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# ***Disease management in organic greenhouse crops: prevention and treatments***

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# Disease management

- › Foliar diseases caused by fungal pathogen on tomato
- › Content:
  - › System approach
  - › Why organic fungicides?
  - › Which ones were effective?
  - › Conclusions

# System approach to control foliar diseases

**4. Plant strengtheners and organic fungicides**

**3. Bio control agent:**  
e.g. *Ampelomyces quisqualis*

**2. Natural enemies:**  
Rather unimportant (e.g. *Psyllobora vigintiduopunctata*)

**1. Cultural practises:**  
Resistant cultivars; Climate control;  
new construction material for glasshouses

# The «Dirty Four» fungal diseases on tomato leaves

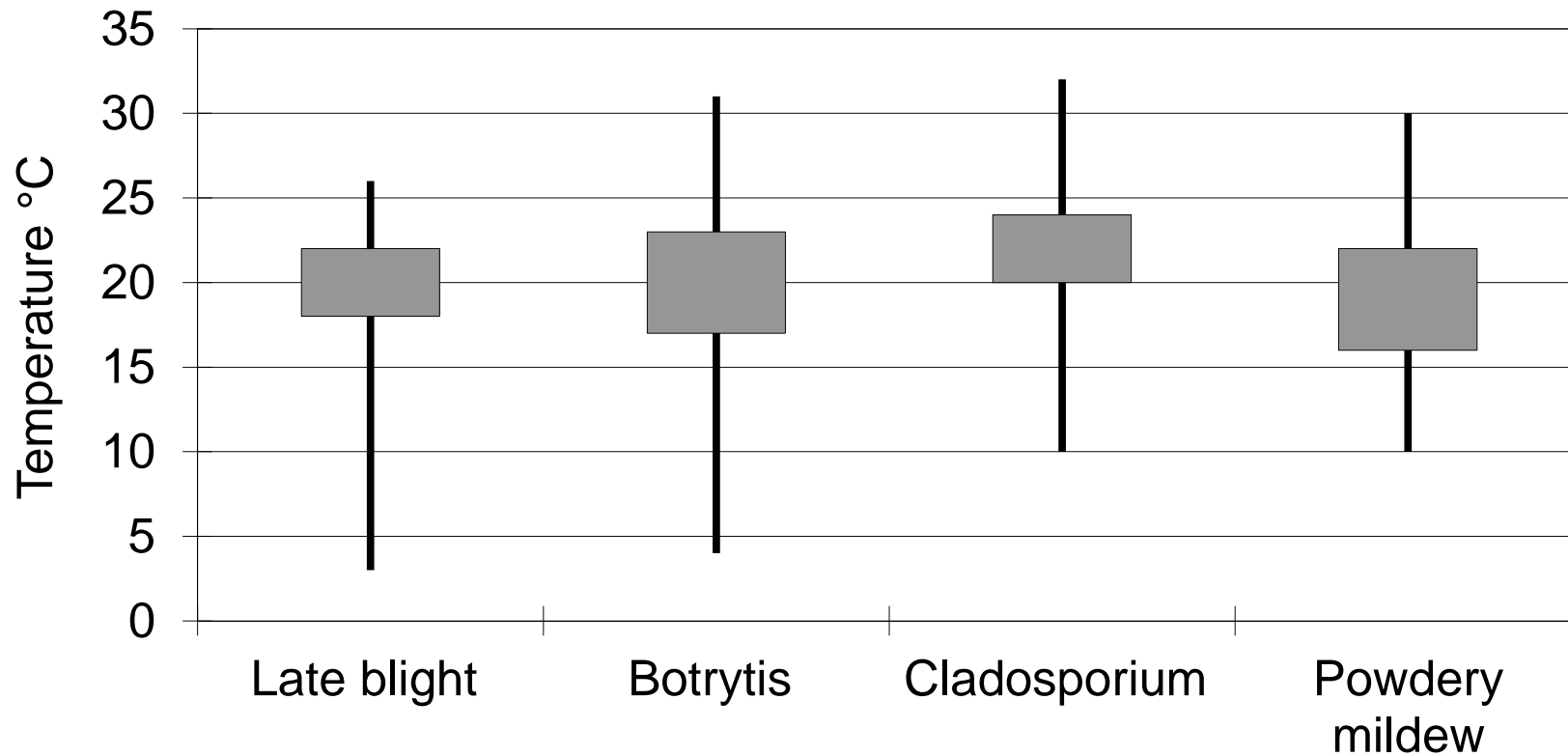


# Why fungicides in organic greenhouse crops?

- › **Climate control can only prevent some diseases (e.g. not powdery mildew)**
- › **Resistant cultivars are not against all 4 diseases and for all crop segments available**



