DE NORA
our research - your future

L'Efficacia delle Soluzioni saline elettrolizzate in Agricoltura

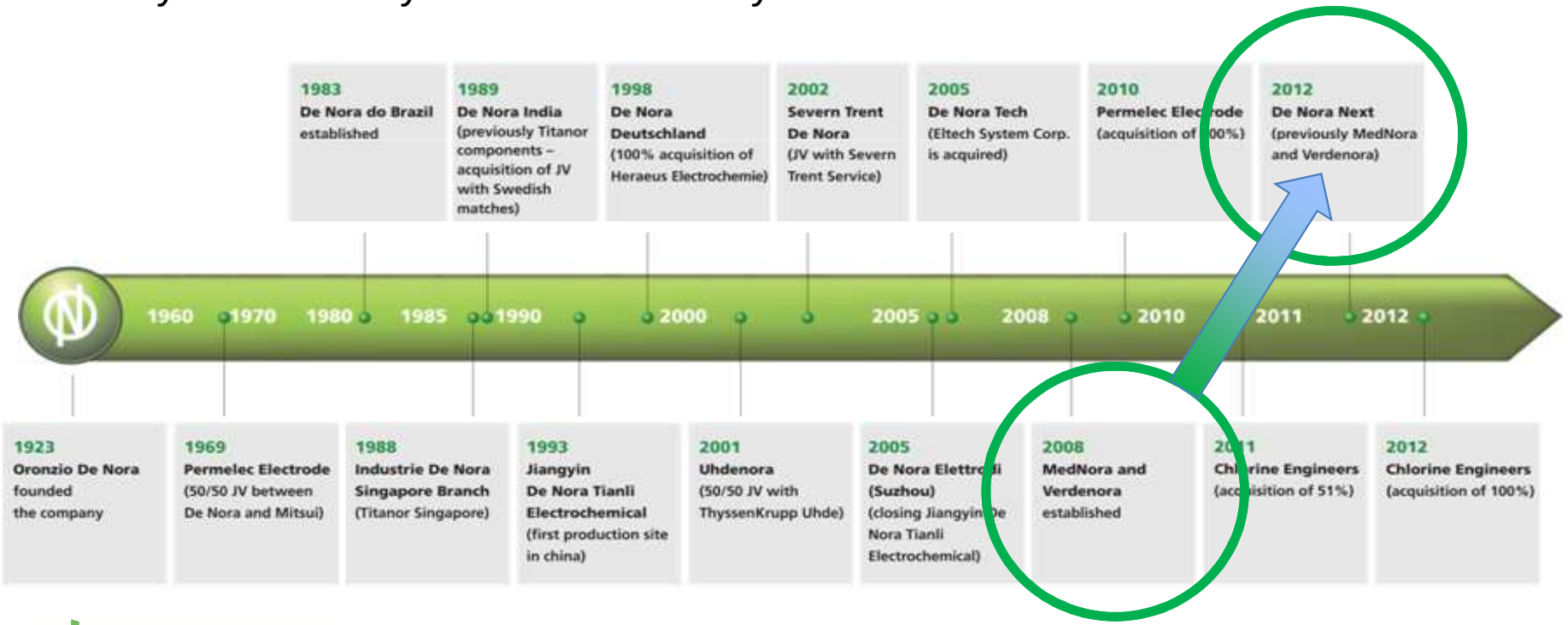
AIDB2015, October 2nd – Politecnico Milano Bicocca

Mariachiara Benedetto

De Nora profile – 2272 Patents

Founded in Italy in 1923 by Oronzio De Nora, a genial chemical engineer, a successful inventor and entrepreneur, strategically expanded worldwide in all continents with direct establishment, joint ventures and acquisitions

Industrie De Nora S.p.A., the holding of De Nora group, is a private company fully controlled by the De Nora family



