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YIELD AND QUALITY OF BLACKBERRIES (*Rubus Fruticosus Agg.*) IN ORGANIC PRODUCTION

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Abstract

Organic fruit growing is mostly related to the berry fruit production (strawberries, blackberries, raspberries).
The aim of this research was to examine the effect of water extracts of nettle, alfalfa and dandelion, with different numbers of days of fermentation, on yield and quality of blackberry. Field test was conducted during 2010 and 2011 on a plantation in municipality of Kozarska Dubica. Laboratory tests were conducted at the Agricultural Institute of the Republic of Srpska - Banja Luka. Water extracts of nettle, dandelion and alfalfa, with fermentation period of 14 days or 21 days were used. The content of macro-elements in water extracts was determined by chemical analysis.
According to the research the average yields of blueberries were from 9.02 t ha^{-1} to 10.94 t ha^{-1}. The highest yield was recorded in the treatment of blackberry bushes with extract of alfalfa with 21 days fermentation period.
Average values of soluble dry matter in ripe blackberry fruits were from 9.06° to 9.36° Brix. The highest content of soluble dry matter in the fruit were found in the treatment with the extract of dandelion where the fermentation lasted for 21 days (9.50° Brix) and lowest in the treatment with extract of alfalfa with the same fermentation period (8.80° Brix).
All tested treatments had higher yields compared to the control. The highest average yield was obtained by treating the blackberry bushes with water extract of alfalfa. The fermentation time did not have significant effect on the quality of fruits in any of treatments.

Key words: *blackberry, yield, fruit quality, water extracts*.

Introduction

The main goal of organic agriculture is the production of healthy food without use of pesticides, while preserving biodiversity and biological activity of soil. This kind of food production eliminates use of mineral fertilizers in the production cycle. Blackberry is a major consumer of nutrients because it forms a large vegetative mass and it is very fruitful. It requires a large quantity of potassium, a little less of nitrogen, and much lower phosphorus quantity for the growth and fruiting (Misic and Nikolic, 2003). In these circumstances, in order to avoid yield reduction, there is a need to increase usage of organic fertilizers instead of mineral. Foliar fertilizers are particularly important among the organic fertilizers, due to the possibility to use during the whole growing season. When using organic fertilizers one should be careful, because their untimely and excessive use may cause intense mineralization, with some negative consequences such as a significant increase in mineral forms of nitrogen in the soil. Because of the negative consequences that may occur during the application of organic fertilizers, use of foliar organic fertilizer is more popular among healthy food producer, thus they can have healthy products and preserve the environment at the same time. The application of water extracts made of different plants provides an opportunity for producers to achieve a good yield and quality for unrestricted placement on the market.

Organic products are the result of organic production with the use of cultural practices that exclude the use of chemical agents. Products that are produced in this way have a higher biological value and higher dry matter content (Milenkovic and Tasic, 2013). Use of organic foliar fertilizer does not have negative impacts on the natural environment. Studies have shown that foliar fertilization in some cases can be 8-10 times more effective than nutrient uptake from the soil, and that about 90% of the nutritional solution can be found in the smallest parts of the roots of plants 60 minutes after application (Akanbi *et al*., 2007). The essential feature of foliar fertilizers is that they absorbed by the plant directly and in limited quantities, unlike fertilizers that are given in soil (Fernandez and Eichert, 2009). Use of organic foliar fertilizer essentially supports the concept of sustainable agriculture. Bearing in mind that the water extracts are environmentally friendly and do not pollute environment (water, soil), undertaken research should make a significant contribution to the advancement of organic fruit growing in our country, and beyond. Plant extracts are products which can be a significant source of various oligo elements, which may depend on the type and quality of soil in which the plants for the preparation of the extract are grown (Popescu *et al.*, 2010).
The aim of this research was to examine the effect of water extract of plants with different numbers of days of fermentation, on yield and quality of blackberry.