# Optimal range of temperature of some foliar diseases on tomatoes

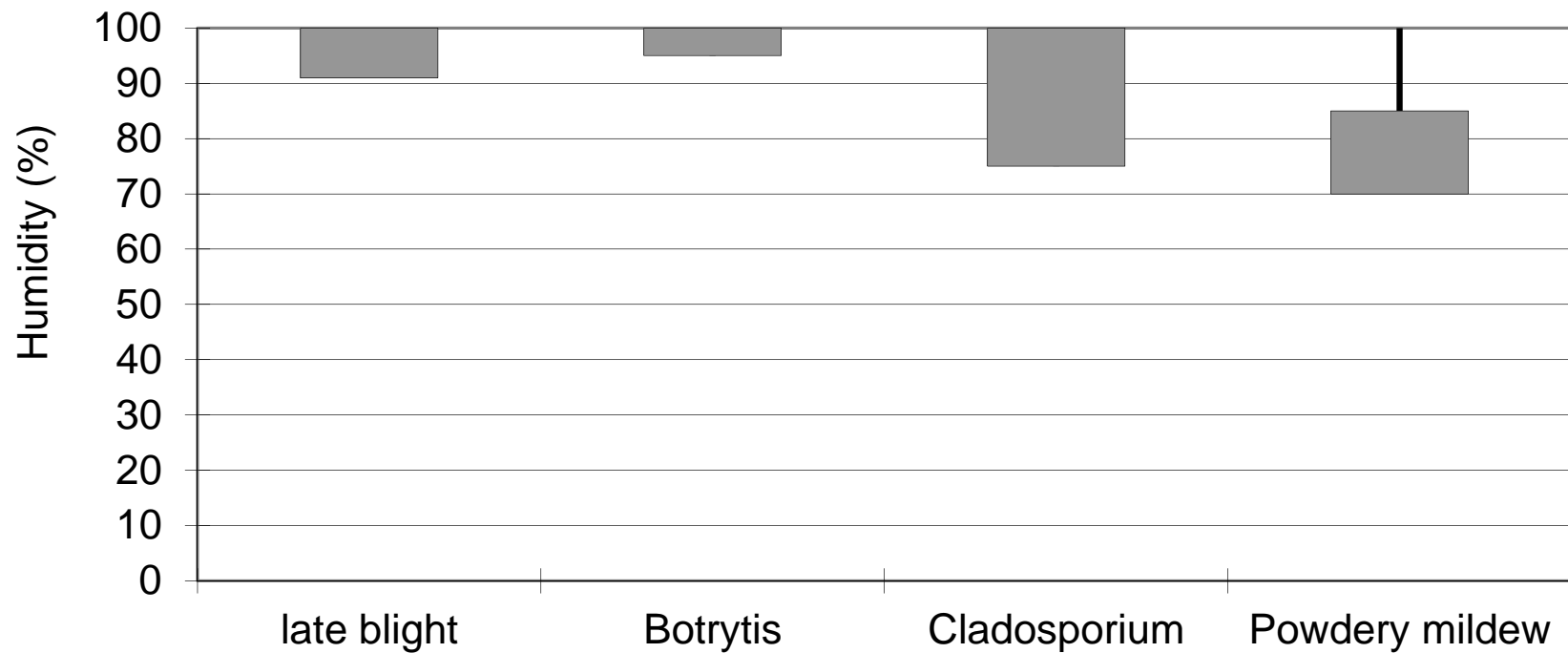


