Short Time-high temperature Hot water shower against Neofabraea rot

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Abstract

Since 2007 the organic fruit production increases in Austria. From that year on, we had to store our apples until July or August of the next year. So we expected an increase of Neofabraea rot and have done some trials with Mycosin (a.i. acidified clay powder). But the results in the years 2007, 2008 and 2012 were not acceptable – especially under high disease pressure. As a matter of fact a hot water shower treatment system was developed with a Styrian company. More than 3000 tons/year of 'Topaz' apples had been given a hot water shower from 2012 on. In practice we worked with a standard hot water program of 52 °C and 120 seconds. But in some cases heat damage could occur. To prevent heat damage and to optimize the system we made further research with short time-high temperature trials. We tested 4 main varieties with temperatures up to 58 °C and reduced the time down to 15 seconds. All fruits were from orchards with a high Neofabraea pressure. After storage under controlled atmosphere I made an evaluation of the Neofabraea rot and the heat damage. The curves of efficiency and heat damage gave a good overview of the efficiency/heat damage ratio. There was only a very small range where we have a high efficiency and a minimum of heat damage.

Keywords: Hot water, Neofabraea, heat damage, short time – high temperature, 'Topaz'

Introduction

Our first experiences in practice with the new hot water shower system were the same or better than in the trials (efficiency 80 to 90 %) on 'Topaz' apples. 'Topaz' is very heat resistant and allows treatments with higher temperatures than other varieties like Golden or Pinova. But the process of hot water showering still takes us a large amount of time. So new trials with high temperature – short time should give us the answer if we can find a program where we can hold the high efficiency and treat more apples in the same time.

Figure 1: The process of the hot water shower (left); the hot water shower machine (right).

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Material and Methods

I took apples from 4 different varieties (‘Golden’, ‘Gala’, ‘Topaz’ and ‘Pinova’) from orchards with a high Neofabrea pressure level. Harvesting time was 10 days delayed due to a better outbreak of the rot in the storage. All varieties were stored under normal condition until the latest variety was picked. The apples where standardized to 120 apples per box from different parts on the tree. After hot water shower we stored the apple under controlled atmosphere until April (6 months). Heat damage and Neofabraea rot were estimated. In practice recooling after the heat water treatment is standard in Styria because of quality reasons. So we did the same in the trials.

Table 1: Overview of the time/temperature schedules in the trials.

Treatment	Temperature hot water shower (°C)	Time hot water shower (seconds)	Time recooling with cold water
Untreated	-	-	-
52/120	52	120	-
52/120-K	52	120	120
54/120-K	54	120	120
54/60-K	54	60	60
54/30-K	54	30	30
54/15-K	54	15	15
56/15-K	56	15	15
58/15-K	58	15	15

The estimation of the heat damage was a very difficult work. In some cases heat damage looked like soft scald. Therefore apples with damage were found also in the untreated plots. So I calculated also a corrected heat damage (= heat damage in the treatment – heat damage in untreated). We found very small and hard visible spots of heat damage. In practice, this small spots had been calibrated as class 1.

Figure 2: Hot water damage (54°C, 120seconds) (left); untreated Pinova – nearly the same damage on the top of the fruit (right).

Results

Table 2: Percentage of heat damage, infestations with Neofabraea rot and efficiency of hot water shower by Topaz 2014.

Treatment	% heat damage	% corrected heat damage	% Neofabraea rot	Efficiency (Abbott) in %
Untreated	7,3		79,5	
52°C / 120sec	23,9	16,6	2,8	96,5
52°C / 120sec-recooling	20,4	13,1	3,6	95,5
54°C / 120sec - recooling	100	-	0	100
54°C / 60sec - recooling	24,1	16,8	12,1	84,8
54°C / 30sec-recooling	0	0	29,6	62,7
54°C / 15sec-reccoling	0	0	55,1	30,7
56°C / 15sec-recooling	6,7	0	38,6	51,4
58°C / 15sec-recooling	27,9	20,6	22,3	72

In this year we found heat damage in the standard program of 'Topaz', which is not so heat sensible. When we increased temperature for 2 °C by the same time we got totally burned apples. 54 °C and only 60 seconds treatment shows the same heat damage, but we lost more than 10 % in efficiency.

Table 3: Percentage of heat damage, infestations with Neofabraea rot and efficiency of hot water shower by Golden, Topaz, Pinova and Gala, 2014.

Traetment	Heat damage Gala (%)	Efficiency Gala (%)	Heat damage Golden (%)	Efficiency Golden (%)	Heat damage Topaz (%)	Efficiency Topaz (%)	Heat damage Pinova (%)	Efficiency Pinova (%)
UK	0	36,1**	9,1	19,6**	7,3	79,5**	11	55,7**
52°C 120sec	3,2	93,2	46,4	98,1	23,9	96,5	19,9	97,8
52°C 120sec-K	4,2	88,7	55	99	20,4	95,5	38,6	98,6
54°C 120sec-K	100	100	100	100	100	100	85,4	94,6
54°C 60sec-K	5,3	84,7	74,8	98,9	24,4	84,8	23,8	83,1
54°C 30sec-K	0,5	53,4	39,3	89,9	0	62,7	13,9	63,7
54°C 15sec-K	0	30,7	11,9	75,1	0	30,7	7,7	30,1
56°C 15sec-K	14,5	66,1	44,4	88,6	6,7	51,4	23,8	54,6
58°C 15sec-K	37	57,7	75,3	100	27,9	72	38,9	73

K means recooling, ** infestation untreated

The same tendency could have been found on all varieties. An increase of 2 °C by the same time leaded to total burned apples. When we reduced time by half we lost about 10 % of efficacy. Temperatures 56 ° upwards leaded to an increase of heat damage also by very short treatment time.

Discussion

With these results we can enclose the time/temperature area of hot water treatments in the case of best efficacy and heat damage. 54 °C will be the highest temperature for heat resistant varieties like ‘Gala’ and ‘Topaz’. Time schedules between 60 and 90 seconds will be tested in the next seasons.

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