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## Effect of anti-hail nets on the yield and fruit quality of raspberry cultivars in Western Serbia

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*\*\*Original scientific paper; Supported by the Ministry of Education, Science and Technological Development of the Serbia, Projects No. TR-31064 and No. R-31093*

### SUMMARY

The impact of anti-hail nets on yield and fruit quality of two floricane red raspberry cultivars 'Meeker' and 'Willamette' and a primocane cultivar 'Polka' has been examined in agro-ecological conditions of Western Serbia. The experiments were set up in the localities in the municipality of Arilje (Western Serbia). Anti-hail net and drip irrigation system were installed in 'Meeker' and 'Willamette' plantations. In the plantation with cultivar 'Polka', beside anti-hail net and drip irrigation, sprinkler irrigation system was installed. During the same period, experiments were also conducted in the plantations of these cultivars grown by the conventional system without anti-hail net and with drip irrigation system.

Obtained results showed that anti-hail net in unfavorable weather conditions (high temperatures, excessive insolation, snow and hail) significantly reduce their negative effects. In contrast, the negative effect of anti-hail net was recorded during seasons with extremely high rainfall and a reduced amount of daylight.

**Key words:** raspberry, weather conditions, effect, anti-hail net, yield

**INTRODUCTION**

Bramble production is under heavy impact of the environmental factors. These factors may have a negative effect on the yield and fruit quality. Anti-hail nets may reduce insolation and possible danger during harvest in summer period, and may also reduce the negative mechanical effect of heavy rainfalls and high temperatures (Petrovi and Leposavi, 2016). The positive effect is manifested during years with unfavorable weather conditions and in following years through better and more regular yield potential and higher yields (Kiprijanovski et al., 2016). The color of anti-hail nets may influence in significant manner on the yield, fruit quality, taste and aroma, but also on the vegetative and generative growth balance (Shahah et al., 2008).

**MATERIAL AND METHODS**

Pomological properties of two florricane raspberry cultivars 'Willamette' and 'Meeker' were studied in the agro-ecological conditions of Western Serbia during 2015-2016. The experiments were set up in locality Mirosaljci, municipality of Arilje. Anti-hail net (shade percentage 18-20%) and drip irrigation system were installed in plantations with raspberries 'Meeker' and 'Willamette'. Raspberries were grown in vertical trellis system with two single wires. In the plantation with raspberry 'Polka', beside anti-hail net and

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170-175 cm (

10

25

(kg),

(kg.ha<sup>-1</sup>).

(kg)

Ohaus Adventurer Pro.

Vernier

(SS)

Carl Zeiss 3828.

drip irrigation, sprinkler irrigation system was installed. During the same period, experiments were also conducted in the plantations of the stated cultivars grown by the conventional system without anti-hail net and with drip irrigation system.

In plantations with raspberries 'Willamette' and 'Meeker' all selected and tied canes were topped at 170-175 cm (two buds above the upper wire) during spring. Each cultivar was included with four repetitions of 10 meters per row. After tying, canes were counted per each repetition. In the plantation with 'Polka' only autumn harvest was conducted, after which all canes were cut above the ground.

The yield was obtained by measuring all harvested fruits on the sample consists of 25 selected canes, from the beginning to the end of the harvest. The yield per meter of row and per unit of area was obtained by multiplication of yield per cane and the number of canes per unit area.

Other yield parameters that were followed were: total number of canes, number of canes per meter of row, yield per cane (kg), yield per row meter (kg) and yield per unit area (kg.ha<sup>-1</sup>).

Fruit mass was measured on the technical balance Ohaus Adventurer Pro. Fruit dimensions (length, width and thickness) were measured with Vernier scale. The soluble solids (SS) were measured by manual refractometer Carl Zeiss 3828.

## RESULTS AND DISCUSSION

Greater number of canes per meter of row and total number of fruiting canes per unit area was recorded in cultivars grown by the conventional system without anti-hail net in both years of the study. Considering the growing system in raspberry 'Polka' (row 60 cm wide), the greatest number of fruiting canes per row

meter and unit area was recorded in the plantation without anti-hail net (44,000 in 2016; Table 1). Raspberries 'Willamette' and 'Meeker' grown in the trellis system gave the greatest number of canes in plantations that were not covered with anti-hail nets.

