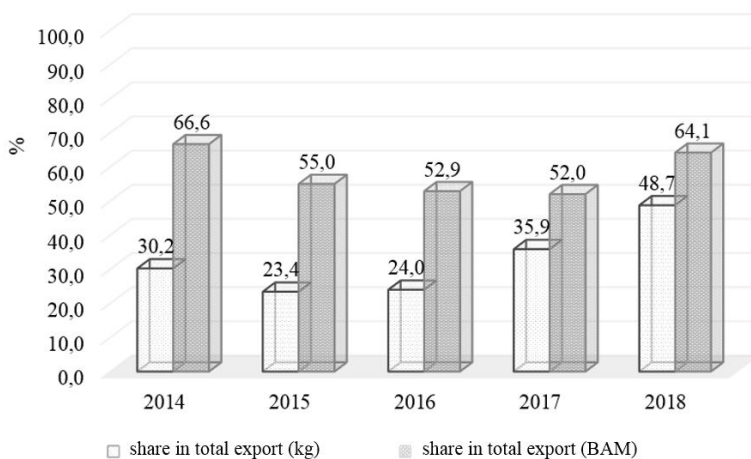
Tab. 1. Total export of fruit and vegetables from B&H [raspberry share (000) in total export of fruit and vegetables from B&H for 2014-2018 period - FARMA II, unpublished data].

| Season                        | 2014   | 2015   | 2016    | 2017    | 2018    |
|-------------------------------|--------|--------|---------|---------|---------|
| Total export (BAM)            | 50.949 | 91.069 | 104.555 | 136.149 | 103.329 |
| <i>Raspberry export (BAM)</i> | 33.940 | 50.060 | 55.271  | 70.768  | 66.251  |
| Total export (kg)             | 24.813 | 43.902 | 49.019  | 61.697  | 48.144  |
| <i>Raspberry export (kg)</i>  | 7.499  | 10.267 | 11.751  | 22.129  | 23.458  |

However, the nominal export of raspberry (kg) demonstrated constant growth for the same period including the season of 2017-2018. In the overall structure of the exported fruit and vegetables from B&H in 2018, with 71% of the total fruit and vegetables export, 5 produces prevail (raspberry, pear, apple, plum and cornichon cucumber) (FARMA II, unpublished data). Fruit and vegetables were mainly exported to Germany, Serbia and Sweden, while Russian Federation was an important export market for apple and pear. EU15 is the largest raspberry market, where about 46% of total raspberry production in B&H was exported. The total import of frozen raspberry on the global market has recorded growth from 526 million USD in 2012 to 700 million USD during 2013, 2014 and 2015 as well as significant decline to 588 million USD in 2016 (Dulić Marković and Teofilović, 2017). This had influence on the raspberry production in B&H, primarily through the quantity of the raspberry produced and its purchase price. Raspberry export share in total export of fruit and vegetables from B&H for the 2014-2018 period (Graph 2) implies its significance in both total quantity and total value of the exported produce.

The raspberry share in total export of fruit and vegetables from B&H was the highest for 2018 (48.7% of the total export). The lowest shares were recorded for the 2015 (23.4%) and 2016 seasons (24.0%).

For the entire period, raspberry export made up more than 50% of the realized revenues from the total fruit and vegetables export. Especially high shares were recorded for the 2014 season (due to relatively high raspberry prices on the global market) and 2018 (due to the decline in the export of other fruit and vegetable produce from B&H).



Graph 2. Raspberry export share in total export of the fruit and vegetables from B&H for the period 2014-2018 (%) FARMA II, 2018

There is no doubt that raspberry is highly profitable and competitive fruit species with significant market demand. In the recent years, production and trade of the fresh raspberry produce have recorded impressive growth. Increased demand for fresh raspberry recorded constant growth until the 2016 season, when the demand for the frozen raspberry declined as well. Considering exported quantities and realized revenues, fresh raspberry export from B&H (Table 2) recorded growth in the period of 2014-2018. However, realized revenues were not directly proportional to the exported quantities.