Box: optimal

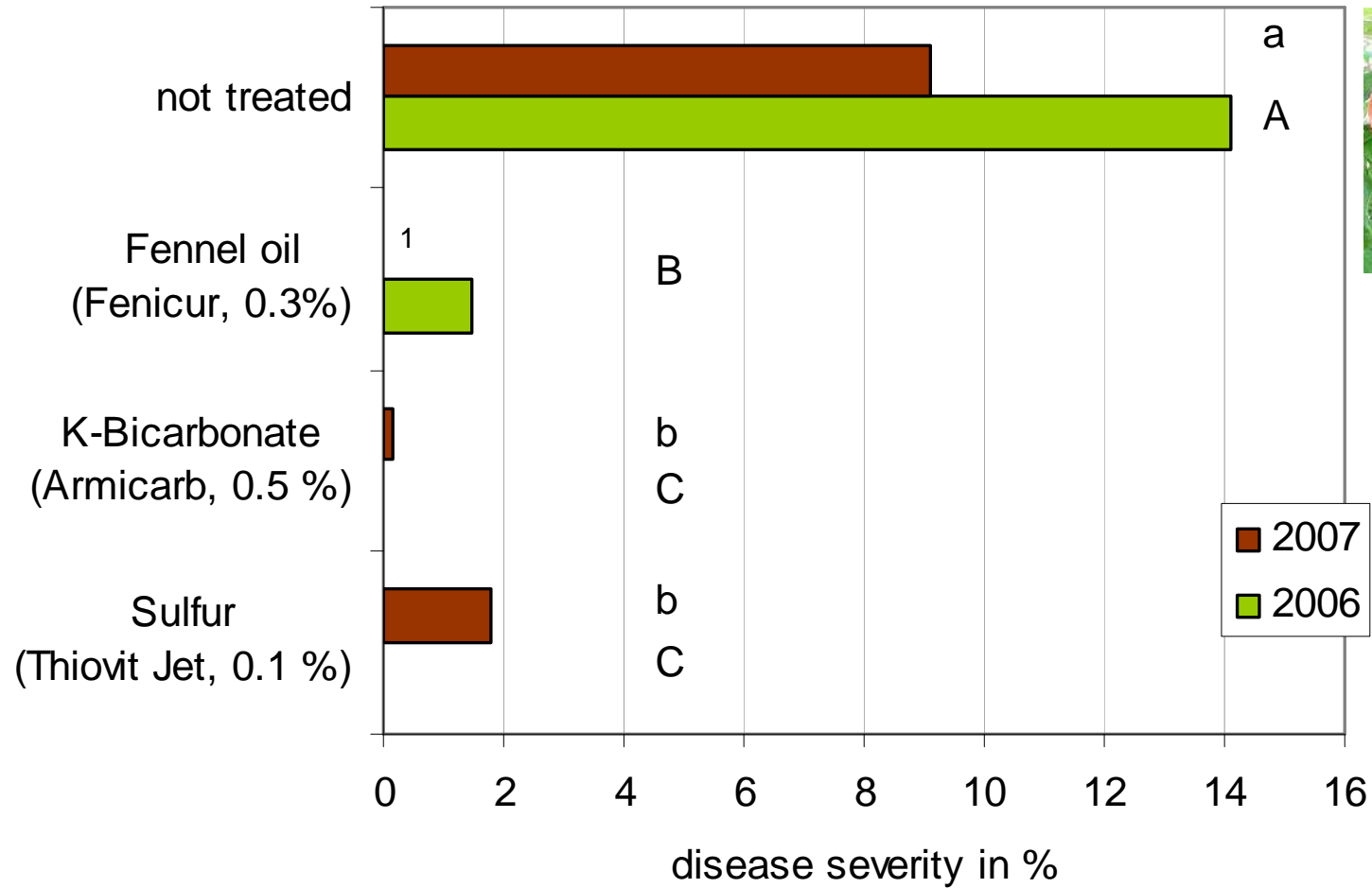
Line: suboptimal, possible growth/infection

