THE EFFECT OF FOLIAR FERTILIZING ON THE YIELD OF PRIMORSKI ALMOND CULTIVAR GROWN IN VALANDOVO

Marina Todor Stojanova[1], Irena Stojkova[2], Igor Ivanovski[1], Monika Stojanova[1]

Abstract: The effect of fertilizing on the yield of Primorski almond cultivar grown in Valandovo region in the period of the year from 2012 to 2013 was determined. The experiment was set in four variants and three repetitions. The variants 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% K_2O) 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 20 plants, and total in all experiment were involved 240 plants. 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+ME (Fe, B, Zn, Mn, Co, Mo) 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 has had a positive influence on the yield in all variants, treated with different kinds of fertilizers, compared with the control, untreated variant.

The highest average content of almond fruit yield (2781 kg ha^{-1}) and the highest average almond kernels yield (1257.30 kg ha^{-1}) was determined in the variant 2 treated with fertilizer 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 lowest almond fruits yield (1822 kg ha^{-1}) and the lowest almond kernels yield (806.45 kg ha^{-1}) was determined in the control variant.

Key words: almond yield, foliar fertilizing, kernel.

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 uninterruptible, high and economically production (Datnoff et al., 2007). The right plant nutrition regime is necessary for normal growth, yield and getting quality product (Domagalski et al., 2008; Brown et al., 2004). It means available 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 (Glintic and Krstic, 1990; Dzamič and Stevanović, 2000). Plants that have timely and right nutrition are getting fruits with characteristic shape, color, size and with typical organoleptic

[1] Faculty of agricultural sciences and food, Ss. Cyril and Methodius, Blvd. Aleksandar Makedonski bb, Skopje, Republic of Macedonia (marina_stojanova@yahoo.com);
[2] Faculty of agriculture, Goce Delcev University, Stip, Republic of Macedonia.

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 leafs, 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 (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 (Youssefi et al., 2000; Velićković, 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 (Bulatović, 1985). On the other hand, the almond has a big value for human nutrition, pharmaceutics, cosmetic industry and so.

The aim of our research was to obtain the influence of soil and foliar fertilizing on the yield of almond cultivar Primorski*,* grown in Valandovo region.

Material and methods

The field experiment with almonds was set in Valandovo region, during the years of 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 m^2, i.e. 635 fruits ha^{-1}.

In the exploration were included 4 variants in 3 repetitions. In each variant and repetition were included 20 plants, or total in whole experiment the number of plants was 240.

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:

1. Control (untreated);
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);
3. NPK+Biolinfa (34% organic matter, 3 %N, 5.80 % K_2O);
4. NPK+Oligomix (1.20 % B, 0.10 % Cu, 4 % Fe, 1.50 % Mn, 0.10 % Mo, 2 % Zn).

NPK fertilizer (Polyfeed 11-44-11) was applied by soil in the end of November 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).

Results and discussion

Climate is one of the most important environmental factors from which successful raising depends of all fruit kinds with no exception of almonds (Šoškić, 1996).

The influence of climate elements manifest as time of vegetation of fruit as well as in the phase of resting.

Almonds best gain a head in regions with short winter without big temperature variants with absents of frost in annual amount of average temperature over 3000^{o}C (Bulatović, 1989).

Valandovo region is known as region with lots 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, the temperature to move from 0 to 6^{o}C for almond awakening.

Average year temperature of the air in the Valandovo region is 15^{o}C. Sensibility of low temperatures is brand characteristic. Almond varieties that blossom early are more sensitive than other.

Unopened blossoms can be damaged on -3^{o}C to -4^{o}C, and open on -1.5 to -2.8^{o}C, and just planted fruit on - 1 to -1.5^{o}C (Bulatović, 1985).

Almonds are sensitive on very high atmospheric humidity and suffer from diseases and don't give good yields.

Average year relative humidity in Valandovo region is 71% with maximum of 80% in November, December and January.

Soil conditions have an especially importance on growing, developing and fruits quality. The almond has the best growth and yield in deep, alluvial - diluvia, 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, too wet and clay are unsuitable for growing almonds.

Tabela 1. Agrohemiska analiza zemljista
Table 1. Agrochemical analyses of soil

Lab. No.	Dubina cm *Depth cm*	pH		Dostupni oblici mg/100g zemljista *Available forms mg/100g soil*			Humus % *Humus %*	$CaCO_3$ %
		KCl	H_2O	N	P_2O_5	K_2O		
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**

Tabela 2. Prosecan prinos plodova badema i jezgra (2011/2012)
Table 2. Average yield of almond fruits and kernels (2011/2012)

Varijanta *Variant*	Plodove kg/stablo *Fruits kg/stem*	Plodove kg ha^{-1} *Fruits kg ha^{-1}*	Jezgra kg/stablo *Kernels kg/stem*	Jezgra kg ha^{-1} *Kernels kg ha^{-1}*
1	2.87	1822	1.27	806.45
2	4.38	2781	1.98	1257.30
3	3.30	2095	1.50	952.50
4	4.15	2635	1.82	1155.70
	LSD (0.05) = 340 LSD (0.01) = 380		LSD (0.05) = 85 LSD (0.01) = 97	

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

From data shown in Table 2 can be concluded that soil and foliar fertilizing have positive influence on the almond yield. All of the variants treated with different kinds of fertilizers have higher yield compared with the control, untreated variant.