Tab. 2. Fresh raspberry export from B&H for the 2014-2018 period

| Season                       | 2014    | 2015    | 2016    | 2017      | 2018      |
|------------------------------|---------|---------|---------|-----------|-----------|
| Fresh raspberry export (BAM) | 537.957 | 832.651 | 892.418 | 1.834.322 | 1.141.206 |
| Fresh raspberry export (kg)  | 79.537  | 97.241  | 123.115 | 452.843   | 485.599   |

Significant decline in revenues for the 2018 season (regardless of the exported quantity) may be attributed to the decline of the frozen raspberry price which lowered fresh raspberry prices as well. Raspberry is highly susceptible to prices fluctuation on the global market, especially considering the EU15.

Understanding the raspberry global market with all its implications, as well as the leading companies in business and contemporary processes regarding raspberry trade are all of great significance for the boost of small producers' expectations.

Small family businesses are very competitive raspberry producers in the regions with established infrastructure and tradition regarding raspberry production and trade.

In the current market conditions – decision-makers as well as all other participants of the market chain have to be informed on the basic requirements of the market and prices as well as all other relevant factors with the goal of being flexible to project production and expectations appropriately to the situation (Dulić Marković and Teofilović, 2017).

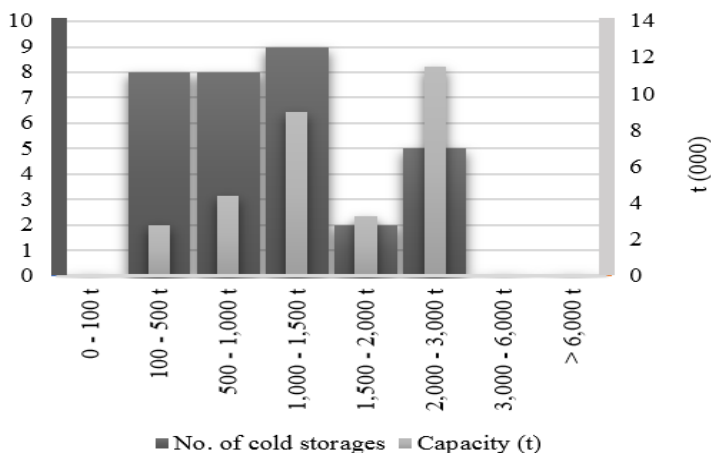
### Processing infrastructure and raspberry prices

Processing facilities (cold storage with freezing regime) represent the focal point in the berry fruit chain. Besides being collection centres, these facilities are often involved in further organization of produce market placement. The most common method of raspberry export to the EU market is via European import companies that distribute raspberry to the processors or traders in the EU. Processing capacities in B&H are at about 30.000 t with a tendency to expand further.

The greatest number of these facilities have a small capacity (100 – 1500 t) and are located in the regions with well-developed raspberry production. Previous experience in raspberry production shows that high raspberry prices are one of the main reasons for the expansion of raspberry production in B&H. Export prices of raspberry have risen in 2012 when they were significantly higher than in previous years. A comparison between average export price and average purchase price shows that during the period prior to 2012, producers were able to achieve the purchase price amounting to 50% of the export price (Graph 4).

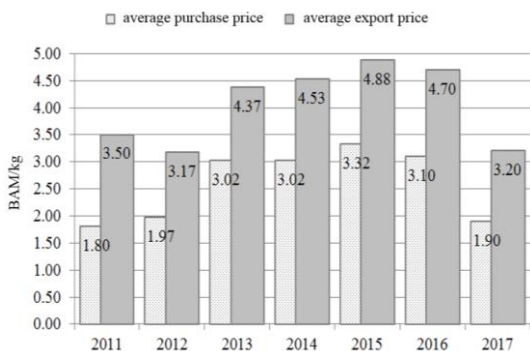
On the other hand, during the 2012-2016 period raspberry producers made extra profits due to high market prices. They were able to achieve purchase price of about 66-67% of the export price for 2013-2015, and 59% in 2016. Export price of raspberry peaked at 3€/kg in the first quarter of 2016. During 2016 export prices declined, which resulted in discontent among the producers due to lower purchase price in the season of 2017. The fluctuation of raspberry prices was influenced by the exchange rate, weather conditions, as well as the dynamics of raspberry supply and demand on the market (Dulić-Marković and Teofilović, 2017).