Jones et al., 1992, Bedlan 2012

# Optimal range of humidity of some foliar diseases on tomatoes



# Effects on powdery mildew in tomatoes (2006/07)



<sup>1</sup> 2006 not in the experiment included



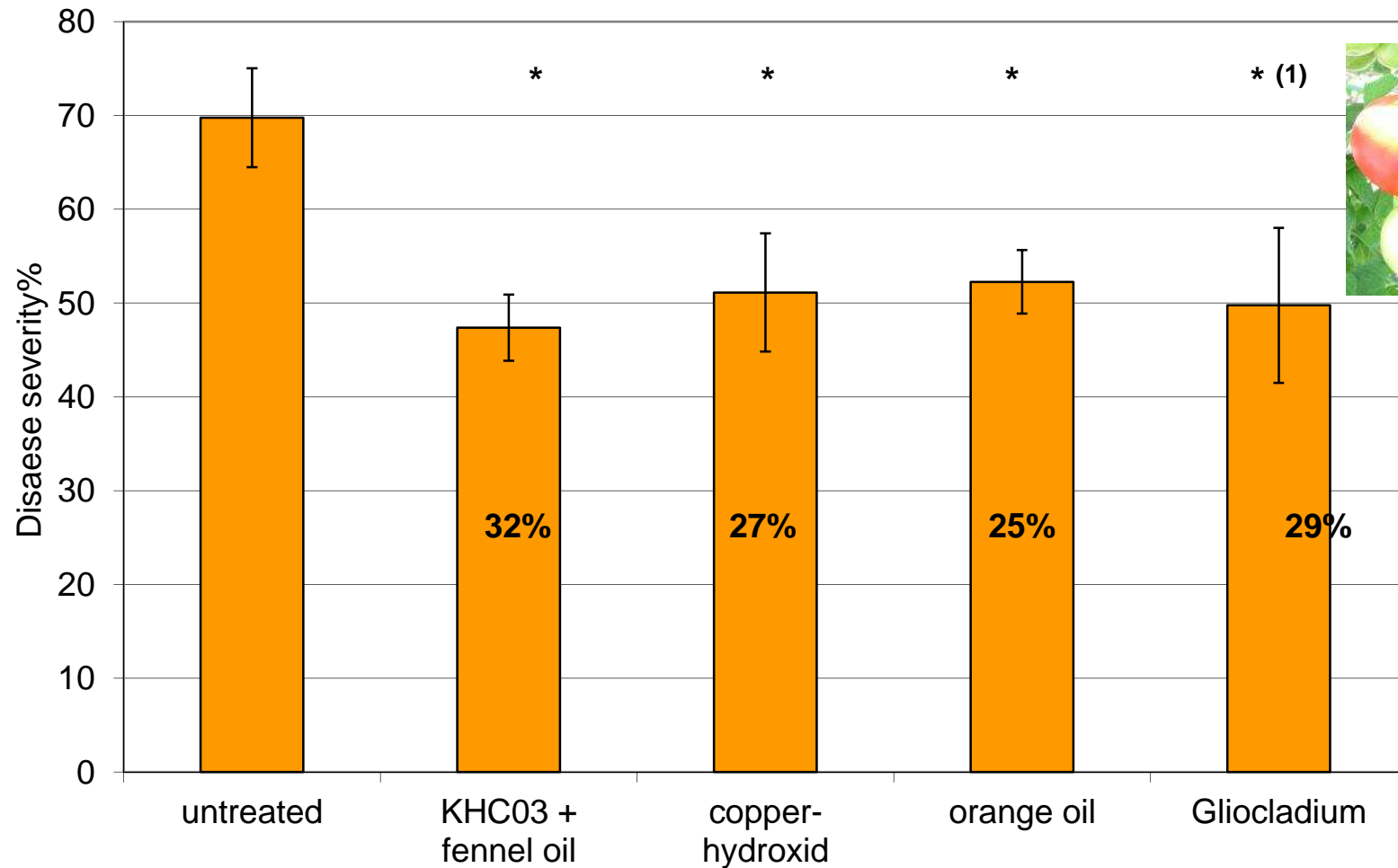
# Control of Cladosporium and powder mildew (2010)

