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RESEARCH ARTICLE

THE EFFECT OF FOLIAR FERTILIZING ON THE CHEMICAL COMPOSITION OF KERNELS OF
PRIMORSKI ALMOND CULTIVAR GROWN IN VALANDOVO

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ABSTRACT

The effect of foliar fertilizing on the chemical composition of kernels from *primorski* almond cultivar grown in Valandovo region in the period of 2012 to 2013 was determined. The experiment was set in four variants and three repetitions. The variants were: Control (untreated); NPK+Ever green co Me (55% organic matter, 2% w/w Mg, 2% w/w Fe, 2% w/w Zn, 2% w/w Mn, 0.5 % w/w Cu, 0.5% w/w B); NPK+Biolinfa (34% organic matter 3% N, 5.80% K₂O) and NPK+Oligomix (1.20% B, 0.10% Cu, 4% Fe, 1.50% Mn, 0.10% Mo, 2% Zn).

The distance of fruit planting was 4.5 m row by row and 3.5 m in the rows. In each variant and repetition were included 60 plants, and total in all experiment were involved 720. Three foliar treatments were applied with given above fertilizers at a concentration of 0.4%. In the end of the November, soil fertilizing with the fertilizer Polyfeed 11-44-11 in quantity amount of 450 kg ha⁻¹ was done.

Before setting up the experiment, soil agrochemical analyses were made, and was concluded good fertility with nitrogen, medium fertility with phosphorus and potassium. The foliar fertilizing had a positive influence on the chemical composition of almond kernels. The highest average content of nitrogen (4.06%), phosphorus (1.18%), potassium (1.17%) and oils (60.46%) were determined in the kernels from variant NPK+Ever green co Me (55% organic matter, 2% w/w Mg, 2% w/w Fe, 2% w/w Zn, 2% w/w Mn, 0.5 % w/w Cu, 0.5% w/w B).

The highest average content of calcium (0.95%) and magnesium (0.40%) were determined in the kernels from variant NPK+Oligomix (1.20% B, 0.10% Cu, 4% Fe, 1.50% Mn, 0.10% Mo, 2% Zn).

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INTRODUCTION

The aim in the modern agriculture is to get higher yield that will characterize with better quality. Plant nutrition is one of the most important agro technical measures, that together with the others have to allow uninterrupted, high and economically production (Kester and Ross, 1996; Datnoff *et al.*, 2007). The right plant nutrition regime is necessary for normal growth, yield and getting quality product (Domagalski *et al.*, 2008; Marschner, 1996; Holevas *et al.*, 1985). It means availability of all macro and micro biogenic elements in appropriate phenophase of plant growth. Each biogenic element has its specific influence on different parts of the plants. Plant nutrition has an influence on numerous physiological - biochemical processes, that affecting growth, development and yield (Dzamič and Stevanović, 2000; Glintic and Krstic, 1990). Plants that have timely and right nutrition are getting fruits with characteristic shape, color, size and with typical organoleptic properties. Limited of the nutritious elements is happened because of the different

reasons. Intensive agriculture and use of high productivity cultivars led to a continuous decrease in soil micronutrient content (Jekić and Brković, 1986; Sarić *et al.*, 1989).

Using of foliar fertilizers the fruit cultures nutrition, has a big importance in getting higher yields as well as products with better quality. Foliar fertilizers allow direct supplying of leaves, flowers and fruits with nutritious elements in a period when they are necessary. Foliar spray with fertilizers is necessary to further activity in the whole system of optimal mineral nutrition of plants (Taiz and Zeiger, 2002; Kostadinov and Kostadinova, 2014). It provides more economical water regime of plants and allows overcoming the physiological disturbances caused by adverse soil conditions that hamper mobility and nutrients absorption.

In unregularly soil conditions, unregularly pH value, low or high soil temperature, fixation in different nutrients, the root cannot adopt the nutrients at all (Sarić *et al.*, 1986; Šaćiragić and Jekić, 1988). In such cases, the foliar nutrition has an important influence. It is an additional nutrition and measure

that allow rapid and efficiency effect of correction of the plant nutrition (Brown, 2004; Veličković, 2002).

The almond, *Amygdalus communis*, is kernel fruit that bellows at the family of *Rosaceae*, and under family *Prunoidae*. It is old fruit culture that is counts in economically importance kernel fruit and has numerous positively characteristic, too.

The importance of almond is because of the kernel, which is very reach in fats, proteins, mineral matters, sugars, cellulose, vitamins and amino acids (Bybordi and Malakouti, 2006; Bulatović, 1985). On the other hand, the almond has a big value for human nutrition, pharmaceuticals, cosmetic industry and so.

The aim of this exploration was to obtain the influence of soil and foliar fertilizing on the chemical composition of kernels by almond cultivar *primorski*, grown in Valandovo region.