De Nora Next:
a business unit looking at the future

Mission

- contribute to Well Being improving quality of life for: Individuals, Families, People and the Planet
- implement innovative, sustainable, on demand electrochemical product and systems
- be one of the future growth factor for De Nora

Objectives

Bring our electrochemical technological excellence across different markets and geographies with solid, strong business partnerships and acquisitions

Project history

2006 First approach and communication from Prof. Achille De Battisti – University of Ferrara

- The Idea was to apply Free Available Chlorine for Trees treatment
- A dedicated patent was deposited and maintained along these years

2007 Four times the Project was presented to the De Nora Board of Directors receiving green light to proceed

- Many times De Nora met University Professor, Researchers and People involved in Agriculture
- A University Spin-off was decided as a New-Company were develop the application of the Elecytrolyzed Water

2008 Verdenora University of Ferrara **Spin-off company started**

- KCl electrolysis process was designed
- Prototypes for Testing were prepared and distributed
- Existing EVA System was designed based on Data from the Field and produced in **2009**

Related Patents

Electrochemical device for biocide treatment in agricultural applications

Application number: 20100183745-

The invention relates to an electrochemical device which simultaneously carries out the production of an oxidising solution at controlled composition containing hypochlorous acid and the sprinkling thereof in a continuous process, useful for biocide treatments in agricultural fields. The device can be installed on motor vehicles or mobile means in...

Inventors: Paolo Rossi, Mariachiara Benedetto, Luca Buonerba, Achille De Battisti, Sergio Ferro, Fabio Galli (Industrie De Nora S.p.a.)

SYSTEM FOR ELECTROCHEMICAL GENERATION OF HYPOCHLORITE

Application number: 20130087449

Abstract: The invention relates to a system for a point-of-use electrochemical generation of hypochlorite on demand in a wide range of volumes and concentration.

Assignee: Industrie De Nora S.p.A.

Inventor: Mariachiara Benedetto

ELECTRODE FOR ELECTROCHLORINATION

Application number: 20130087450

Abstract: The invention relates to an electrode for electrochemical generation of hypochlorite.

Assignee: Industrie De Nora S.p.A.

Inventors: Antonio Lorenzo Antozzi, Mariachiara Benedetto, Alice Calderara, Chiara Pezzoni, Christian Urgeghe

Why Electrolyzed Water?

Electrolyzed water **produced on site** from **natural raw materials**, safeguard the environment before and after its use.

Electrolyzed water is produced by the electrolysis of ordinary tap watercontaining the salt Potassium chloride

- **Less** resources exploitation
- **Less** fuel consumption and transport costs
- **Less** plastic and chemicals to be disposed

- **No persistence in the environment** (Environmentally friendly)
- No surplus production
- **Effective against fungi and bacteria**

Agriculture

- Our technology is based on patented electrochemical system producing the Potassium Hypochlorite solution on site and on demand, aimed at preventing and treating certain fruit tree diseases.
- The effectiveness of Hypochlorite ion is well known.
- To promote a new type of crop.
- To sanitize fruits and vegetables for the customer without pathogens inside and without pesticide residuals.
- Potassium is one of the major nutrients for plants.
- Potassium hypochlorite is not phytotoxic on fruit trees and on vegetables
- Has been demonstrated that Electrolyzed Water is successful in crop treatment.

Project Partners

- ✓ University of Ferrara
- ✓ University of Bologna
- ✓ University of Tuscia
- ✓ Ospedale Sacco - Milan

OTHER CONSULTANTS:

- ✓ RTC- Research Toxicology Center
- ✓ Agrofarma (National Pesticides Company Association of Italy).
- ✓ Chemservice
- ✓ Centri di Saggio (official trials testers): Italy (BETA, AGREA, SPF) and Germany (DLR e Koga).
- ✓ Other testers involved in the project:
  - ❖ Italians testers
  - ❖ The Netherlands testers
  - ❖ Spain testers
  - ❖ France testers

De Nora Next project recognized as one of the 10 best sustainable practices by EXPO MILANO 2015.