Material and methods

Testing of effects of nettle water extracts, dandelion and alfalfa on yield and quality of blackberries was conduct during 2010 and 2011 at the plantation in the Kozarska Dubica municipality. Laboratory tests were conducted at the Agricultural Institute of the Republic of Srpska - Banja Luka. Two-factorial field trial (factor A–extract of plant, factor B-number of days of fermentation), with four repetitions and randomized blocks, was set up at the organic plantation in Brekinja village in Kozarska Dubica in 2010 (Fig. 1). Each repetition consisted of five blackberry bushes.

Figure 1. Trial of blackberry variety Cacanska bestrna

Water extracts of nettle, dandelion and alfalfa, with fermentation periods of 14 and 21 days were used for these experiments. Research consists of the following water extracts treatments:
1. Water extract of nettle with 14 days of fermentation (K14);
2. Water extract of nettle with 21 days of fermentation (K21);

3. Water extract of dandelion with 14 days of fermentation (M14);
4. Water extract of dandelion with 21 days of fermentation (M21);
5. Water extract of alfalfa with 14 days of fermentation (L14);
6. Water extract of alfalfa with 21 days of fermentation (L21);
7. The control (untreated plants).

Water extracts obtained from the alfalfa, nettle and dandelion, after fermentation cycle, and before the foliar were strained and then diluted with rainwater to a ratio of 1:10. Spraying with extracts was performed with motor sprayers WILAGER DM 25 which has volume of 15 l. The first treatment was carried out on May 18, 2010, and the following treatments were performed every 10 to 15 days. The treatments were repeated until the first ripe blackberry fruit.
The first harvest of ripe blackberry fruit was carried out on July 14, at the stage of their physiological ripeness. Blackberries were harvested six times by the end of August. During harvest, the yield measurement was performed with the precise “TEHNIKA” scale, for each blueberry bush. We calculated yields of each variety, including the control by measuring the weight of harvested fruits.
Research results have been statistically analyzed using analysis of variance (ANOVA) and significant differences in mean values was determined by LSD test.

Results and discussion

In order to have clearer picture of the impact of different type of plant extract on the yield and quality of fruits, before the application, extracts were chemical analysed for the contents of macro elements and pH. The results of the analysis are given in table 1.

Table 1. The chemical composition of water extracts of 14 days fermentation time

	Extract	pH	N (mg l^{-1})	P (mg l^{-1})	K (mg l^{-1})
1.	Nettle	6,4	56,8	56,3	700,2
2.	Dandelion	5,2	41,0	42,5	1205,3
3.	Alfalfa	5,4	105,6	40,2	670,4

The results of chemical analysis of plant extracts showed that the pH of the dandelion and alfalfa extracts were acidic and nettle was weakly acidic. The nitrogen content is particularly high in alfalfa extract (105.6 mg l^{-1}). Phosphorus content is fairly uniform, and dandelion extract has the highest potassium content (1205,30 mg mg l^{-1}). Water extract of nettle contains high levels of nitrogen, mainly in ammonium form (Peterson and Jensen, 1985). Dandelion has a high content of potassium (Ertas *et al*, 2005) as shown in the results of our research.
Blackberries yield depends on many factors, of which the most important are: varieties, growing systems and agro ecological conditions. Yields from these tests are shown in Tab 2.

Table 2. Yield of blackberries (t ha^{-1}) with different water extract treatment

Fermentation time	Extract			
	Control	Nettle	Dandelion	Alfalfa
14 days	9,02	10,55	10,21	10,91
21 days	9,01	10,26	10,37	10,97
$\bar{X}$	9,02	10,41	10,29	10,94
Level	A*	B**	AB***	

LSD	0,05	1,52	1,07	2,13
	0,01	2,04	1,45	2,88

* Factor A - Extract; ** Factor B - Fermentation time, *** Interaction AB - Interaction

