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POSTHARVEST WEIGHT LOSS AND SHELF LIFE OF TOMATO

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SUMARRY: Three tomato genotypes (F_1-18 rin, Athens F_1 and K-91) were studied during postharvest period. In the first experiment decay of ripe and immature fruits were observed. Significant differences between the average weights were identified in immature rin wild homozygote fruits and heterozygote, respectively. In the second experiment, half of fruits were treated with etrel and the control was without treatment. Then, maturation and decay of fruits was followed. It was observed that the heterozygote fruits have longer shelf life and quality during preservation then the wild type.

Key words: tomato, shelf life, ethylene

INTRODUCTION

Maturation process of tomato genotypes with *rin* genes (*ripening inhibitor*) is prolonged or stopped. These mutants do not produce ethylene and the climacteric peak in maturation is absent (Timoty and Tigchelaar, 1977). F_1 hybrids, combination of *rin* genotypes and varieties with normal ripening, change colour later (Zdravkovic *et al*. 2005). Late appearance of colour of fruits proves slower lycopene synthesis. These fruits ripe and overripe slowly, which influences better postharvest preservation (Agar *et al*. 1994, Granges *et al*. 1995, Farkas 1995, Zdravkovic *et al*. 2003a, Zdravkovic *et al*. 2004b). There are other measures to save fruits after harvesting such as: washing of fruits, removal of pathogens from the fruit that could complicate or unable preservation (Silva *et al*. 2008), paraffin coating film (Corzo *et al*. 2002), applying TiO_2 (Passam *et al*. 2007) and growing genotypes with ripening inhibitors.

Slow maturation allows putting ethylene in stocks and provoking maturation (Zdravković *et al*. 2004b). During shelf life, fruit weight decreases and the colour changes (Faria *et al*. 2003) as well as content of anti-oxidative compound – phenol, lycopene

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and vitamin C (Toor and Savage 2006). Tomato hybrids with mutant genes (ripening inhibitors) change physiological processes during post-harvesting period (Passam *et al*. 2007). Heterozygote (normal × mutated genotypes) change through decrease of fruit weight and delayed ripening (Zdravkovic *et al*. 2000). Production of ethylene in *rin* genotypes (mutant) comparing to genotypes with uniform ripening (wild type) is low or completely absent. Above results with delayed or slow ripening and therefore delayed over-ripening and decadence of fruits. *Rin* genotypes have longer shelf life than wild type.

Today there are a number of commercial tomato hybrids *rin gene* carriers with delayed fruit ripening. In practical terms, these are medium-late hybrids with firm fruits and long shelf life which enables longer transport and storage (Gavrish and Korol 1988, Zdravkovic *et al*. 2003). It is possible to manage tomato fruit maturation according to market demands by treating harvested immature fruits with etrel.

MATERIAL AND METHODS

Research material was tomato from the finishing cycles of selection: K-91 (clean line), F_1-18 *rin* (hybrid) and Atina F_1 (commercial hybrid). K-91 (*rin/rin*) is homozygote for *rin* gene and in the study of shelf life it was a control, F_1-18 *rin* (*rin*/+) is heterozygote for *rin* gene and Atina F_1 was a represent of a wild type with uniform ripening.

Study was divided in two trials. In the first trial, mature and immature fruits were picked four days after colour appearance and 50-55 days from fruit setting and without lycopene coloration, respectively. After the harvest on August 27th, number of fruits of each treatment were shelved at 20±3^{0}C. Determining the number of the decayed fruit and measuring of fruit weight were carried out in 11 terms: 27th August, 3rd September, 16th September, 24th September, 1st October, 8th October, 15th October, 22nd October, 29th October and 5th November 2007.

In the second trial, the influence of ethylene-releasing chemical on fruit maturation of the listed tomato genotypes was studied. Half of the fruits of each treatment were treated with 1000 ppm Ethephon solution for 1 minute. The other half of fruits without the Ethephon treatment represented the control.

