

# Dutch tests of biocontrol agents and hotwater treatments (ISAFRUIT)

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## Introduction

The challenge to develop alternative strategies to protect fruits against storage rot is initiated by tendencies in society and market demands. Keywords are sustainable, environmentally safe, health and food safety.

Yet retailers demand fruits with residue levels lower than the minimum residue levels.

Combined treatments of hot water (HW) and biological control agents (BCA) might be an alternative for regular chemical crop protection in orchards with integrated disease management and might be a solution to avoid high losses during storage of fruits of organic growing.

In outlines rots during storage are caused by fungi that use different strategies to infect fruits.

- a- A damaged fruit skin is an entry for fungi like *Botrytis cinerea* (gray mold) or *Penicillium expansum* (blue mold). Fruits might be infected by these wound pathogens via these entries
- b- Rots caused by *Phlyctema vagabunda* (*syn Gloeosporium album*) or *Nectria galligena* are based on latent infections. Fruits could be infected from bloom till harvest but symptoms are shown during storage.

Protecting fruits from several types of rot needs more than one treatment. A bio control agent (BCA) to compete with graymold. This competition is about nutrients and colonizing the wound of damaged fruit. Infections of *Botrytis c.* might be reduced by using a BCA in a postharvest treatment. Fruits will be dipped in or showered with a BCA suspension.

Hot water treatments (several minutes in water heated till 48-52 °C (depending on variety and immersion time) have been proved to be effective in decreasing incidences of rot caused by *Gloeosporium album*.

During 2006-2007 and 2007-2008 more or less similar experiments have been carried out. Only in 2007-2008 growers stopped chemical treatments with fungicides or copper and sulphur (organic growing) earlier on some trees. In 2006-2007 the experiments didn't show the expected results. Treatments with BCA were not as effective against inoculated *Botrytis* as expected. A possible explanation might be the application of crop protection products within the last weeks before harvest. These crop protection treatments might decrease the viability of the BCA that was used in these experiments. For that reason we asked growers to stop spraying fungicides, Sulphur and Copper in the last 6 till 9 weeks before harvest. In one orchard (variety Elstar) we picked also fruits from trees that had been treated with copperoxychloride in the last period before harvest. So we could compare the results of these fruits with those from fruits from trees where spraying had stopped earlier.

## Experiments (2007-2008)

- Cvs. tested: Golden Delicious, Elstar and Topaz.
- Fruit condition: naturally infected (fruits from all orchards) or wounded fruits inoculated with *Botrytis cinerea* after hot water treatment and/ or biological control agent (BCA) treatment.
- Hot water treatment (HWT)
  - Water temperature: 49 °C (Elstar); 50 °C (Topaz); 49 °C (Golden Delicious).
  - Immersion time: 2 minutes.
- Immersion time BCA treatment: 2 minutes.
- Ca- storage till April and June
- Assessments: incidence of rots in April 2008 and June 2008

Separate experiment: effect of a hot water treatment (HWT) on fruit quality ((Varieties Elstar, Topaz and Golden Delicious), especially hot water damage of the fruit skin (treatments in table 1).

Tabel 1 Hot water treatments

Immersion time (minutes)	Temperature (°C)			
	46	48	50	52
2		x	x	x
3		x	x	x
10	x			

## Results

### Inoculated fruits:

- BCA treatment is effective on inoculated Elstar (2007/2008) that haven't been sprayed with copperoxychloride in the last weeks before harvest.
- No effect on Elstar fruits (2006/2007 and 2007/2008) that have been sprayed in the last weeks before harvest.
- Theory that the efficacy of BCA treatment is depending on used crop protection during the last weeks before harvest is supported by results at The University of Gembloux (prof. H.Jijakli). Experiments showed : Growth of BCA spores is influenced by the presence of some fungicides or the presence of copper and sulphur.

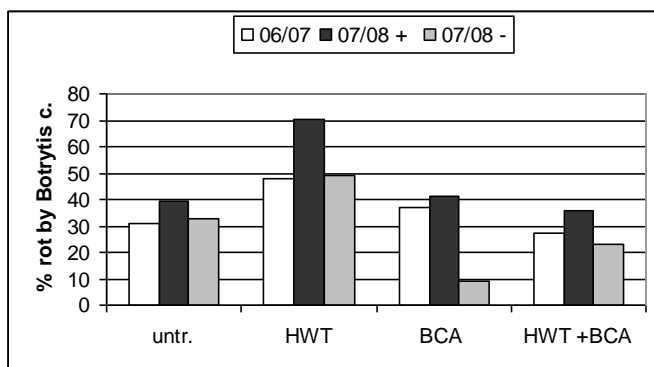


Figure 1: Rot incidences by *Botrytis cinerea* in inoculated organic grown Elstar. Fruits 06/07 and 07/08 + have been sprayed after July 18th. Fruits 07/08 - came from trees with no Cu sprays after July 18<sup>th</sup>. Results after CA-storage till April.

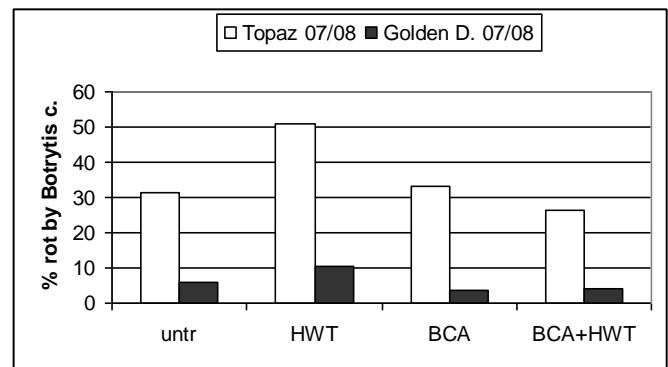


Figure 2: Rot incidences by *Botrytis cinerea* in inoculated organic grown Topaz and in Golden Delicious (integrated disease management) . Results after CA-storage till June 2008.