MATERIALS AND METHODS

The field experiment with almonds was set in Valandovo region, during the 2012 and 2013. During the field experiment setting, the fruits were 7 years old. The material of work was almond cultivar *primorski*.

The planting distance was 4.5 m row by row and 3.5 m in the rows. The nutritional area was 15.75 m², i.e. 635 fruits ha⁻¹. In the exploration were included 4 variants in 3 repetitions. In each variant and repetition were included 60 plants, or total in whole experiment the number of plants was 720.

The field experiment was set in terms of watering in system drip. During the almond vegetation period were applied all basic agricultural measures.

Variants in experiment were:

- ✓ Control (untreated);
- ✓ NPK+Ever green with Me (55% organic matter, 2%w/w Mg, 2%w/w Fe, 2%w/w Zn, 2% w/w Mn, 0.5 %w/w Cu, 0.5 %w/w B);
- ✓ NPK+Biolinfa (34% organic matter, 3 %N, 5.80 % K₂O);
- ✓ NPK+Oligomix (1.20 % B, 0.10 %Cu, 4 % Fe, 1.50 % Mn, 0.10 % Mo, 2 % Zn).

The soil fertilizing was applied in the end of November and the fertilizer Polyfeed was used in the quantity amount of 450 kg ha⁻¹. Each variant and repetition was treated foliar with 0.4% solution of the tasted fertilizers. The application of fertilizers was done with manually spraying the played leaves. The treatments were made in the evening hours. During the vegetation period were conducted 4 foliar treatments. The first treatment was made 10-15 days before flowering, and the other treatments was made after flowering at a distance of 15-20 days.

The harvesting was carried out separately by variants and repetitions. Before setting up the experiment soil samples were taken for agrochemical analyses and were performed on the following parameters:

- pH value - determined potentiometric with pH meter (Bogdanović *et al.*, 1966);
- Content of easy available nitrogen – determined by method of Tjurin and Kononova;

- Content of easy available phosphorus – determined by AL method and reading of spectrophotometer (Bogdanović *et al.*, 1966);
- Content of easy available potassium – determined by AL method and reading of spectrophotometer (Bogdanović *et al.*, 1966);
- Content of humus – determined by permanganese method of Kotzman (Bogdanović *et al.*, 1996);
- Content of carbonates–determined with Schaiblerov Calcimeter (Bogdanović *et al.*, 1966).
- In the kernels were determined the following parameters:
- Content of nitrogen (N) - determined using Kjeldal method (Sarić *et al.*, 1989);
- Content of phosphorus (P₂O₅) - determined using atomic emission spectrometry with inductively coupled plasma (ICP - AEC) (Sarić *et al.*, 1989);
- Content of potassium (K₂O) - determined by incineration of the material with concentrated H₂SO₄ and phlamenphotometar (Sarić *et al.*, 1989).
- Content of calcium (SAT) - determined using atomic emission spectrometry with inductively coupled plasma (ICP - AEC) (Sarić *et al.*, 1989).
- Content of magnesium (Mg) - determined by applying atomic emission spectrometry with inductively coupled plasma (ICP - AEC) (Sarić *et al.*, 1989).
- Content of oil - determined with Sokslet method (Sarić *et al.*, 1989).
- Statistical data processing was performed using LSD test represented at the levels of probability of 0.05 and 0.01.

RESULTS AND DISCUSSION

Climate is one of the most important environmental factors which affect the success of cultivation of all fruit kinds without excluding the almonds (Šoškić, 1996). The influence of climate elements manifest through the time of vegetation of fruit as well as through the separate phenophases.

Valandovo region is known as region with lot of shiny days. Temperature requirements of almond for growth and development in the period of standby are large. It is enough in sequel of 100 hours, temperature variations from 0 to 6°C for almond awakening.

The average year temperature of the air in the Valandovo region is 15°C. Sensibility of low temperatures is variety characteristic. Almond varieties that blooming early are more sensitive than others. Bulatović (1989) found that unopened blossoms can be damaged on -3°C to -4°C, opened on -1.5 to -2.8°C, and just planted fruit on -1 to -1.5°C.

Almonds are sensitive on very high atmospheric humidity, suffer from diseases and in that ways don't give good yields. The average year relative humidity in Valandovo region is 71 % with maximum of 80 % in November, December and January.

Soil conditions have an especially importance for growing, developing and fruits quality. The almond has the best growth and yield in deep, alluvial - diluvial, loamy - sandy, humus

carbonate soils with significant content of lime (Ubavić *et al.*, 2001). Particularly suitable are soils with neutral reaction and good penetration of water and air. Salty and acidic soils or wet and clay are unsuitable for growing almonds.