- › **Cultivar: heritage variety «Baselbieter Röteli»**
- › **11 treatments between week 22 and 33,**
- › **11 l water /100 m<sup>2</sup>**

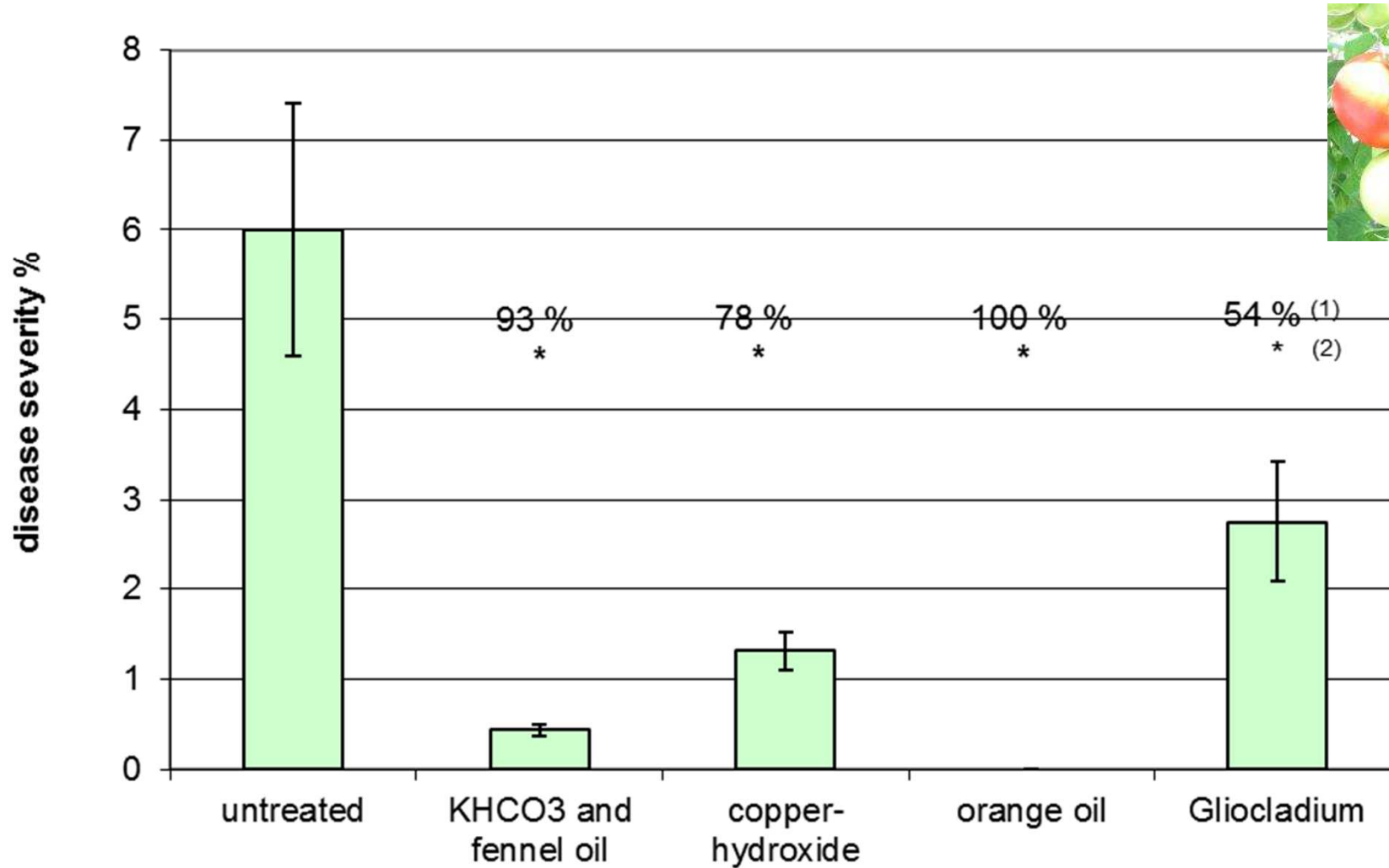


PPP (product name and distributing company)	Active substance	Konzentration
Armicarb (Stähler) and Fenicur (BioControl)	Potassium hydrogencarbonate (KHCO <sub>3</sub> ) and fennel oil	0.5 + 0.4%