On July 8th De Nora NEXT will present its project "Ozone and electrolyzed water: green innovation for a paradigm shift in sustainability, quality and safety of mediterranean agri-food products " at the Conference Center of EXPO for the Best Sustainable Development Practices Week.

DE NORA
electrochemistry at your service

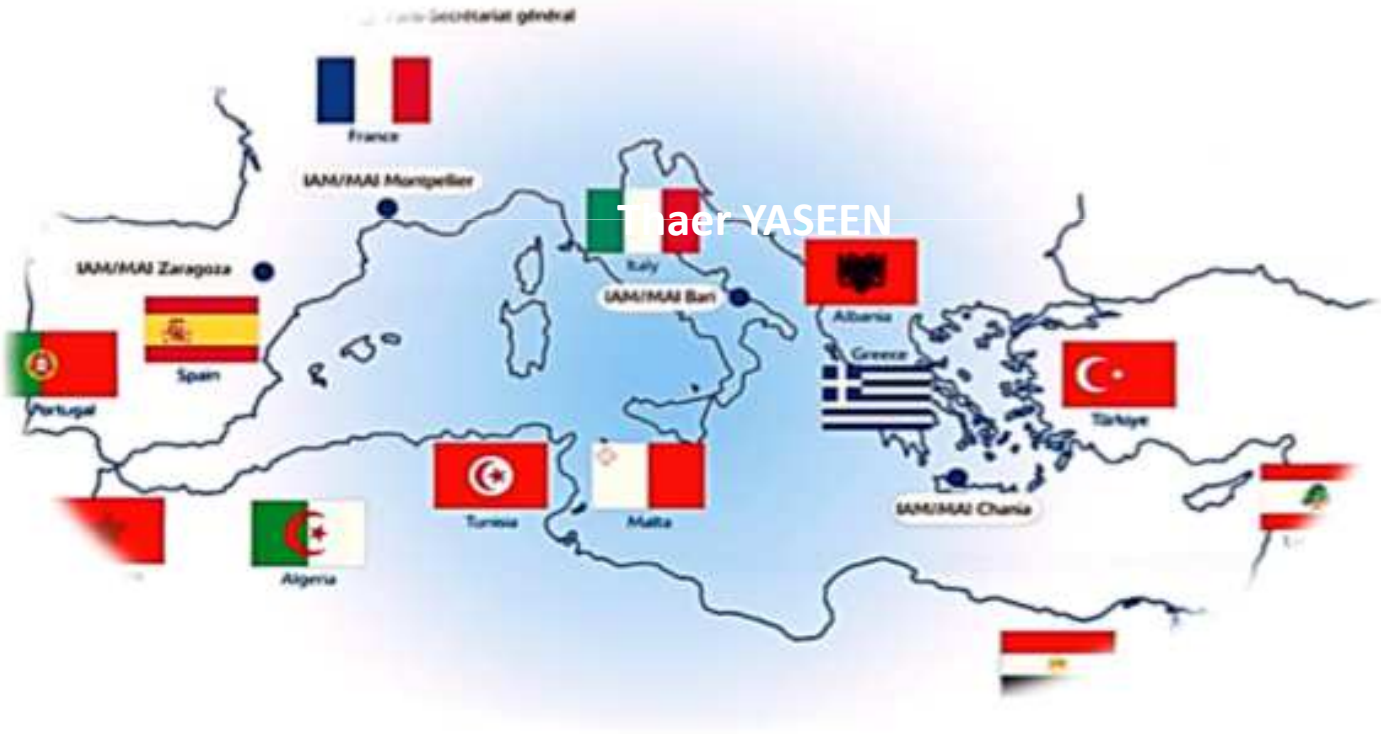
VI WORLD CONGRESS OF AGRONOMISTS

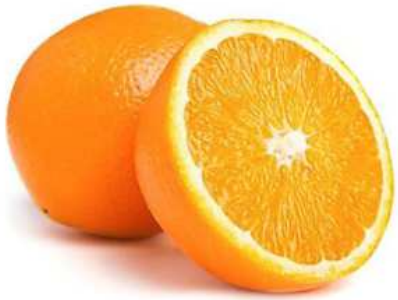
DE NORA
electrochemistry at your service

