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EFFECTS OF CHEMICAL THINNING OF SOUR CHERRRY FLOWERS*

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SUMMARY: The paper presents the results of chemical thinning of sour cherry flowers of the Šumadinka and the Čačanski rubin cultivars. The treatments were performed in the full flowering phase, using 0.0025% concentration of the LG-GER-ATS (ammonium thiosulphate). Following the application of the LG-GER-ATS, the number of set fruits was reduced by 9.8% and 8.0% for the Šumadinka and Čačanski rubin cultivars respectively, compared to trees receiving no treatment. The thinning of the flowers had an impact on the increase of the fruit mass by 19.1% and 10.9% in the Šumadinka and the Čačanski rubin cultivars respectively. Trees treated with LG-GER-ATS recorded a higher yield in both years of trial – the yield in Šumadinka cultivar was higher by 20.7% per tree, while the yield of the Čačanski rubin cultivar was higher by 17.1% per tree.

***Key words**: sour cherry, ammonium thiosulphate, chemical thinning of flowers, fruit, yields.*

INTRODUCTION

Chemical thinning of flowers or fruits in early embryonic phase is a regular pomotechnical measure for certain types of fruits. Chemical thinning is especially successfully performed in apples, peaches and apricots (Costa and Vizzotto, 2000; Keserović et al.; 2012, Lukić et al., 2010; 2012; Mratinić, 2012; Milatović, 2013). The thinning is performed in order to eliminate alternative productivity and obtain a higher average fruit mass, as well as a higher share of the larger-size fruits, better colouring and higher contents of sugar, acids, and other components (Link, 2000). According to Webster and Spencer (2000), excessive vigour of trees may result in a harvest of smaller-size fruits

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and fruits of lower quality, breaking of branches, exhaustion of trees and reduced frost resistance. Stopar (2002) points out that with non-thinned trees of the Golden Delicious apple cultivar, 83% of the harvested fruits were smaller than 70 mm, while at the same time the total yield in the treated trees was not larger than that of the non-treated trees, since the trees that produced larger-size fruits were at the same time the ones with a lower yield per tree. In recent years, there has been a growing use of thinning of flowers and fruits in the cherry production, with an aim of meeting the market demands for high-quality fruits (Whiting et al.; 2006; Schoedl et al.; 2007; Milić et al., 2012). Chemical thinning is insufficiently used in sour cherry production, mostly due to the fact that sour cherry fruits are mainly used in industrial processing.

The aim of the research was to evaluate the effect of the ammonium thiosulphate on the quality of fruit and the yield of sour cherry cultivars.

MATERIAL AND METHODS

The trial was conducted in the collection orchard of sour cherries in the Fruit Research Institute in Čačak, during 2011 and 2012. The orchard lies at an altitude of 242 m, on soil with the category of alluvial loam sediments. The sour cherries were planted at the distance of 4 x 3 m (833.3 trees/ha) and the trial included the Šumadinka and Čačanski rubin cultivars, both created at the Fruit Research Institute in Čačak.

The treatments were conducted at the phase of full bloom, in dry and warm weather conditions (22°C) using the LG-GER-ATS (ammonium thiosulphate) preparation, in the 0.0025% concentration (25 ml/10 l water). The orchard was treated with standard agro-technical and pomo-technical measures, supported by the drip irrigation system. The trial was set up using the randomised block system (2 cultivars x 5 trees x 3 replications).

The ratio between percent fruit set and non-fertilised flowers was determined in the end-of-flowering and fruit set phase. Samples of fruits were taken every ten days during the period from the fruit set to the ripening of fruits. The fruit mass was measured in order to monitor the dynamics of growth of fruits, while the yield per tree and per unit of area was determined in the harvesting phase. Major pomological-technical traits of fruits were also determined.

The dimensions of fruits, stone and stalk were determined using a digital calliper with a 0.01 mm resolution, while the mass was determined using the 'Metler' technical scales, with a 0.01 g precision. The dry soluble matter was determined using the German 'KRUSS' digital refractometer.

The paper presents average results for the two-year period of the trial, statistically processed using the Analysis of Variance and Duncan's Test for significance threshold $P \leq 0,05$.