Microperl (Burri, CH)	Copper hydroxid (40 % Cu)	0.125%
Prev-AM™ (Oro Agri)	Orange oil	0.4%
Test product	<i>Gliocladium sp.</i>	0.5%

# Efficay of organic fungicides on *Cladosporium*



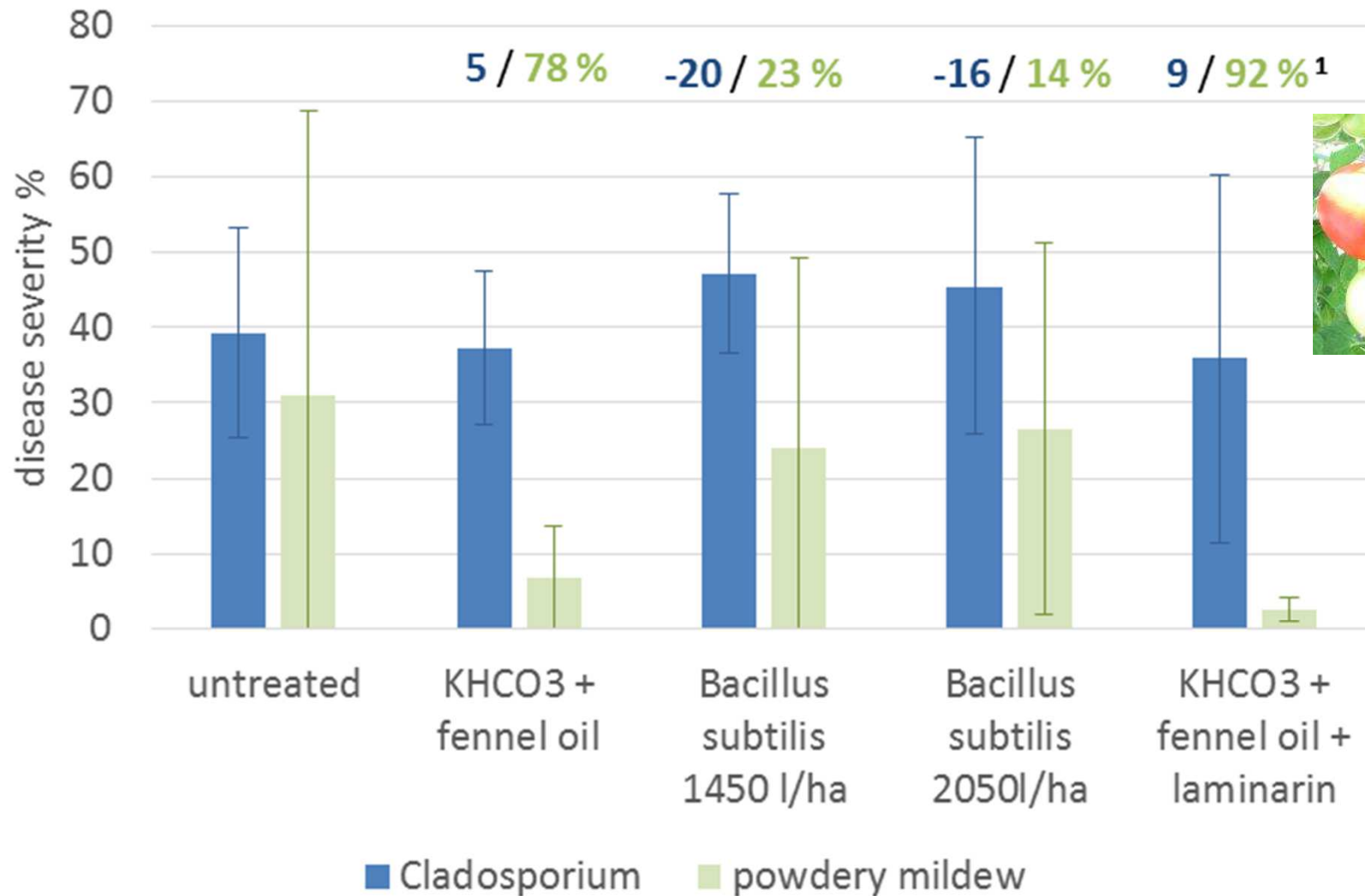
# Efficacy of organic fungicides on powdery mildew