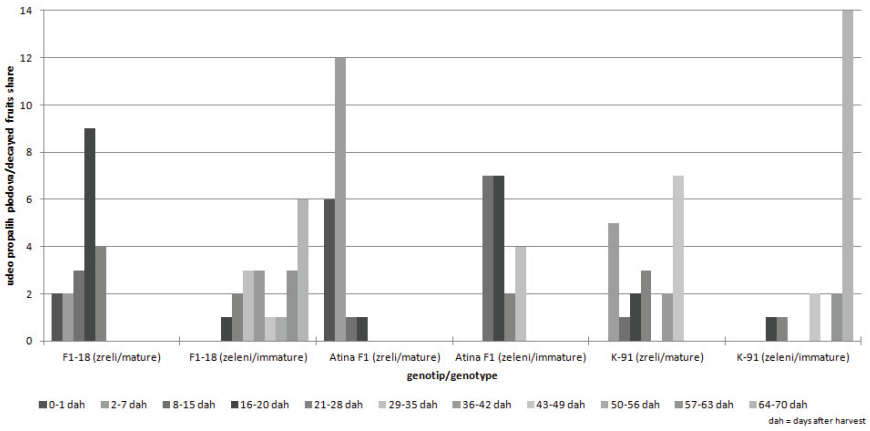
RESULTS

Results of research showed that genotypes of different genetic configuration behaved differently. In the first trial the share of decayed mature fruits after harvest, indicates that the commercial hybrid Atina F_1 - wild type deteriorated the fastest due to 90% decayed fruits in 7 days after harvest. On the contrary, 65% fruits of heterozygote configuration F1-18 *rin* lasted 15 days after harvest. Between 16 and 20 days after harvest decayed 9 mature fruits (45%) of genotype F1-18. Control mature fruits, homozygote K-91, had the longest shelf life because 45% of fruits lasted 35 days after harvest and which were completely decayed two weeks after (49 days after harvest).

Between harvested immature fruits, first were decayed from wild type. All fruits of Atina F_1 decayed 35 days from harvest. Fruits of heterozygote and homozygote configuration, F_1-18 *rin* (*rin*/+) and K-91(*rin/rin*), respectively, lasted till the end of study (70 days), but the share of the preserved fruits differed. Measures taken in 10th term

(63 days after harvest) showed that heterozygote genotype had 30% of preserved fruits while homozygote genotype had even 70% of preserved fruits.

Fig. 1: Decay dynamics of mature and immature tomato fruits
Graf 1: Dinamika propadanja zrelih i zelenih plodova paradajza



There were no significant differences in the mature fruits weight between researched genotypes per measuring terms. On the contrary, differences in the immature fruits average weight between rin/rin genotype (K-91) and heterozygote F_1-18 rin, also wild type Atina F_1 were very significant. Difference between immature fruits average weight of heterozygote F_1-18 *rin* and wild type Atina F_1 were not significant (Tab. 1)

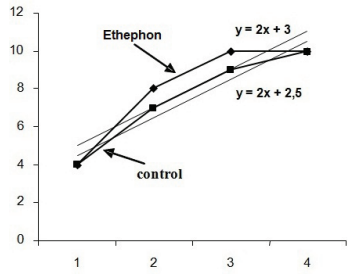
Tab 1:Decay and weight loss of tomato fruit during postharvest period -withoutEthephon
Tab 1 Propadanje i gubitak mase ploda rajčice tijekom čuvanja -bez tretmana etafonom

Measuring dates	*Genotype*					
	F_1-18 *rin*		Atina F_1		K-91	
	Immature	*Mature*	*Immature*	*Mature*	*Immature*	*Mature*
August 27	107.3	134.6	105.6	98.6	91.3	118.6
September 3	104.2	122.58	101.3	92.5	87.4	112.1
September 11	102.55	113.81	101.1		84.4	111.1
September 16	100.54	106.28	99.1		81.3	106.5
September 24	98.43	78.9	75.6		79.4	104.2
October 1	95.12		74.0		78.2	99.9
October 8	92.84				76.4	98.7
October 15	85.06				74.7	95.6
October 22	83.94				72.6	
October 29	82.38				70.6	
November 5	82.13				69.9	
$^1t_{\text{Atina F1; F1-18}} = 0.2963^{ns}$ $t_{\text{Atina F1; K-91}} = 3.7836^{**}$ $t_{\text{F1-18; K-91}} = 2.8825^{**}$						

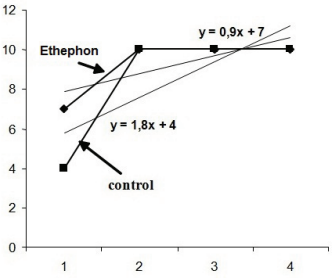
[1] For immature fruits

In the second trial with the ethylene-releasing chemical, F_1-18 *rin* (*rin*/+) genotype proved the similarity in the ripening of treated and untreated fruits. Treated fruits of Atina F_1 (+/+) and F_1-18 *rin* (*rin*/+) ripened in 5 days, but Atina F_1 treated fruits ripened quicker. Other than this, in the control group without the ethephon, fruits of both genotypes ripened after 5 days (Fig 2 and 3). Ethephon in concentration of 1000 ppm did not cause the color change on fruits of K-91 (*rin/rin)* genotype until the end of the study.

Graf 2: Sazrevanje plodova F_1-18 (rin/+) genotipa zavisno od uticaja etafona
Fig. 2 Effect of ethephon on fruit ripening of F_1-18 (rin/+) genotype

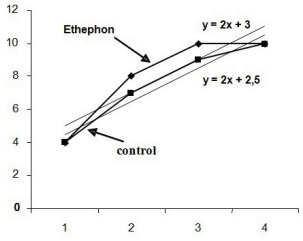


Graf 3: Sazrevanje plodova Atina F_1 (+/+) genotipa zavisno od uticaja etafona
Fig 3: Effect of ethephon on fruit ripening of Atina F_1 (+/+) genotype