RESULTS AND DISCUSSION

The implementation of the ammonium thiosulphate caused a reduction in the number of set fruits in Šumadinka cultivar by 9.8% on average per year of trial, i.e. by an average 8.0% in Čačanski rubin cultivar. The results for the rate of non-fertilised flowers were

opposite to the results obtained for the rate of set fruits. There were highly significant differences that were determined between the treatments (Table 1).

Table 1. Effects of chemical thinning of flowers

Parametri	Year	Šumadinka		Čačanski rubin	
		treated	control	treated	control
Number of treated flowers	2011	747	984	877	728
	2012	783	726	723	742
	Mx	765	855	800	735
Set fruits (%)	2011	52,7 b	62,5 a	52,2 b	60,4 a
	2012	54.7 b	64.5 a	54.8 b	62.6 a
	Mx	53.7 b	63.5 a	53.5 b	61.5 a
Non-fertilised flowers (%)	2011	47,3 a	37,5 b	47,8 a	39,6 b
	2012	45.3 a	35.5 b	45.2 a	37.4 b
	Mx	46.3 a	36.5 b	46.5 a	38.5 b

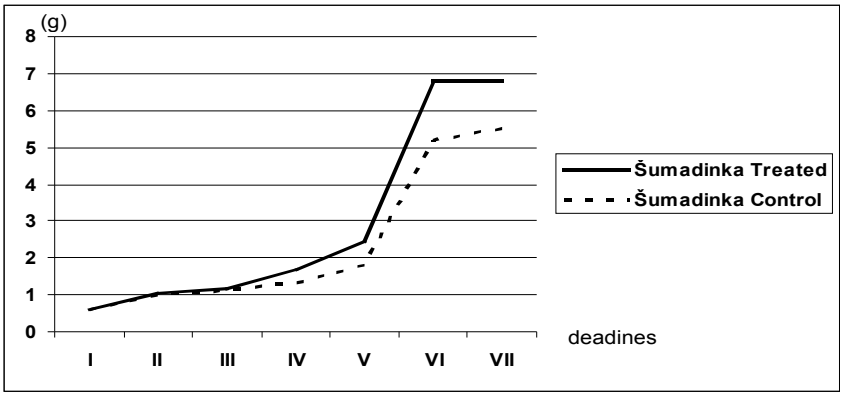
The reduction in the flowering and fruit-setting potential resulted in an increase in fruit size and mass among the treated trees. The fruit mass in the treated trees was on average higher by 1.3 g (19.1%) and 0.9 g (10.9%) in the Šumadinka and the Čačanski rubin cultivars, respectively, compared to the fruit mass of the non-treated trees. The differences detected in the fruit mass resulting from the different treatments were highly significant. The stone mass did not show any significant differences in different treatments so that consequently no statistical differences have been established for this parameter. The flesh ratio in treated Šumadinka cultivar was significantly higher for 2.5% than with untreated fruits, while it was only insignificantly (0.4%) higher in Čačanski rubin cultivar.

The stalk length is an important parameter for the speed and quality of sour cherry harvesting. The trial did not reveal any significant differences between the tested treatments, regarding the length of the stalk and the dry soluble matter contents. The obtained results indicate that the increased yield causes no disturbances in the content of the dry soluble matter, which is a basic indicator of the quality of fruits regarding determination of the proper time for harvesting and processing of fruits (Table 2).

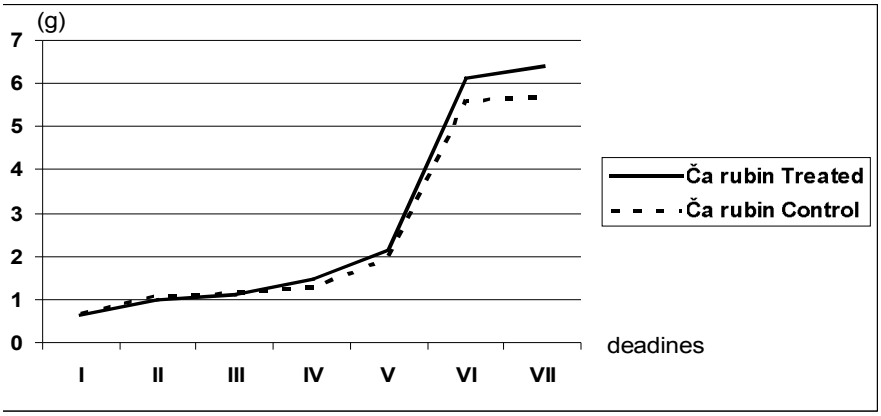
Table 2 Effects of thinning on fruit size and mass

