Hot water treatment - using the apples own defence potential

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Abstract

In organic fruit production most postharvest losses develop during storage. About 30% is a normal loss after long term storage. The biggest challenge is to fight fungal diseases, especially those caused by Neofabraea alba *and* N. perennans (*syn*. Gloeosporium spp.)*. Any postharvest treatment of fruit is forbidden in Germany and for organic production in particular. However, it is possible to use the fungicidal effects of hot water treatments. Efficacy is not based on the water temperature, which was only 52°C, but on the physiological defence reaction of the fruit because of the temperature shock. In two study years 'Pinova' apples were hot water treated at Centre for Competence in Fruit Growing at Lake Constance. Results showed more sound fruit after hot water treatment in comparison to the control and even after preharvest fungicide application. The predominant pathogen detected was* Gloeosporium spp*. Rot incidence was reduced by 30 to 40% in 2015 and between 30 and 65% in 2016. The storage conditions also had an impact on the appearance of fungal disease: there were more sound fruit under controlled atmosphere (CA) as compared to regular air (RA). For hot water treated fruit storage at CA condition and 3°C was more or just as preventive as 1°C.*

Keywords: *Malus domestica*, postharvest losses, rot prevention

Introduction

Reduction of postharvest losses is a permanent topic in fruit production. Especially after long-term storage of organic produced pomefruit, losses of at least 30% are calculated every year. The main problem is fungal rots caused by *Neofabraea alba* and *N. perennans* (syn. *Gloeosporium spp*.). In times of increasing nutrition safety standards and high sensitivity by consumers for residue free fruit, the importance of good alternatives to pest management agents grows continuously. Therefore, also organic producers have a strong need to find and use methods to reduce plant protectants. Hot water treatment can help towards these aims. (Gasser et al., 2015; Francesco et al., 2018)

Material and Methods

The trials were conducted in 2015 and 2016 at Competence Centre for Fruit Growing at Lake Constance. 'Pinova' apples were harvested at mid-October from the Institute's organic production area with a ripening index (Streif index) of 0.19 (2015) and 0.24 (2016). The fruit were brought directly to the hot water dipping (HWD) facility. The treatment was done on the same day of harvest at 52°C for 130sec. After returning the fruit to the Institute's storage facility, they were cooling for 24h. Afterwards, fruit were placed in different storage conditions: RA (regular air) and CA (controlled atmosphere: 1kPa O_2; 2.5kPa CO_2) at 1 and 3°C. The fruit quality parameters flesh firmness, total soluble solids, titratable acid and skin colour were assessed.

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Also, the appearance of fungal diseases was recorded (Fig. 1). The assessments were done after HWD plus cooling and after storage plus 7d of shelf life (RA, 20°C) for better definition of the fungal diseases.

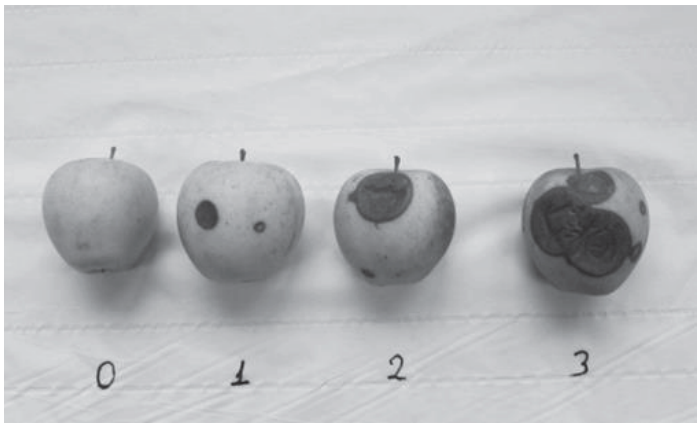

Figure 1: Scoring severity scale for fungal rots
(0=sound, 1=little spots, 2= ≤25%, 3= >50% affected)

Results

In 2015, the apples were taken out of storage after 4 and 6 months in 2015 (Figure 2). The incidence of fungal infection was higher at the earlier examination date. After HWD at both examination dates the apples showed between 30 to 65% lower rots compared to the UTC. In addition, rots were less severe than without HWD. CA condition, storage at 3°C and a later assessment date showed much lower infection rates. The assessments in 2016 supported the results from the previous year; the previously mentioned effects were the same. Besides, for both RA treatments with storage at 1°C, HWD showed 27% more sound fruit. The storage atmosphere also had an impact on the incidence of fungal rots, and showed even lower infection with CA plus HWD in comparison to RA at 3°C.