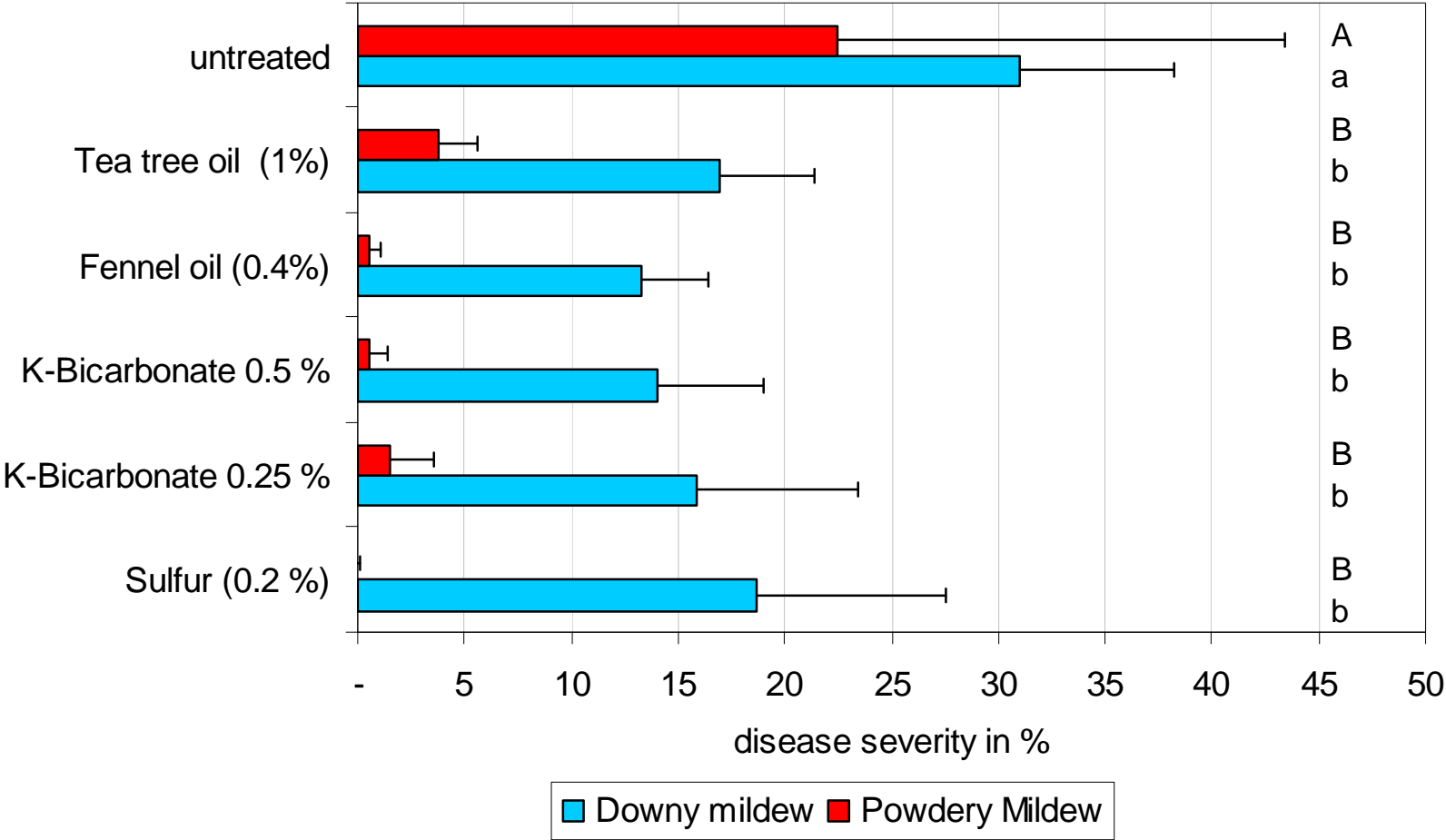
(1) \* = significant different to untreated (Student-T)

