

The effect of methods accelerating fruit ripening on the yield of small-sized tomato

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ABSTRACT

The purpose of the studies, conducted in the years 2001 – 2003, was to examine the effect of the methods accelerating ripening (Ethrel, truss cutting, Ethrel + truss cutting) on yielding of two cultivars of small-sized tomato ('Cheresita F₁', 'Favorita F₁').

It was found that the total and marketable yield significantly decreased as a result of truss cutting. Ethrel did not increase either total or marketable yield whereas a significant increase in the yield of early tomato was observed after Ethrel application or Ethrel + truss cutting. 'Cheresita F₁' gave a significantly higher total, marketable and early yield but produced smaller fruits. The use of plant growth regulators (Ethrel + truss cutting) limited the number of harvests to 7 and shortened the harvest period by 12 days in comparison with the control.

INTRODUCTION

Small-sized tomato (*Lycopersicon esculentum* var. *cerasiforme* Alef.), also called cherry or cocktail tomato, has been well-known and consumed in Western Europe. In recent years its popularity has been growing in Poland.

Varieties recommended for the cultivation under covers produce long trusses, consisting of several to a few dozen flowers. Since the fruit ripening of such trusses is not uniform, harvest is time – and labour – consuming and to obtain a high early yield the number of fruits should be reduced (Dobromilska and Fawcett 2000, Orłowski et al. 2000) or plant regulators should be applied (Ohta et al. 1992, Lee et al. 1996).

Pudelski (1998) and Wysocka-Owczarek (2001) reported that tomato ripening was correlated with their ethylene (C₂H₄) content. Storing the fruits in ethylene enriched atmosphere or applying compounds containing ethylene directly on the plants or fruits accelerate ripening. One of such compounds is Ethrel, which at the concentration of 2.5% is applied by means of a brush at the base of the truss, by rubbing till a slight skin damage.

The aim of the present study was to determine the effect of Ethrel treatment and truss cutting on small-sized tomato yielding.

MATERIAL AND METHODS

In the years 2001 – 2003 at the Department of Horticulture of Szczecin University of Agriculture the effect of different methods of accelerating fruit ripening (Ethrel, Ethrel + truss cutting, truss cutting) on yielding of two cultivars of cherry tomatoes ('Cheresita F₁', 'Favorita F₁') were studied. Tomato seeds were sown into boxes, 1g per box, after 20 March. Three weeks later seedlings were transplanted into 10 cm plastic pots with peat substrate.

Tomatoes were planted in mid-May in a high unheated foil tunnel on pressed straw at a spacing 100 x 25 cm (ten plants per plot) and cultivated for 6 trusses. Previcur 607 SL at the concentration of 0.15% was used for watering the seedlings after planting them into the ground. Per 100 kg of dry straw the following fertilizers were applied: 2 kg of ammonium nitrate, 1 kg of potassium sulphate, 0.6 kg of triple superphosphate, 0.3 kg of magnesium sulphate. In the case of plants with truss cutting and those treated with Ethrel + truss cutting, the fruits were removed to leave 15 on single or multiple truss. Ethrel was applied at the base of each truss at the concentration of 2.5%. Solution of ammonium sulphate (0.2%) was applied 3 weeks later and Agrecol (20 g per plant) a month later.

In order to protect the plants from fungus diseases they were sprayed with Bravo (0.2%) and Acrobat (0.3%). For each cultivar different criteria were taken to divide marketable yield into choice groups.

Harvest finished at the beginning of September. Total, marketable (including grades) and early yields were evaluated. According to breeders mean fruit weight is: for 'Cheresita F₁' 10-15 g, 'Conchita F₁' 20-25 g, 'Favorita F₁' 13-17 g, 'Picolino F₁' 30-35 g. These values were taken as the criteria for the first grade and the fruits of smaller weight were classified as the second grade. Early yield consisted of fruit picked during first three weeks. The experiment was set in the randomised block design in four replications. The obtained results were subjected to statistical analysis with the use of Tuckey's test at the significance level $p = 0.05$.