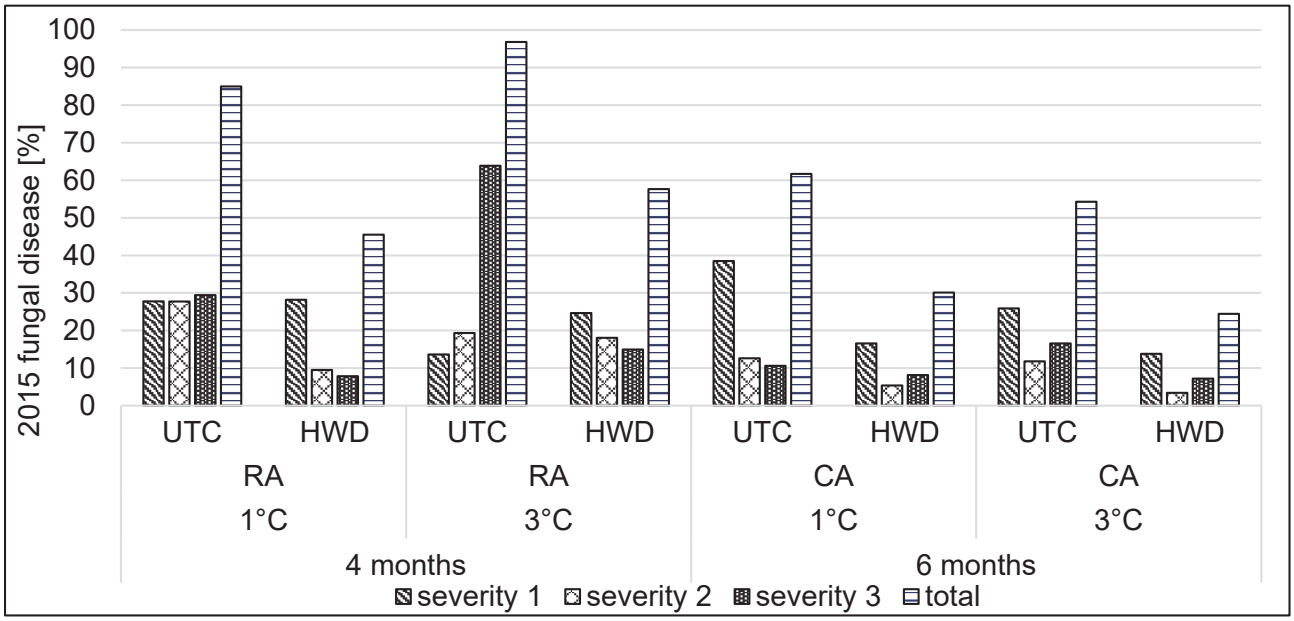

Figure 2: Fungal disease severity (in three classes) and total disease incidence in 2015 after storage of 4 or 6 months in RA (regular air) or CA (1.0kPa O_2; 2.5 kPaCO_2) for UTC (untreated control) and HWD (hot water treatment).

The examination of fruit quality parameters showed a strong influence of storage conditions. Storage in CA maintained flesh firmness, titratable acids and skin colour better than RA storage (Figure. 3). An effect of HWD on the internal fruit quality could not be found.

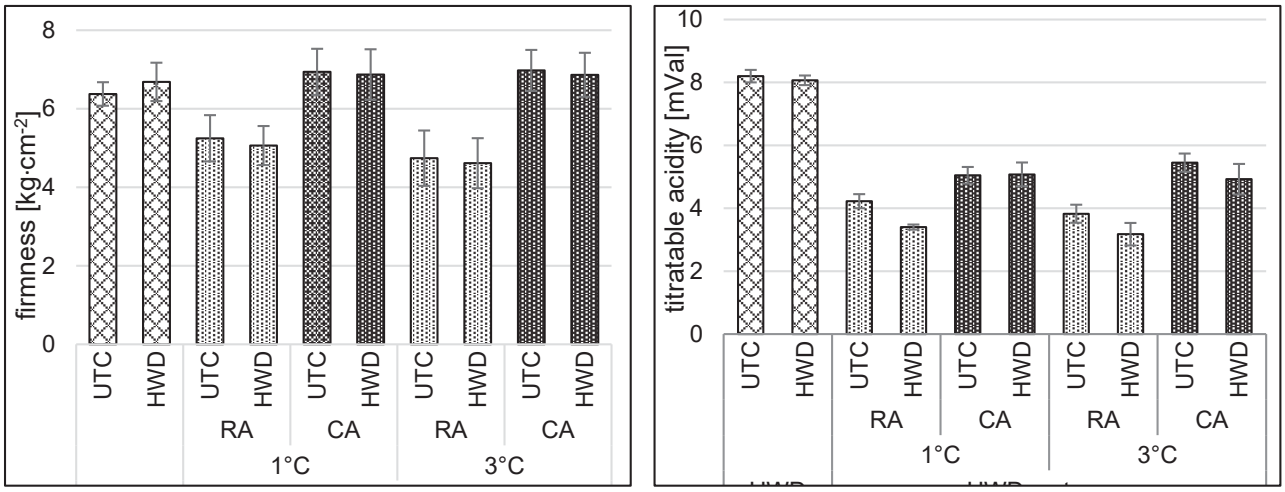

Figure 3a, b: Flesh firmness and titratable acidity as examples for internal fruit quality parameter after storage of 4 or 6 months in RA (regular air) or CA (1.0kPa $O_{2;}$ 2.5 kPaCO_2) for UTC (untreated control) and HWD (hot water treatment).

Discussion

For ‘Pinova’ apples HWD as described above is a very good technique. The benefit of this rot control method should not be underrated. However, problems with heat damage could appear. It is necessary to do further research on the optimum temperature, time and even application method specifically for a range of varieties and for other physiological aspects like fruit size or maturity.

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References

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