Parameters *Parametri* treated		Šuma-dinka	Čačanski rubin		
		control	treated	control	
Fruit (mm)	Lenght	21.0 a	19.1 b	21.2 a	19.6 b
	Width	20.9 a	19.3 b	21.2 a	19.7 b
	Thickness	23.0 a	21.4 b	22.3 a	20.9 b
Stone (mm)	Lenght	11.7 a	11.1 a	11.5 a	11.4 a
	Width	11.8 a	9.9 b	10.1 a	10.2 a
	Thickness	7.9 a	7.6 a	7.8 a	7.7 a
Fruit mass (g)		6.8 a	5.5 b	6.4 a	5.7 b
Stone mass / *Masa koštice* (g)		0.45 a	0.50 a	0.54 a	0.50 a
Flesh ratio/ *Sadržaj mezokarpa* (%)		93.4 a	90.9 b	91.6 a	91.2 a
Fruit stalk-lenght / *Dužina peteljke* (mm)		35.3 a	36.8 a	37.4 a	38.2 a
Soluble solids / *Rastvorljive suve materije* (%)		13.4 a	13.7 a	12.8 a	12.5 a

Graphs 1 and 2 illustrate the growth dynamics of the fruits in the tested cultivars. The trial revealed that the fruits had a similar growth dynamics in the first growing phase (from the fruit-set until the beginning of stone formation), followed by an increasing difference in the fruit growth dynamics in the second phase (stone formation phase) and the significant increase in the fruit growth of treated trees, compared to the non-treated, occurring in the third phase (fruit-growth phase). These differences in the growth of fruits between the different treatments were especially noticeable in the Šumadinka cultivar.



Graph. 1. Dynamics of fruit growth of the Šumadinka cultivar (g)



Graph 2. Dynamics of fruit growth of the Čačanski rubin cultivar (g)

The best indicator of the positive effect of the flower-thinning in the tested sour cherry trees was the yield per tree and per unit of area. In the Šumadinka cultivar, the yield per tree in the first year was higher by 0.6 kg (8.1%), and in the second year by 6.6 kg (33.3%), i.e. the average increase in the yield for the two years of trial was 3.0 kg (20.7%). The increase in the yield in the Čačanski rubin cultivar in the first year was 0.7 kg (8.2%), and 3.9 kg (26.0%) in the second year, amounting to the average increase of 2.3 kg (17.1%) for the two trial years. Expressed in the yield per unit of area, the average increase in the Šumadinka cultivar yield was 3 t/ha (26.5%), while the average increase in the yield of the Čačanski rubin was 1.92 t/ha (19.6%). Highly significant differences have been detected between the treatments, in both yield per tree and yield per unit of area (Table 3).

Tab. 3. Effects of flower-thinning on the fruit yield

Parameters		Year treated	Šumadinka		Čačanski rubin	
			control	treated	control	
Yield	Kg / tree	I	7.4 a	6.8 a	8.5 a	7.8 a
		II	19.8 a	13.2 b	15.0 a	11.1 b
		Mx	13.3 a	10.3 b	11.75 a	9.45 b
	t/ha	I	6.17 a	5.67 a	7.08 a	6.49 b
		II	16.49 a	10.99 b	12.5 a	9.25 b
		Mx	11.33 a	8.33 b	9.79 a	7.87 b

Schoedl et al. (2007) report that chemical thinning of sour cherry cultivars using ammonium thiosulphate in two concentrations – one of 8.82 g/l and the other of 17.6 g/l – resulted in an increase in the fruit mass and the content of the dry soluble matter, without having a significant impact on the yield. In their treatment of the Bing cultivar raised on Gisela 6 rootstock, in addition to ammonium sulphate (2%), Whiting et al. (2006) were using fish oil (2%) + lime sulphur (2,5%) and a vegetable oil emulsion (200 gal/acre), achieving satisfactory results regarding fruit quality. Milić et al. (2012) were researching the effect that various preparations including ammonium thiosulphate had on thinning of flowers and size of fruits in sweet cherry cultivars, reaching a conclusion that thinning of flowers using ammonium thiosulphate resulted in a reduction of set fruits, accompanied by an increase in the fruit mass. The results achieved in sour cherries using the ammonium thiosulphate treatment indicate the possibility of a successful use of this compound in the thinning of sour cherry flowers.