RESULTS AND DISCUSSION

The studies conducted in 2001 showed a highly significant effect of ripening acceleration methods on the quantity of total and marketable yield. The highest total yield was obtained from the control and Ethrel treated plants, 7.25 kg m^{-2} on the average (Fig. 1). Truss cutting and truss cutting + Ethrel treatment significantly reduced the yield to 6.18 kg m^{-2} . Marketable yield of the plants treated with Ethrel + truss cutting was the smallest. However, these practices as well as Ethrel application only, contributed to obtaining a high early yield, on average 0.90 kg m^{-2} (Fig. 4).

Wysocka-Owczarek (2001) stated that setting too many fruits per truss reduced the yield quality and earliness. In medium size tomato cultivation for excessively developed inflorescences the removal of their upper parts is recommended. Adriaenssens (1998) also recommended reducing the number of fruits or using plant growth regulators to accelerate ripening.

In the case of plants with truss cutting and those treated with Ethrel + truss cutting, the fruits were removed to leave 15 on single or multiple truss. Ohta et al. (1992) advised to thin single trusses to 15 fruits and multiple ones to 20 prior to Ethrel or ABA treatment. These practices accelerated fruit maturation. 'Cheresita F₁' cultivation resulted in significantly higher total, marketable, early, the first grade yields in comparison with 'Favorita F₁'.

In 2002 no effect of the applied methods on total, marketable, early and I grade yield was found (Figs 2 and 4). Ethrel application + truss cutting significantly reduced the yield of II grade fruits (0.72 kg m^{-2}). Control plants gave the highest yield (1.70 kg m^{-2}). Cultivar turned out to be a differentiating factor with regard to total and marketable yield. The total and marketable yields of 'Cheresita F₁' were significantly higher compared to 'Favorita F₁'.

In 2003 the methods of ripening acceleration had no influence on total, marketable, I and II grade yield but did affect significantly the quantity of early yield. The highest early yield was obtained from plants treated with Ethrel 2.12 kg m⁻² (Figs 3 and 4).

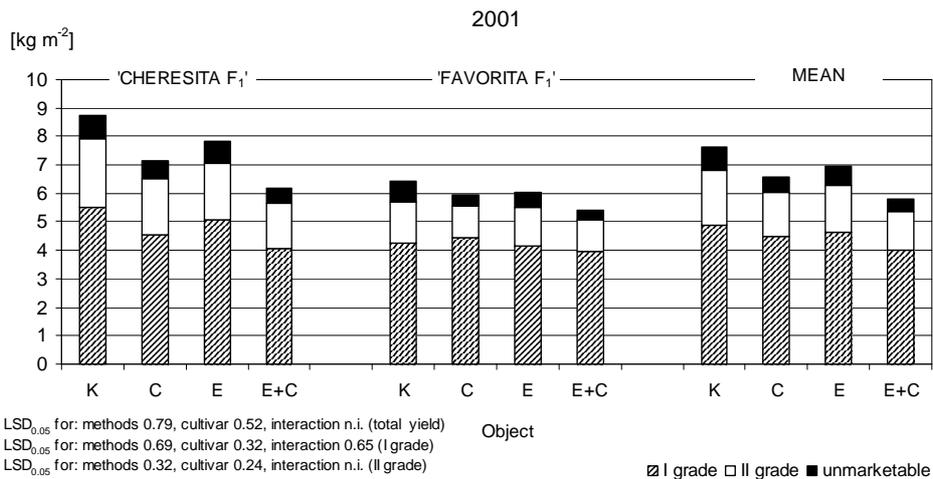


Figure 1. Effect of the methods accelerating fruit ripening on the yield of cherry tomato (2001),
 K – Control, C – Truss cutting, E – Ethrel, E + C – Ethrel + truss cutting