- Results on inoculated Topaz and inoculated Golden Delicious differ from the results on Elstar for yet unknown reasons. The number of rot incidences in inoculated Golden Delicious might be too low to obtain reliable (statistical) results (figure 2).
- Inoculated fruits treated with HW showed an increase of rot incidences (in all three varieties). Possible explanations:
  - Micro lesions caused by HWT create extra entries for *Botrytis c.* to infect the fruits.
  - HWT reduces or damages the micro flora at the surface of the fruits, which decreased the number of microbiological competitors for *Botrytis c.* to infect the (wounded) fruits.

### Natural infected fruits

- Results of BCA treatments in experiments with natural infected Elstar fruits (no inoculation) don't show results similar to those of the experiment with inoculated fruits, possibly due to:
  - Absence or limited presence of gray mold spores.
  - Other fungi that sustain BCA presence (*Gloeosporium a.* and *Nectria g.*).
- HWT decreases rot incidences caused by *Gloeosporium a.* (figures 3 and 4).
- HWT don't have only benefits for damage on fruit skin is a side effect . The brownish glow or brown colored surface will decrease the commercial value of the fruits (figures 5 and 6). Hot water damage was observed on fruits of Topaz, Elstar and Golden delicious.

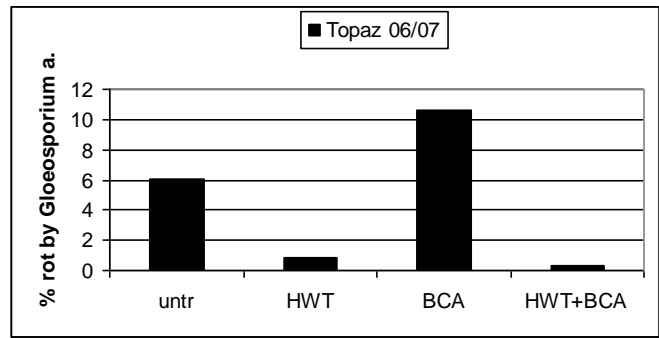
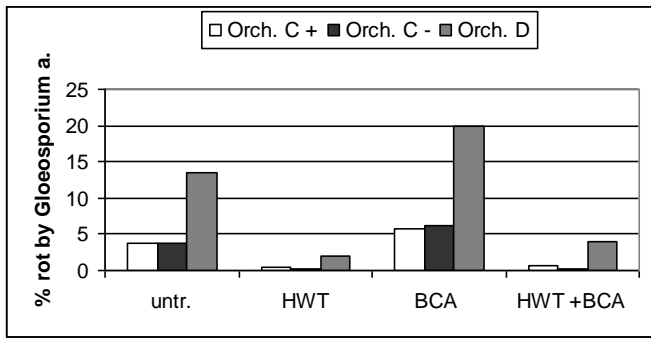


Figure 3: Rot incidences by *Gloeosporium a.* in organic grown Elstar (07/08). Fruits from 2 orchards (C+ fruits have been sprayed after July 18th. C- fruits and D fruits no Cu or S in last period before harvest. Results after CA-storage till June 2008

Figure 4: Rot incidences by *Gloeosporium a.* in organic grown Topaz (natural infection). Results after CA-storage till June 2008.

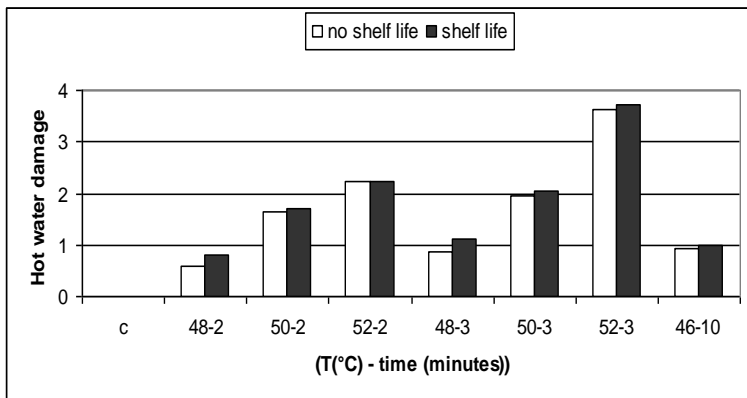


Figure 5: Hot water damage in Topaz per treatment after CA-storage till February 2008. Damage is an index (0=no damage, 5= much damage)

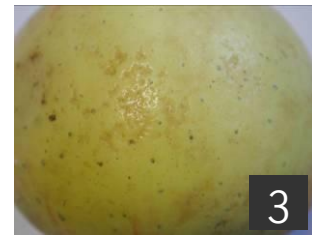


Figure 6: Damage caused by HWT on fruit skin of Topaz fruits. (Index: 0= no damage, 5 = much damage)

## Conclusions and perspectives

- Rots caused by different kinds of fungi will probably need different treatments.
- In the future postharvest HW an/or BCA treatment might be alternatives to avoid storage rot. These alternatives will be needed to reduce the level of residue of chemical treatments of storage rot.
- Optimizing those treatments by continued research will be necessary:
  - HWT because of the risk of skin damage
  - Perhaps alternatives to protect fruits from *Gloeosporium*. Alternatives without the disadvantage of a damaged skin.
  - BCA because of the fact that we obtained promising results with Elstar but less clear results with Topaz and Golden Delicious.