Chemical thinning of sour cherry fruits is a practice rarely used in fruit production and apart from certain fragmentary and general declarations, no concrete research results exist in this area. The reason for this situation can be found in the fact that sour cherry fruits are primarily used for industrial processing. Mratinić (2002), Milenković et al. (2006) and Blagojević et al. (2012) state that fruits of the Šumadinka sour cherry cultivar can be used as table fruits, as well as in industrial processing, where they are converted into confitures, jams, juices and similar products requiring the use of larger-size fruits, while the fruits of the Čačanski rubin cultivar are primarily used in industrial processing. According to the results obtained by Rakićević et al. (2008), the Šumandinka cultivar is characterised by an average fruit mass ranging from 4.5 to 6.6 g, the flesh ratio of 83.5 to 84.0% and a yield per tree in the range of 10.8 to 12.6 kg, while Nenadić-Mratinić et al. (2006) state that the average fruit mass of the Čačanski rubin cultivar amounts to 5.61 g. This trial showed that the trees treated with ammonium thiosulphate produced fruits that were characterised by a larger mass than the ones found by the quoted authors, which points to the fact that chemical thinning of fruits is more justified, given the fact that it produces fruits of larger dimensions and mass. The yields per tree and unit of area recorded in the trial were also higher in trees undergoing the treatment that the results obtained by Rakićević et al. (2008), which can contribute to better financial results in sour cherry production. On the other hand, the increased yield did not have a significant impact on the dry soluble matter contents, i.e. quality of fruit, which provides further justification for a more widespread use of this treatment in future practice.

CONCLUSIONS

Based on the obtained results, it can be concluded that thinning of sour cherry flowers based on the use of ammonium thiosulphate has a positive impact on the fruit quality and yields.

The use of the LG-GER-ATS reduced the number of set fruits by 9.8% in the Šumadinka cultivar, i.e. by 8.0% in the Čačanski rubin cultivar, when compared to the non-tretaed trees. The thinning of the flowers led to an increase in the fruit mass of 19.1% in the Šumadinka cultivar, i.e. 10.9% in the Čačanski rubin cultivar, while at the same time the contents of the dry soluble matter in the fruits did not demonstrate any significant differences between the tested treatments. The trees treated with ammonium thiosulphate

recorded a higher yield in both trial years, with the actual increase in yield per tree of 20.7%, i.e. 26.5% increase in yield per unit of area in the Šumadinka cultivar, and 17.1% increase in yield per tree, i.e. 19.6% increase in yield per unit of area in the Čačanski rubin cultivar.

However, the success of the thinning treatment is highly dependent on the numerous external factors – primarily on the weather conditions during and following the treatment, the active substance of the preparation, its formulation and concentration, the time and method of application, and other factors. In order to be able to recommend the thinning of sour cherry flowers to be used in wider production practice as a necessary measure for improving the fruit quality and yield, it will be necessary to continue the research into various sour cherry cultivars, at various sites.

REFERENCES

BLAGOJEVIĆ, R., BOŽIĆ, V., STANKOVIĆ, M.: Tehnologija proizvodnje višnje i marele. Niš, pp. 3-42, 2012.

COSTA, G., VIZZOTTO, G.: Fruit thinning of peach trees. Plant Growth Regulation, 31 (1/2)113-119, 2000.

KESEROVIĆ, Z., MILIĆ, B., MAGAZIN, N., DORIĆ, M.: Efikasnost preparata na bazi 6-benziladenina u proređivanju plodova jabuke. Voćarstvo, 46(179-180)91-98, 2012.

LUKIĆ, M., MARIĆ, S., GLIŠIĆ, I., MILOŠEVIĆ, N.: Primena NAA i BA u hemijskom proređivanju plodova sorti jabuke grupe 'Red Delicious'. Voćarstvo, 46(177-178)7-15, 2012.