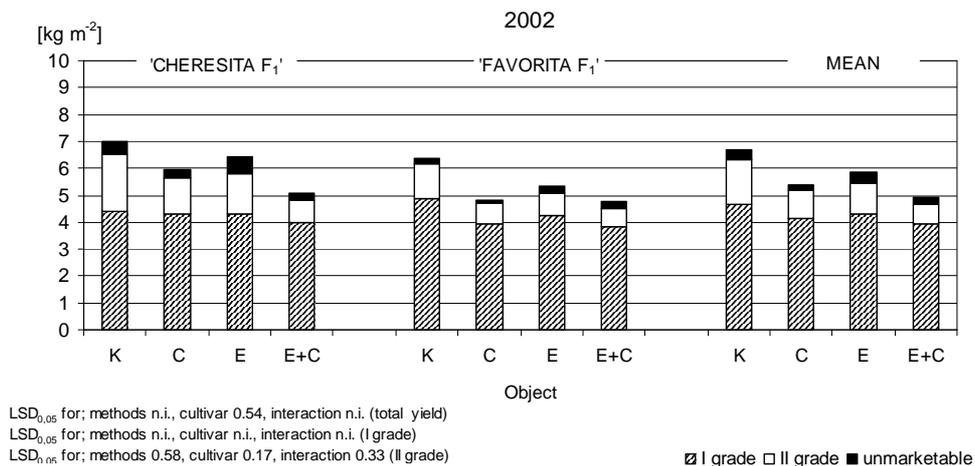


Figure 2. Effect of the methods accelerating fruit ripening on the yield of cherry tomato (2002),
 K – Control, C – Truss cutting, E – Ethrel, E + C – Ethrel + truss cutting

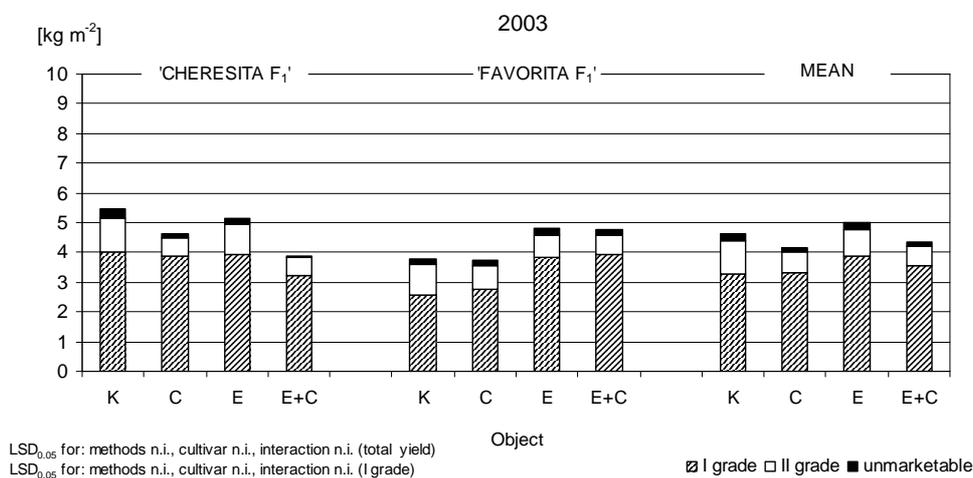


Figure 3. Effect of the methods accelerating fruit ripening on the yield of cherry tomato (2003), K – Control, C – Truss cutting, E – Ethrel, E + C – Ethrel + truss cutting