There is a growing trend of frozen raspberry production in the region, so it is expected that the competition on the frozen raspberry market will probably remain challenging.

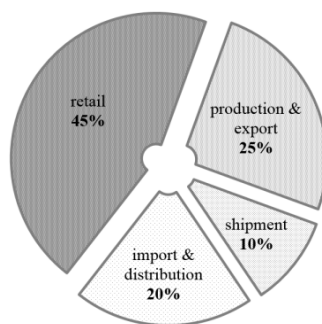


Graph 3. Number and capacities of cold storages with freezing regime in fruit or vegetable business in B&H (Source: National Union of Berry Producers in B&H, adapted by Dulic-Markovic and Teofilovic, 2017)

Raspberry producers' expectations in regards with the purchase price are very often shaped by the raspberry retail price. In most cases, raspberry purchase price amounts to only 25-30% of the retail price (Graph 5). This price structure is a result of intermediary expenses in the market chain and unified supply through single supplier (Dulić-Marković and Teofilović, 2017).



Graph 4. Average purchase price of raspberry in relation to the average export price from B&H during the 2011-2017 period (Source: FARMA II)



Graph 5. Structure of the retail raspberry price (adapted by Dulic-Markovic and Tefilovic, 2017)

## Cultivar assortment and planting material

The most popular raspberry cultivation system in B&H is a trellis system that was patented in Serbia in 1970s (Nenadić, 1986; Mičić et al., 2000; Petrović and Milošević, 2002). The main feature of this system is its suitability for production of floricanes cultivars ('Willamette' being the most popular) in small plantations (0.1 – 0.5 ha). Other floricanes cultivars such as 'Meeker' are produced to a lesser extent, and 'Tulameen' is encountered only sporadically. In the recent years there has been a significant increase in the production of primocane cultivars such as 'Polka' (Kurtović et al., 2012; Maličević et al., 2013), which is combined in plantations with 'Heritage', 'Tulamagic' and most recently with the 'Himbo Top' cultivar.

Significant quantities of the planting material in B&H were provided by a large number of international programs and projects that had an aim of intensifying raspberry production. Most nurseries in B&H sell raspberry plants of different cultivar assortment and quality (bare root and potted). Considering the raspberry cultivar assortment in the nurseries across the Republic of Srpska, 'Willamette' is the most common and followed by Meeker and Tulameen (Table 3; Source: The Republic of Srpska Inspectorate). During the period of 2014-2018, the total of 3.370.000 raspberry plants were produced. The 'Heko' Company based in Bugojno (personal communication) that produces more than 90% of the planting material sold in the Federation of Bosnia and Herzegovina produced about 4.600.000 raspberry plants during the period between 2015 and 2018. The greatest production was recorded for the 2015 season (2.000.000), after which decline in the production occurred with 120.000 raspberry plants produced in 2018.

Tab. 3. Nursery production of raspberry plants in the Republic of Srpska for the 2014-2018 period (000)

| Cultivar       | Production season |      |      |       |      | 2014-2018 |
|----------------|-------------------|------|------|-------|------|-----------|
|                | 2014              | 2015 | 2016 | 2017  | 2018 |           |
| 'Willamette'   | 205               | 252  | 627  | 900   | 646  | 2.630     |
| 'Meeker'       | 10                | 31   | 203  | 261   | 103  | 608       |
| 'Tulameen'     | -                 | 35   | 93   | 105   | 20   | 254       |
| 'Polka'        | -                 | 1    | 24   | 85    | 60   | 171       |
| 'Autumn Bliss' | -                 | 22   | 22   | 22    | -    | 66        |
| Total          | 215               | 342  | 970  | 1.373 | 830  | 3.730     |



Demand for planting material was significantly affected by the market prices of raspberry fruit. In the years with low purchase prices, there was less interest for planting material and establishing new raspberry plantations. Planting material provided by local nurseries is generally well controlled and of a satisfactory quality.