LUKIĆ, M., MARIĆ, S., MITROVIĆ, M., MILOŠEVIĆ, M.: Primena hemijskih preparata za proređivanje plodova jabuke. XV savetovanje o biotehnologiji sa međunarodnim učešćem, Agronomski fakultet, Čačak, pp. 325-330, 2010.

LINK, H.: Significance of flower and fruit thinning on fruit quality. Plant Growth Regulation, 31 (1/2)17-26, 2000.

MILENKOVIĆ, S., RUŽIĆ, Đ., CEROVI, R., OGAŠANOVIĆ, D., TEŠOVIĆ, Ž., MITROVIĆ, M., PAUNOVIĆ, S., PLAZINIĆ, R., MARIĆ, S., LUKIĆ, M., RADIČEVIĆ, S., LEPOSAVIĆ, A., MILINKOVIĆ, V.: Sorte voćaka stvorene u Institutu za voćarstvo-Čačak. Institut za istraživanja u poljoprivredi SRBIJA, Beograd, pp. 1-174, 2006.

MILATOVIĆ, D.: Kajsija. Naučno voćarsko društvo Srbije, Čačak, pp. 1-442, 2013.

MRATINIĆ, E.: Višnja, Vizartis, Beograd, pp. 1-171, 2002.

MRATINIĆ, E.: Breskva. Partenon, M.A.M. Sistem, Beograd, pp. 1-655, 2012.

MILIĆ, B., KESEROVIĆ, Z., MAGAZIN, N., DORIĆ, M.: Chemical flower thinning in sweet cherry cultivars. Paper and Abstract Proceeding, Vrnjačka Banja, Serbia, pp. 182, 2012.

NENADIĆ-MRATINIĆ, E., MILATOVIĆ, D., ĐUROVIĆ, D.: Biološke osobine sorti višnje u beogradskom Podunavlju. Zbornik naučnih radova, Beograd, 12(3)24-29, 2006.

RAKIĆEVIĆ, M., MILETIĆ, R., BLAGOJEVIĆ, M., MITROVIĆ, M.: Uticaj podloge i rezidbe na početnu rodnost i kvalitet plodova sorte višnje Šumadinka. Zbornik naučnih radova, Beograd, 14(5)49-54, 2008.

SCHOEDL, K., MODL, P., FORNECK, A.: Flower thinning with sweet cherry (*Prunus avium* L.): A first year field study. Mitteilungen Klosterneuburg, 57(176-179), 2007.

STOPAR, M.: Thinning of Gala and Golden Delicious apples with BA, NAA and their combinations. Journal of Central European Agriculture, 3(1)1-6, 2002.
WHITING, D. M., OPHARDT, D., McFERSON, J.: Chemical Blossom Thinners Vary in Their Effect on Sweet Cherry Fruit Set, Yield Fruit Quality and Crop Value. HortTechnology, 16(1)66-70, 2006.
WEBSTER, A.D., SPENCER, J.E.: Fruit thinning plums and apricots. Plant Growth Regulation, 31 (1/2)101-112, 2000.

EFEKTI HEMIJSKOG PROREĐIVANJA CVETOVA VIŠANJA

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Izvod

U radu su prikazani rezultati hemijskog proređivanja cvetova višanja, sorti Šumadinke i Čačanski rubin. Tretiranja su obavljena u fazi punog cvetanja preparatom LG-GER-ATS (amonijum tiosulfat) u koncentraciji od 0,25%. Primenom preparata LG-GER-ATS smanjen je broj zametnutih plodova za 9,8% kod sorte Šumadinka i za 8,0% kod sorte Čačanski rubin u odnosu na netretirana stabla. Proređivanje cvetova uticalo je na povećanje mase plodova za 19,1% kod sorte Šumadinka i za 10,9% kod sorte Čačanski rubin, dok se sadržaj rastvorljivih suvih materija u plodovima nije bitnije razlikovao između ispitivanih tretmana. Stabla tretirana amonijum tiosulfatom ostvarila su veće prinosi u obe godine ispitivanja za 20,7% po stablu ili 26,5% po jedinici površine kod sorte Šumadinka i za 17,1% po stablu ili 19,6% po jedinici površine kod sorte Čačanski rubin.

Ključne reči: višnja, amonijum tiosulfat, hemijsko proređivanje cvetova, plod, prinosi.

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