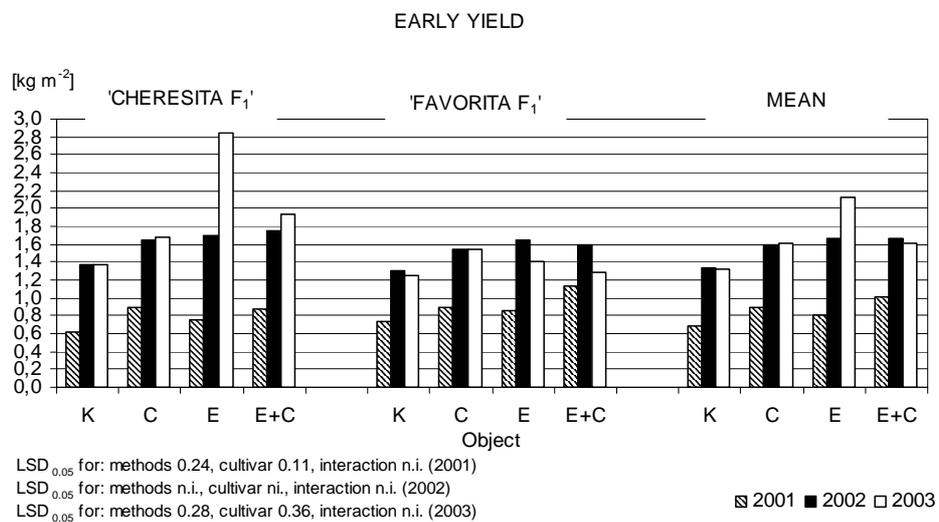


Figure 4. Effect of the methods accelerating fruit ripening on the early yield of cherry tomato (2001 – 2003), K – Control, C – Truss cutting, E – Ethrel, E + C – Ethrel + truss cutting

The synthesis of the results showed significant differences in total, marketable and early yield as affected by the applied methods (Table 1). The highest total and marketable yield were obtained from the plants treated with Ethrel (5.93 and 5.50 kg m⁻², respectively) and the control plants (6.29 and 5.84 kg m⁻², respectively). Significantly smaller total and marketable yields were obtained from the plants with truss cutting and those treated with Ethrel together with truss cutting. Truss cutting and growth regulator application reduced the total yield by 0.92 and marketable yield by 0.76 kg m⁻² in comparison with the plants treated only with Ethrel.

Ethrel treatment and Ethrel treatment + truss cutting resulted in the highest early yield (mean 1.48 kg m⁻²). Orłowski et al. (2000) proved that truss cutting to 12 and 16 fruits, decreased the total and marketable yield of small-size tomatoes, increased early yield and the weight of one fruit as well as improved the storage life of fruits. In addition, it increased the content of vitamin C in the fruits (Dobromilska and Fawcett 2000).

Highly significant differences in total and marketable yield were found in particular cultivars. The total, marketable and early yields in 'Cheresita F₁' were significantly higher than those in 'Favorita F₁' (by 0.95, 0.82 and 0.19 kg m⁻², respectively).

Lee et al. (1996) examined the effects of 4 CPA (1%) and Ethrel (0.2 and 0.3%) and their mixture on the yield and uniform colouring in cherry tomatoes. Growth regulators, their mixture in particular, significantly increased marketable yield, fruit colouring, and enabled harvesting all the tomatoes at the same time. Marketable yield increased by 121% in comparison with the control. In the present study Ethrel only increased early yield by 22.8% and the harvests were more contracted, 9 harvests in the case of the control plants, 7 harvests in the case of truss cutting + Ethrel, and 8 harvests in Ethrel treated plants. Small-sized tomatoes, evenly ripening and intensively coloured may be harvested using modern equipment, e.g. robot with computer aided visual sensor (Subrata et al. 1996).

The synthesis of the results of average fruit weight in marketable yield revealed that 'Favorita F₁' (16.83 g) produced significantly larger fruits than 'Cheresita F₁' (15.61 g) (Table 1). Piróg and Komosa (2002), evaluating yielding of small-sized tomato in greenhouse cultivation on mineral wool, stated that 'Favorita F₁' produced the fruits of 13 g on average. There was also interaction between the cultivars under study and the methods of maturing acceleration. The highest fruit weight in marketable yield was found in 'Favorita F₁' treated with Ethrel + truss cutting (17.24 g) in comparison with control. Atta-Aly et al. (1999) supposed that Ethrel application increased the weight of one fruit. However, in the present study 'Cheresita F₁' treated with Ethrel produced the fruits of smallest weight – 14.91 g.