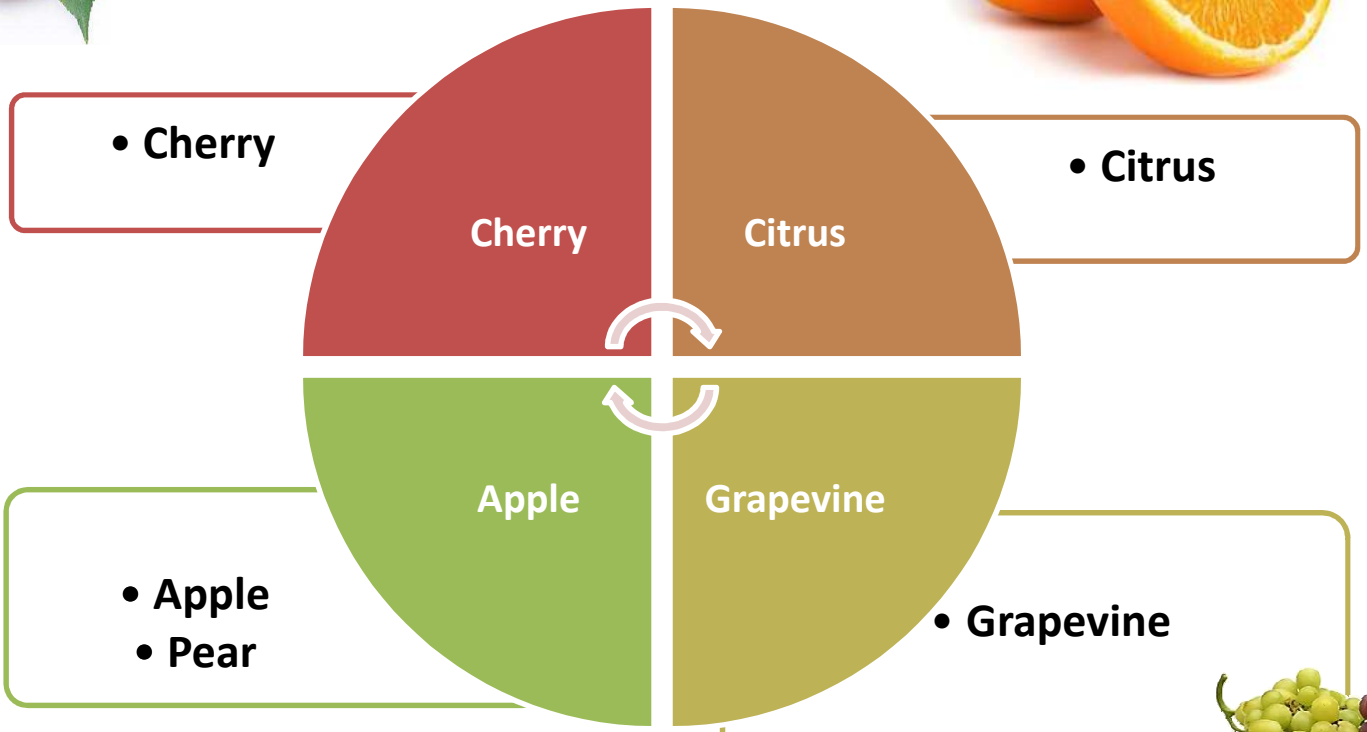
CENTRE INTERNATIONAL DE HAUTES ETUDES AGRONOMIQUES MÉDITERRANÉENNES

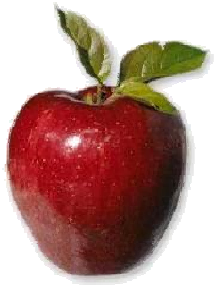
Dr. Thaer YASEEN

1962 - General Secretariat, Paris
MAI-Montpellier, MAI-Bari, MAI-Zaragoza, MAI-Chania