From data shown in Table 1, can be concluded that soil in which the field experiment was set, had neutral pH value, good fertility with available nitrogen, but a medium fertility with available phosphorus and potassium. It had medium fertility with humus, too. There was low presence of carbonates.

Table 1 Agrochemical analyses of soil

Lab. No.	Depth cm	pH		Available mg 100g ⁻¹ soil			Humus CaCO ₃	
		KCl	H ₂ O	N	P ₂ O ₅	K ₂ O	%	%
1	0-20	7.14	7.62	14.70	6.60	20.00	1.86	1.30
2	20-40	7.19	7.98	15.26	6.20	17.00	1.90	1.02
3	40-60	7.05	7.86	11.48	5.00	17.00	1.80	2.50
Average 0-60		7.13	7.83	16.20	5.93	18.00	1.85	1.61

From data shown in Table 2 and Table 3, can be concluded that soil and foliar fertilizing had positive influence on the chemical composition of kernels. In all of the variants treated with different kinds of fertilizers, analyzed parameters had higher value compared with the control, untreated variant.

Table 2 Chemical composition of kernels in % of dry matter (average 2012/2013)

Variant	N	P ₂ O ₅	K ₂ O
1	3.51	1.05	1.04
2	4.06	1.18	1.17
3	3.93	1.10	1.11
4	3.81	1.13	1.14

LSD (0.05) = 0.09 LSD (0.05) = 0.04 LSD (0.05) = 0.05
 LSD (0.01) = 0.13 LSD (0.01) = 0.06 LSD (0.01) = 0.07

Table 3 Chemical composition of kernels in % of dry matter (average 2012/2013)

Variant	CaO	MgO	Oils
1	0.88	0.36	55.35
2	0.91	0.39	60.46
3	0.90	0.37	57.05
4	0.95	0.40	56.70

LSD (0.05) = 0.01 LSD (0.05) = 0.02 LSD (0.05) = 1.72
 LSD (0.01) = 0.01 LSD (0.01) = 0.03 LSD (0.01) = 2.46

The highest average nitrogen content (4.06%), phosphorus (1.18%), potassium (1.17%) and oils (60.46%) were determined in kernels in variant 2. For the nitrogen content, statistically significance differences were determined in all of the variants at both levels.

For the phosphorus content statistically significance differences at LSD level 0.05 was determined in variants 2 and 3 and at LSD level 0.01 in the variant 2. For the potassium content statistically significance differences at LSD level 0.05 was determined at all variants but at LSD level 0.01 in the variant 2 and 3. For the content of oils statistical significant differences were obtained in variant 2 in both analyzed levels.

The highest average content of calcium (0.95%) and content of magnesium (0.40%) were determined in the kernels from variant 4. For the content of calcium and magnesium were obtained statistically significance differences at LSD level 0.05 in variants 2, 3 and 4. At LSD level 0.01 for the content of calcium were obtained significance differences in variants 3 and 4 and for the magnesium content in the variant 4.

According to Weinbaum *et al.* (1984) the content of nitrogen in almond kernels is 3.70%. On the other hand, Youssefi *et al.* (2000) found that the average content of nitrogen in almond kernels is between 3.8-4.10%. Dinesh and Ahmed (2014) obtained that the content of phosphorus in almond kernels is 1.25%. According to Meyer (1996) the content of potassium in almond kernels is 1.30%.

Higher content of tested elements in all of the variants, compared with the control variant was a result of the chemical composition of used foliar fertilizers as well as their absorption in the plant organs, i.e. kernels.

Macro and micro biogenic elements in the content of used fertilizers had an influence on numerous physiological – biochemical processes that are of vital importance in plant vegetation cycles.

CONCLUSION

Based on the obtained results for the influence of foliar fertilizing on the chemical composition of almond kernels from *primorski* cultivar grown in Valandovo region can be concluded that using of foliar and soil fertilizing had an important influence on increasing the content of all tested elements at all variants with different fertilizers compared to control variant. The highest average content of nitrogen (4.06%), phosphorus (1.18%), potassium (1.17%) and oils (60.46%) were determined in kernels from the variant 2 (NPK+Ever green with Me (55% organic matter, 2%w/w Mg, 2%w/w Fe, 2%w/w Zn, 2% w/w Mn, 0.5 %w/w Cu, 0.5 %w/w B). The highest average content of calcium (0.95%) and magnesium (0.40%) were determined in kernels from variant 4 (NPK+Oligomix (1.20 % B, 0.10 % Cu, 4 % Fe, 1.50 % Mn, 0.10 % Mo, 2 % Zn). For the nitrogen content, statistically significance differences were determined in all of the variants at both levels. For the phosphorus content statistically significance differences at LSD level 0.05 was determined in variants 2 and 3, and at LSD level 0.01 in the variant 2. For calcium and magnesium content were obtained statistically significance differences at LSD level 0.05 in the variants 2, 3 and 4.

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