(2) Efficacy (%) after Abbott

# Efficacy of organic fungicides on powdery mildew and *Cladosporium* 2014



# Effects on powdery and downy mildew in cucumbers



# Fungicides in organic horticulture:

## Examples against foliar diseases on greenhouse crops

Active substance	Permitted EU organic EC 889/2008	Listed in EU as PPP EC 1107/2009	EU Countries with registrations
Copper (-hydroxid, -oxychlorid)	✓	✓	22
Sulphur	✓	✓	24
K-Bicarbonate	✓	✓	16
Laminarin	✓	✓	10
Orange oil	✓	✓ (Insecticide)	BE, CY, FR, IT, RO
Tea tree oil	✓	✓	BG, PL
Fennel oil	✓	✗	(CH)
Lecithin	✓	✓ (Basic substance)	(CH)
<i>Gliocladium</i>	✓	✓	13
<i>Ampelomyces quisqualis</i>	✓	✓	12
COS-OGA	✗	✓	BE, FR, NL

# Fungicides on organic tomatoes: Experience and estimation on efficacy in Switzerland

Active substance	Late blight	Powdery mildew	Clado-sporium	Botrytis
Copper	+++	+ / -	+ / -	-
Sulphur	-	+++	-	-
K-Bicarbonate	-	+++	+ / -	-
Laminarin	-	+	-	+
Orange oil	-	+++	+ / -	-
Tea tree oil	-	++	?	-
Fennel oil	-	++	+	-
Lecithin	-	+	-	-
<i>Gliocladium</i>	-	+ / -	+ / -	+
<i>Ampelomyces q.</i>	-	+	-	-
COS-OGA	-	++	-	?

# Fungicides on organic tomatoes: Experience and estimation on efficacy in Switzerland

Measurements	Late blight	Powdery mildew	Clado-sporium	Botrytis
Climate control (e.g. decrease of humidity)	+++	–	+	+++
Resistant cultivars	Only few	+++	Few against new strains	–
Organic fungicides (& bio control)	Only copper (yet)	+++	–	(+)

## › Outlook

- › Late blight: projects on copper alternatives (e.g. Co-free)
  - › Some products are in the pipeline
- › Botrytis: new bio controls (e.g. *Aureobasidium pullulans*) and elicitors in the pipeline, potential still unclear



# Conclusions

- › **Climate control**
  - › Control on late blight and botrytis (outside of rainy weather)
  - › Poor control on powdery mildew
- › **Resistant cultivars are not against all 4 diseases and for all crop segments available**
  - › Wide range of cultivars with HR against powdery mildew
- › **Organic fungicides**
  - › Late blight: copper «to help through rainy weather»
    - › CH: 0.2 kg Cu ha<sup>-1</sup> a<sup>-1</sup> in tomato (Speiser et al. 2015)
  - › Powdery mildew: several organic fungicides available
  - › Botrytis and Cladosporium: not solved yet



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