• Cherry
Cherry
Citrus
• Citrus
Apple
Grapevine
• Apple
• Pear
• Grapevine



CANKER due to *Nectria Galligena*

Treatments:
Winter time (opening and closing season) and Spring time

Agust 2008

September 2008

May 2009

September 2009

Block of trunk canker and formation of a scar

April 2010

March 2011

November 2011

April 2012

Formation of new wood and closing of canker wounds

APPLE & PEAR

EUROPEAN CANKER
Neonectria Galligena

GLOESPORIUM ROT
Gloesporium spp.

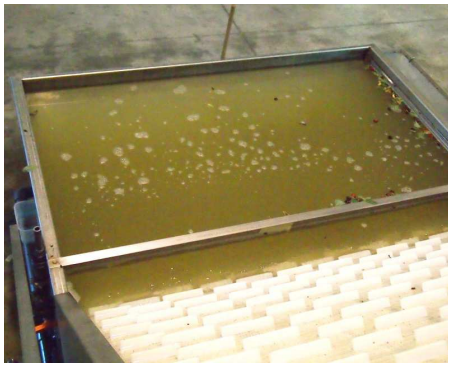
BACTERIAL FIRE BLIGHT
Erwinia amylovora

APPLE SCAB
Venturia inaequalis

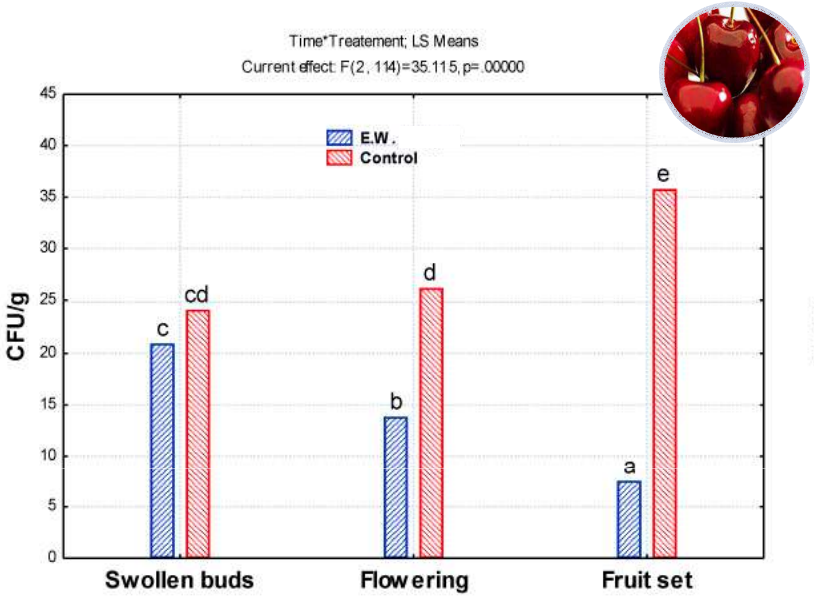
CHERRY

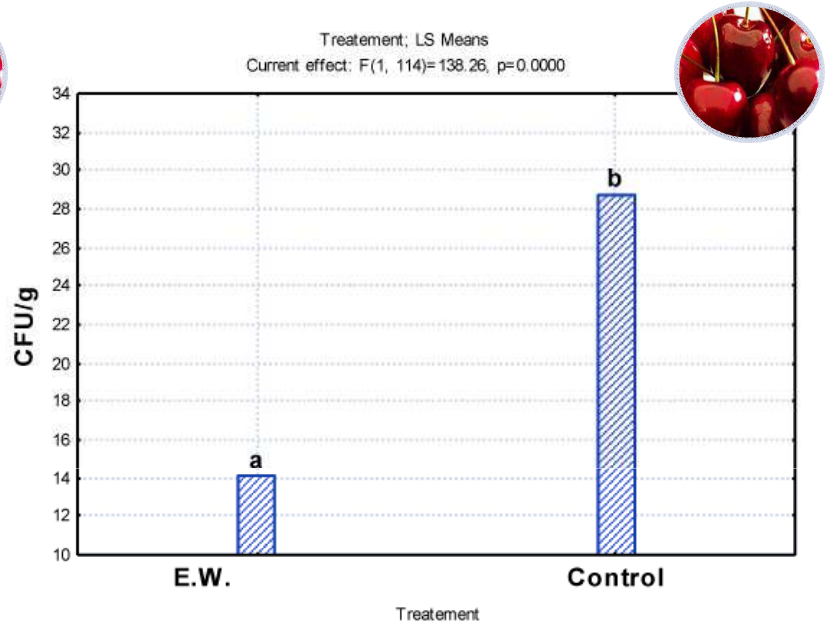
Monilinia spp.