Table 1. Effect of the methods accelerating fruit ripening and cultivar on the yield and mean weight of fruit in marketable yield, number of harvest and length of harvest period of small-sized tomato fruits (mean 2001 – 2003).

Cultivar	Method of accelerating	Yield [kg m ⁻²]					Mean weight of fruit [g]	Number of harvests	Harvest period [days]	
		Total	Marketable	Early	I grade	II grade				Unmarketable
'Cheresita F ₁ '	Control	7.06	6.53	1.19	4.63	1.90	0.53	15.85	9	63
	Truss cutting	5.91	5.56	1.24	4.26	1.30	0.35	16.44	8	54
	Ethrel	6.47	5.94	1.76	4.43	1.50	0.53	14.91	8	54
	Ethrel + truss cutting	5.04	4.76	1.53	3.76	1.00	0.28	15.25	7	51
	mean	6.12	5.70	1.43	4.27	1.43	0.43	15.61	8	55
'Favorita F ₁ '	Control	5.53	5.16	1.16	3.90	1.26	0.37	16.24	9	63
	Truss cutting	4.82	4.59	1.17	3.71	0.88	0.23	16.92	8	54
	Ethrel	5.39	5.06	1.29	4.08	0.98	0.33	16.93	8	53
	Ethrel + truss cutting	4.97	4.71	1.33	3.92	0.79	0.26	17.24	7	51
	mean	5.17	4.88	1.24	3.90	0.98	0.29	16.83	8	55
Mean for methods of accelerating	Control	6.29	5.84	1.18	4.26	1.58	0.45	16.05	9	63
	Truss cutting	5.37	5.08	1.20	3.98	1.09	0.29	16.68	8	54
	Ethrel	5.93	5.50	1.53	4.26	1.24	0.43	15.92	8	53
	Ethrel + truss cutting	5.01	4.74	1.43	3.84	0.90	0.27	16.25	7	51
LSD _{0.05} for:										
methods of accelerating		0.69	0.67	0.18	n.s.	0.27	0.10	n.s.		
cultivar		0.38	0.37	0.13	0.35	0.11	0.05	0.35		
interaction		n.s.	n.s.	n.s.	n.s.	0.22	n.s.	0.70		

CONCLUSIONS

1. Truss cutting of small-sized tomato significantly reduced the total and marketable yield.
2. Ethrel application and Ethrel + truss cutting resulted in a significant increase in early yield.
3. Ethrel + truss cutting reduced the number of harvests to 7 and shortened harvest period by 12 days in comparison with the control.
4. Total, marketable and early yields of 'Cheresita F₁' were significantly higher than those of 'Favorita F₁'.

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**BADANIA NAD WPLYWEM ZABIEGÓW PRZYSPIESZAJĄCYCH
DOJRZEWANIE OWOCÓW NA PLON POMIDORA DROBNOOWOCOWEGO**

Streszczenie: W doświadczeniu przeprowadzonym w latach 2001–2003 badano wpływ różnych metod przyspieszenia dojrzewania (Ethrel, Ethrel + cięcie gron oraz cięcie gron) na plon dwóch odmian pomidora drobnoowocowego ('Cheresita F₁', 'Favorita F₁'). Wykazano, że plon ogółem i handlowy pomidora istotnie zmniejszył się pod wpływem stosowania zabiegu cięcia gron. Ethrel nie zwiększył plonu ogółem i handlowego. Natomiast uzyskano istotne zwiększenie plonu wczesnego pomidora pod wpływem stosowania samego Ethrelu oraz Ethrelu z jednoczesnym cięciem gron. Przy uprawie odmiany 'Cheresita F₁' otrzymano istotnie większy plon ogółem, handlowy i wczesny, jednakże odmiana ta tworzyła owoce o mniejszej masie jednostkowej. Stosowanie roślinnych regulatorów wzrostu w postaci Ethrelu i cięcia gron spowodowało zmniejszenie liczby zbiorów do 7 oraz skrócenie okresu zbioru o 12 dni w stosunku do kontroli.

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