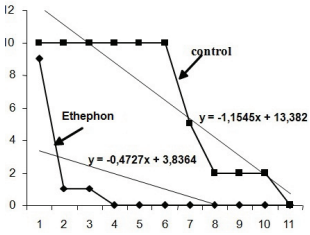


There were bigger differences between the results of the decay of tomato fruits than of ripening. Fruits of *rin*/+ genotype decayed successively, but the treated fruits decayed quicker than untreated. Treated fruits of Atina F_1 decayed suddenly, while untreated fruits prolonged the time of satisfactory shelf life. Fruits had the best quality during first 18 days of shelf life and then, almost all, decayed suddenly. Fruits of the control (*rin/rin* genotype) decayed only in case of infection with saprophyte pathogens. Fruits treated with ethephon decayed successively due to general senescence and they did not have a red colouration at that moment (Fig. 4-6).

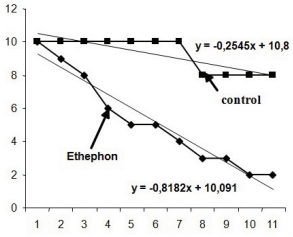
Graf 4: Starenje plodova genotipa F_1-18 *rin*
Fig. 4: Fruit senescence of genotype F_1-18 rin



Graf 5: Starenje plodova genotipa Atina F_1
Fig. 4: Fruit senescence of genotype Atina F_1



Graf 6: Starenje plodova genotipa K-91
Fig. 6. Fruit senescence of genotype K-91



DISCUSSION

Interval of two weeks is a usual time for transporting tomato on far destinations. Therefore it is necessary to pick up fruits in late non mature period so they could last up to 90 days of transport (Sisler 1982, Logendra *et al*. 2004). Consequence of inhibition of ethylene synthesis for genotypes bearers of *rin* genes is losing the aroma (McGlasson

et al. 1987). In tomato selection aiming to prolong post-harvesting period of shelf life genotypes with ripening inhibitors, it is important to take care of the quality of fruits. *Rin* genes are very important in producing ethylene and in fruit ripening (Passam *et al.* 2007). Having in mind that tomato contains antioxidant compounds that go through great changes in post-harvest period (Toor and Savage 2006), *rin* genes are considered to effect the increase of phenol and vitamin C.

Ethephon concentration of 1000 ppm used in this research did not cause the colour change on fruits of *rin/rin* genotypes. In the study of various genotypes Buescher *et al.* (1975) found that carotene synthesis is enlarged with ethephon influence. In our research, different reactions of certain genotypes on ethephon treatment were determinate. The rapid appearance of colour for genotypes with uniform ripening is the most obvious one, as well as rapid senescence of fruits of this genotype. Fruits of *rin* homozygote decayed quickly although they did not change colour previously. Mc Glasson (1985) and Mc Glasson *et al.* (1987) found that fruits of *rin* homozygote behave typically non climax. Heterozygote F_1-18 *rin* (*rin*/+) was similar to Atina F_1 (wild type), emphasizing that Atina had longer shelf life then wild genotype (Zdravkovic *et al.* 2004a). Comparing to *rin* homozygote (K-91), heterozygote (F_1-18 *rin*) has shorter shelf life.

The cause of longer shelf life is better firmness of fruits. Slow ripening and better firmness enable longer shelf life and additional time for transport (Zdravkovic *et al.* 2003). Initiation of quicker ripening with ethylene is a way of controlled ripening which is very important in commercial vegetable production (Sherman 1985).

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GUBITAK MASE PLODOVA TOKOM ČUVANJA PARADAJZA

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Izvod

Ispitivano je ponašanje plodova paradajza tri genotipa (F1-18 rin, Atina F1 i K-91) u periodu nakon njihovog branja. U okviru prvog ogleda je posmatrano propadanje zrelih i zelenih plodova. Značajne razlike između prosečnih masa su utvrđene kod zelenih plodova između rin homozigota i divljeg tipa odnosno heterozigota. U okviru drugog ogleda polovina plodova je tretirana etrelom a kontrolna varijanta je bila bez tretmana. Praćeno je sazrevanje i propadanje plodova. U okviru naših istraživanja su utvrđene različite reakcije pojedinih genotipova na tretman etafonom. Najuočljivija je ubrzana pojava boje kod genotipova sa uniformnim sazrevanjem, kao i ubrzano starenje plodova kod ovog genotipa. Ubrzano su propadali i plodovi rin homozigota, iako predhodno nisu promenili boju. U slučaju plodova heterozigota F1-18 rin (rin/+) utvrđeno je slično ponašanje kao i kod plodova Atina F1 (divlji tip), sa tom razlikom da su dugotrajniji i imaju duži "shelf life" od genotipa divljeg. U odnosu na plodove rin homozigota (K-91), plodovi heterozigota (F1-18 rin) imaju kraći rok preživljavanja. Iniciranje bržeg sazrevanja etilenom predstavlja način kontrole sazrevanja plodova posle branja što je od velike važnosti za komercijalno povrtarstvo.

Ključne reči: paradajz, čuvanje ploda, etilen