During the first year of the study plants of all three cultivars under anti-hail net had higher yields per cane and unit area than plants grown without net (Tables 1 and 2).

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**Table 1. Yield of raspberry cultivars in plantations grown by the conventional system**

Cultivar	Year	( m ) Number of canes (per m of row)	( ha ) Total number of canes (on ha)	Yield per cane (g)	Yield per unit area (kg.ha <sup>-1</sup> )
'Meeker'	2015	5.3	21,200	690	14,628
	2016	5.5	22,000	470	10,340
'Willamette'	2015	5.6	22,400	745	16,688
	2016	5.8	23,200	510	11,832
'Polka'	2015	9.4	39,686	215	8,532
	2016	11.0	44,000	225	9,900

2.

**Table 2. Yield of raspberry cultivars in plantations under anti-hail nets**

Cultivar	Year	( m ) Number of canes (per m of row)	( ha ) Total number of canes (on ha)	Yield per cane (g)	Yield per unit area (kg.ha <sup>-1</sup> )
'Meeker'	2015	5.2	20,800	750	15,600
	2016	5.4	21,600	520	11,230
'Willamette'	2015	5.4	21,600	790	17,064
	2016	5.7	22,800	580	13,224
'Polka'	2015	9.0	38,000	242	9,196
	2016	10.5	42,000	218	9,156

The highest yield was recorded in raspberry 'Willamette' (790 g per cane, 17,064 kg.ha<sup>-1</sup>), followed by 'Meeker' (750 g per cane; 15,600 kg.ha<sup>-1</sup>) and 'Polka' (242 g per cane, 9,196 kg.ha<sup>-1</sup>). Similar results were obtained in the second year of the study. 'Willamette' had the highest yield in both plantations (with and without anti-hail net). The yield under

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13,224 kg.ha<sup>-1</sup>. " " , 1.392 kg  
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 892 kg - , -  
 - . -  
 (16 2016 .; 1).

net was 580 g per cane, and 13,224 kg.ha<sup>-1</sup>. 'Willamette' grown without net had 1,392 kg less yield per ha, than the one grown under net. Raspberry 'Meeker' grown under net had 892 kg higher yield than the one grown without net. One of the main cause of higher yields in plantations under anti-hail net is that net prevented the damages of fruiting laterals under late snowfall (16 May 2016; Figure 1).



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**Fig. 1. Snow breakage of raspberry fruiting laterals**

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The results of the morphometric parameters of raspberry fruits and soluble solids content are given in Tables 3 and 4.

3.

**Table 3. Morphometric parameters of fruits and soluble solids content in raspberry cultivars grown by the conventional system**

Cultivar	Year	Fruit mass (g)	Fruit length (mm)	Fruit width (mm)	Fruit thickness (mm)	Soluble solids (%)
'Meeker'	2015	3.75	21.33	17.86	17.54	12.88
	2016	3.94	21.84	18.14	16.64	12.10
'Willamette'	2015	3.94	21.84	19.56	19.22	12.55
	2016	4.09	23.76	18.82	18.08	11.70
'Polka'	2015	4.44	26.02	20.68	19.86	11.17
	2016	4.21	22.98	19.40	18.74	10.55





2.  
 Fig. 2. Fruit rot of raspberry 'Polka'

## CONCLUSIONS

Obtained results showed that anti-hail net, under unfavorable weather conditions (high temperatures, sunscald, late snowfall and hail) significantly reduce their negative effects.

In contrast, the negative effect of anti-hail net was recorded during seasons with extremely high rainfall and a reduced amount of daylight. Heavy rainfall and reduced sunlight were expressed during the second year of the study during flowering and fruiting.

The negative effect was reflected in lower yields, fruit size and soluble solids content. In the second part of the vegetation period, during fruiting of raspberry 'Polka', a higher number of rotted fruits was evidenced.

Further studies on the influence of anti-hail nets with lower shade percentage on the yield and quality of raspberry fruits are needed.

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