### Cultivation technology of the florican raspberry cultivars

Three distinct categories of raspberry producers are evident in B&H (Dulić Marković and Teofilović, 2017). The first category is made up of producers that are improving their production “step by step”, primarily through the advancements in the production processes i.e. adequate and timely applied agrotechnical procedures (adequate fertilization, fertigation and crop protection based on the professional advisor recommendations and according to the principles of the Integrated Farming) as well as constant education. This category of producers is capable of achieving high yields (10-15 t/ha) of excellent quality. They are gradually increasing their plantations and are very often directly connected to buyers, who provide them with fertilizers and pesticides as a form of pre-financing. The second category is made up of producers with slightly lower production levels and greater expectations at the same time.

A large number of such producers entered this sector of fruit production allured by high market prices of raspberry during the 2012-2016 period and stimulated by high unemployment, lack of alternatives as well as the initiative of the aid agencies and local, regional and national institutions. The third category is comprises prospectors that are investing significant amounts of money (earned in other sectors of agriculture or elsewhere) in large raspberry plantations and storage/refrigeration infrastructure, thus ensuring the large quantities of produce. At this moment, it is hard to estimate the exact number of individuals that are involved in the raspberry production in B&H. However, data provided by the FARMA II, 2018 project stated the estimation that some 20.000 families or 60.000 individuals are directly involved in the raspberry business, which merely confirms the significance of this fruit species and the necessity for permanent improvement of the cultivation technology. Producing florican raspberry cultivars in the trellis system represents the standard of raspberry cultivation in B&H.

Based on the previous experience, it is evident that serious raspberry producers (1<sup>st</sup> category) are able to achieve high yields within this cultivation system if adequate agrotechnical and pomotechnical procedures are applied (Mičić and Cvetković, 2002; Mičić and Cvetković, 2003a; Mičić and Cvetković, 2003b).

With the aim of achieving higher yields some producers within this cultivation system lack the clear vision of the necessary number of aboveground shoots and generative (mixed) buds they carry, thus leaving too many aboveground shoots (10 and more) per 1 meter of trellis. This approach leads to a dense canopy which negatively affects the development of the shoots required for the next season. The research that was conducted for 'Willamette', 'Meeker' and 'Tulameen' in the Bratunac region during the seasons of 2015 and 2016 implies that the increase of the number of mixed buds per 1 meter of trellis may affect the yield increase to a certain degree (Table 4).

Tab. 4. Influence of fruiting potential (number of mixed buds per 1 meter of trellis) on the yield per cane, per 1 meter of trellis and per 1 ha of the plantation for the 'Willamette', 'Meeker' and 'Tulameen' cultivars (2015-2016 seasons average)

| Cultivar    | mixed buds | g/cane | g/m <sup>-1</sup> | t/ha <sup>-1</sup> |
|-------------|------------|--------|-------------------|--------------------|
| 'Willamete' | 80         | 537.5  | 4299.8            | 13.8               |
|             | 100        | 536.0  | 5359.8            | 16.1               |
|             | 120        | 565.7  | 5091.3            | 16.3               |
| 'Tulameen'  | 80         | 800.2  | 6401.8            | 20.4               |
|             | 100        | 744.3  | 7443.2            | 23.8               |
|             | 120        | 775.9  | 6983.1            | 22.3               |
| 'Meeker'    | 80         | 643.7  | 5149.5            | 16.5               |
|             | 100        | 660.5  | 6605.2            | 21.1               |
|             | 120        | 688.4  | 6195.3            | 19.9               |

The research suggested that the most optimal fruiting potential is achieved by 100 mixed buds (well developed and of satisfactory morphology) per 1 meter of trellis. The number of 100 buds per 1 meter of trellis is achieved by pruning to a different combination of the number of the aboveground shoots and the buds they carry. The reduction of the number of mixed buds (80) results in the decreasing total yield. The application of adequate agrotechnical and pomotechnical procedures has to be based on the understanding of the biology of raspberry growth and development. Mičić et al. (2015) concluded that the raspberry rhizome formed from the initial adventitious points of growth has all properties of the typical rhizome considering the rooting capabilities and vertical growth with the formation and differentiation of vegetative buds and from which pseudostems – aboveground raspberry shoots are developed. There are certain specifics of the raspberry rhizome considering the development of vegetative growth points, since lateral offshoots of the rhizome develop from a number of vegetative buds on the rhizome, on which new pseudostems are developed but without taking roots.