Yields of blackberries, according Stancevic (1990) are from 22-25 t ha^{-1} depending on the variety (Thornfree, Thornes logan and Gionta dell Giardino) up to 30 t ha^{-1} in a variety Smoothstem. The same author states that blackberries on poor soils produce yields below 15 t ha^{-1}. Osmancevic and Brzica (1991) point out that in our conditions blackberry can achieve average yields of about 20t ha^{-1}. In testing of characteristics of new varieties of blackberries in the agro-ecological conditions of eastern Serbia (Miletic et al., 2006) average yields of 14 t ha^{-1} were achieved in the conventional production.
Yields of blueberries in our tests were from 9.02 t ha^{-1} (control) to 10.94 t ha^{-1} (alfalfa extract) Higher yield of blackberries with all of the applied treatments compared to the control was recorded. The highest yield was achieved with water extracts of alfalfa (10.94 t ha^{-1}). There were no significant differences recorded in blackberry yield between the treatments of water extracts with different fermentation periods. The blackberry fruit has various organic and inorganic compounds, which give nutritional and medicinal value. Chemical composition of fruits (Vracar, 2001) is given in Table 3.

Table 3. Average chemical composition of blackberry fruit

Water	84,50
Total sugar content	7,30
pH	3,2
Total acid content	1,5
Pectin	0,4
Proteins	1,2
Fat	0,9
Cellulose	4,1
Vitamin C	24 mg/100g
K	180 mg/100g
Ca	40 mg/100g

The quality of the fruit, from a technological point of view, depends on the content of soluble dry matter (SDM). Content of SDM depends on the maturity of the fruit, bushes vigour and total leaf surfaces. In our study, it was measured SDM content in the fruit of blackberries treated with different plant extracts and the results are shown in Table 4.

Table 4. Content of soluble dry matter (° Brix) in ripe blackberry fruit treated with different water plant extracts

Fermentation time		Extract			
		Control	Nettle	Dandelion	Alfalfa
14 days		9,24	9,43	9,20	9,32
21 days		9,20	9,07	9,51	8,80
$\bar{X}$		9,22	9,25	9,36	9,06
Level		A*	B**		AB***
LSD	0,05	0,52	0,37		0,72
	0,01	0,70	0,50		0,98

* Factor A - Extract; ** Factor B - Fermentation time, *** Interaction AB - Interaction

Blackberry fruit is rich with a various components, and the chemical composition of fruits varied (Nikolic, 2004). Chemical composition of fruits depends on the variety, environmental growing conditions, abundance of fruit, ripening stage of the fruit at the time of harvest, as well as cultivation practices applied during the growing season. Wild blackberry fruit contains an average of 6.0 to 13.1 ° Brix SDM. Soskic (1984) and Nikolic (2004) reported that ripe blackberries contain from 9-14% SDM. In the results of our research the average values of SDM was from 9.06 to 9.36 ° Brix.

The results of our study are similar to the research results of Miletic et al. (2006). In our experiment the highest content of SDM in blackberry fruits were found in the treatment with the extract of dandelion where the fermentation lasted 21 days (9.50° Brix), and the lowest values were observed in the application of an extract of alfalfa with the same number of days of fermentation (8.80° Brix). Statistically significant differences in the content of SDM in blackberry treated with alfalfa extracts with different number of days of fermentation. In wild blackberries SDM content of 6.0 to 13.1%. The content of total dry matter and sugar may depend a great deal on the variety and environmental growing conditions and can vary by up to 40% every year.

Conclusion

On the basis of these results, the following conclusions can be derived:

Chemical analysis of macronutrient content determined that an extract of alfalfa contained mostly nitrogen, nettle extract phosphorus, and dandelion extract had highest content of potassium.

All tested treatments had higher yields compared to the control. The highest yield was obtained by treatment of blackberry bushes with extract of alfalfa.

Duration of fermentation period of plant extract showed no effect on the yield of berries in any treatment.

The application of plant extracts did not significantly affect the quality of fruits which is reflected in the content of SDM.

Taking into consideration the increasing interest in natural control of plant pathogens, increasing demand for healthy food, and the fact that we have not done much on this issue in our country, we consider it necessary to continue research in order to obtain as much information on the use of water extracts in agriculture.

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