The highest average almond fruits yield (2781 kg ha^{-1}) and the highest average almond kernels yield (1257.30 kg ha^{-1}) was obtained in variant 2 where the treatments were made with fertilizer 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 lowest average almond fruit yield (1822 kg ha^{-1}) and the lowest average yield of kernels (806.45 kg ha^{-1}) was determined in control, untreated variant.

In the variants treated with different fertilizers, the lowest average fruit yield (2095 kg ha^{-1}) and the lowest average kernels yield (952.50 kg ha^{-1}) was determined in the variant 3 treated with NPK+Biolinfa (34% organic matter, 3 %N, 5.80 % K_2O).

Statistical significant differences for the average almond fruits yield are determined in the variants 2 and 4 at the both levels.

Statistical significant differences for the average almond kernels yield at the LSD level 0.05 are determined in the variant 2 and 4, but at the LSD level 0.01 only in the variant 2.

The positive foliar influence of used fertilizers on almond yield is due to their chemical composition. The presence of micro elements in the analyzed fertilizers has a great influence on the regular growing, development and almond yield (Gramatikov, 2005). This elements has an influence on numerous physiological – biochemical processes that has a vital importance on culture vegetation cycle. Balanced nutrition plays a significant role for increasing of fruits and kernels yield and its quality and presents an essential component of nutrient management (Brown et al., 2004; Panayotova et al., 2014).

Conclusion

Based on the obtained results for the influence of foliar fertilizing on the yield of Primorski almond cultivar grown in Valandovo region, the following conclusion can be made:

- The soil where the field experiment were carried out, was characterized with neutral pH value, good fertility with available nitrogen and medium fertility with available phosphorus and potassium;
- Organic foliar fertilizing had achieved positive effects on the yield at all variants with different organic fertilizers compared with control variant;
- The highest average almond fruits yield (2781 kg ha^{-1}) and the highest average yield of kernels (1257.30 kg ha^{-1}) was obtained in variant 2 where the treatments were made with fertilizer 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);
- In the variants treated with different fertilizers, the lowest fruit yield (2095 kg ha^{-1}) and the lowest kernels yield (952.50 kg ha^{-1}) was determined in the variant 3 treated with fertilizer NPK + Biolinfa (34% organic matter, 3 %N, 5.80 % K_2O).

References

Bogdanović M., Velkonija N., Racz Z. (1966). Chemical methods of soil analysis. Book I, *sine loco*, 93–98.

Bulatović C. (1989). Modern fruit production, Nolit, Belgrade, Republic of Serbia, 69–75.

Bulatović S. (1985). Walnut, hazelnut, almond, Nolit, Belgrade, Republic of Serbia, 110–117.

Brown P.H., Zhang Q., Stevenson M., Rosecrance R. (2004). Nitrogen fertilization recommendation for almond. University of California 18–27.

Datnoff L.E., Elmer W.H., Huber D. M. (2007). Mineral nutrition and plant disease. American Phytopathological Society, St Paul, M. N. (278): 89–93.

Domagalski J.L., Ator S., Coupe R. (2008). Comparative study of transport processes of nitrogen, phosphorus and herbicides to streams in five agricultural basins, USA. J Environ Qual, 37 (1158): 69–72.

Dzamič R., Stevanović D. (2000). Agrochemistry, Faculty of agriculture, Belgrade, 93–98.

Glintic M., Krstic Z. (1990). Plant nutrition and protection, Sabac, Republic of Serbia, 102–108.

Gramatikov, B. (2005). Effect of microfertilizer "Humustim" on the productivity of some field crops. 2nd Barley response, Balkan Science Conference, Book of proceedings, Karnobat, Vol:2, pp. 476–479.

Jekić M., Brković M. (1986). Agrochemistry and plant nutrition, Faculty of agriculture, Prishtina, 78–82

Kostadinov K., Kostadinova S. (2014). Nitrogen efficiency in eggplants (*Solanum Melongena L.*) depending on fertilizing. Bulgarian Journal of Agricultural Science, 20: 287–292.

Panayotova G., Bozhanova V., Kostadinova S., Valkova M., Almaliev A. (2014). Response of durum wheat (*Triticum durum Desf.*) cultivar progress to foliar feeding. Journal of International Scientific Publications: Agriculture and Food, 2: 288–297.

Sarić M., Stanković Z., Krstić B. (1989). Plant physiology, Science book, Novi Sad, Serbia, 123–125.

Sarić M., Kastori R., Pertovic M., Krstic B., Petrovic N. (1986). Practical book of physiology, Science book, Belgrade, 27–33.

Ubavić M., Kastori R., Oljaća R., Marković M. (2001). Fruit nutrition, Faculty of agriculture, Banja Luka, Republic of Serbia, 49–55.

Veličković M. (2002). Fruit production, Faculty of agriculture, Belgrade, Republic of Serbia, 23–27.

Youssefi F., Weinbaum S.A., Brown P.H. (2000). Regulation of nitrogen partitioning in field-grown almond trees: effects of fruit load and foliar nitrogen applications. Plant soil. 227: 273–281.

Šaćiragić B., Jekić M. (1988). Agrochemistry, Faculty of agriculture, Saraevo, Bosnia and Herzegovina, 125–132.

Šoškić M. (1996). Modern fruit production, Partenon, Belgrade, Republic of Serbia, 68–73.