Thus, on the underground raspberry stem etiolated underground growths that take roots – the primary rhizome can be identified; and etiolated underground growths in the form of lateral offshoots (secondary rhizome) that do not take roots which results in the development of the pseudostems – aboveground shoots on the secondary rhizome at the cost of the primary rhizome roots which leads to the competition with the aboveground shoots that are developed on the primary rhizome (Figure 1 and 2).



Fig. 1-2 Etiolated growth in the form of lateral offshoots developed on the primary rhizome without taking root



Fig. 3 Old raspberry underground parts with disturbed structure of the root system

Regardless of the apparent confirmation of differences in the quality of the aboveground shoots depending on their origin, as well as the necessity to favour the shoots on their own roots during pruning, this approach has yet to find understanding and practical application among commercial producers. Positions in the plantation at which shoots are developed on their own roots (away from the trellis line), simpler pruning with the principle of making high cuts above the ground while removing old canes, faster pruning if there is no control of the type of the shoots that are left are only some of the reasons why secondary aboveground shoots are favoured to the primary aboveground shoots, thus resulting in lower yields. This approach towards the aboveground shoots favours older raspberry parts with the root system of disturbed structure and with no other roots except for the skeletal roots (Figure 3).

Absorptive roots are often non-existent (or partially present) in the structure of the root system. This induces decreased activity of the root system and prevents absorption of water and nutrients in the quantities required for normal growth and development of the fruit bearing shoots.

It is desirable to remove old raspberry “heads or stumps” from the plantation, so the development of the new aboveground shoots on their own roots could be initiated. This procedure can be carried out with specialized tools that facilitate complete removal of the old parts at one planting space (Mičić and Mičić, 2016) or with swift pulling of the aboveground shoots that are formed on the stumps, thus removing the remaining part of the stump. When replacing old parts of the plant, a uniform and successive approach is necessary as to avoid having too much empty space in the trellis line after the procedure.

## Conclusion

Raspberry production is a very profitable aspect of the fruit production in B&H. Furthermore, a large number of small family businesses depend on this production. The application of modern cultivation technologies is not entirely supported by the understanding of the basics of raspberry growth and development, which affects the intensity of production. Besides market prices fluctuation, the raspberry production in B&H is affected by unfavourable climate conditions during some production seasons, lack of competent consultants, poor organization of primary producers and purchase price issues that were all recorded in the field. Analysis of the current situation, with special focus on purchase price fluctuation indicates the decline of the production in the coming period. The main reasons for this situation are low export prices, evident lack of work force, decreased interest in raspberry, as well as poor biological condition of most of the plantations and producers’ discontent with the purchase prices in the previous period. The raspberry production in B&H has to be based primarily on the realization of optimal and regular yields, which would provide for the profitability of the production, regardless of the fluctuation of market prices.

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## Карактеристике производње малине у Босни и Херцеговини

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<sup>3</sup>USAID/Шведска Подстицање активности пољопривредних тржишта 2 (FARMA 2)

### Сажетак

У раду су приказане најважније карактеристике производње малине у Босни и Херцеговини. У периоду од 2012. до 2017. године, производња малине је постала веома важан сегмент пољопривредне производње и руралног развоја. Извоз замрзнуте малине у овом периоду чинио је више од 50% укупног извоза воћа и поврћа из БиХ. Производњу малине пратила је и изградња савремених складишних капацитета (хладњаче). У укупној структури производње малине доминирају сорте двогодишњег типа (Виламет). Последњих година у производњу се значајније уводе и ремонтантне сорте (Полка). Услед недостатка информација и знања у погледу специфичности узгоја и биологије раста и развоја, остварени приноси у производњи су испод реалног родног потенцијала ове воћне врсте. Промјене (флукуације) цијене на глобалном (свјетском) тржишту могу имати дугорочно негативан утицај на производњу малине у БиХ.

*Кључне ријечи:* производња, цијена, сорта, биологија, технологија гајења

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Received: March 2, 2018  
Accepted: April 10, 2019