Botrytis cinerea



PRE HARVEST TREATMENT BY E.W. DEMONSTRATED REDUCTION OF FUNGI





CITRUS

Post harvest application
***Penicillium* spp.**

Field application

POST HARVEST WASHING BY E.W. DEMONSTRATED REDUCTION IN PATHOLOGY INCIDENCE AND GOOD CITRUS QUALITY

CIHEAM

Step 1

Wounding the fruits

Penicillium Italicum Inoculation

Step 2

Washing the fruits

✓Electolyzed water at different concentrations

✓Washing time: up to 5 min

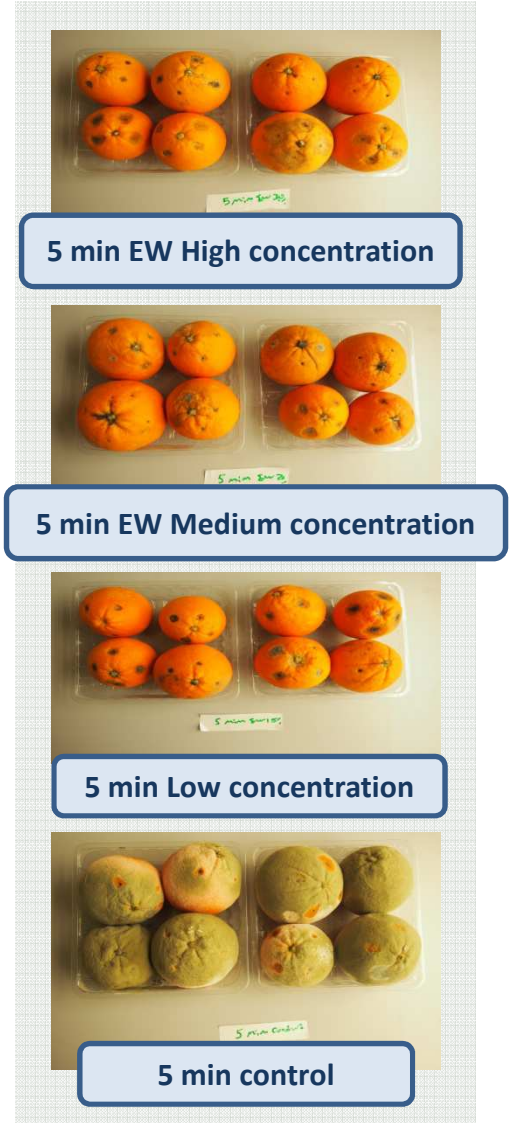
✓Replicate box: 2-4

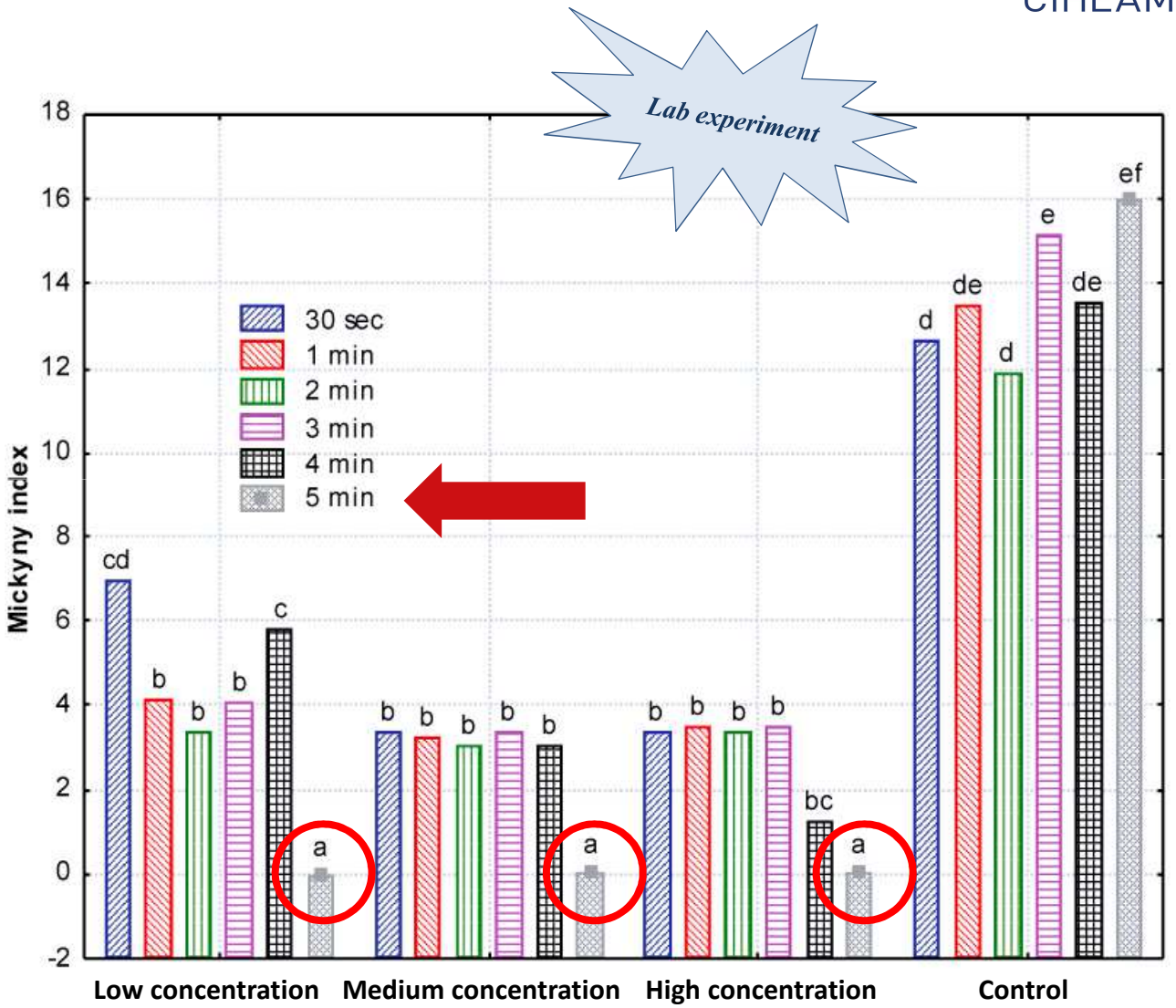
Step 3

Conservation at 23° C for 7 days

Lab experiment

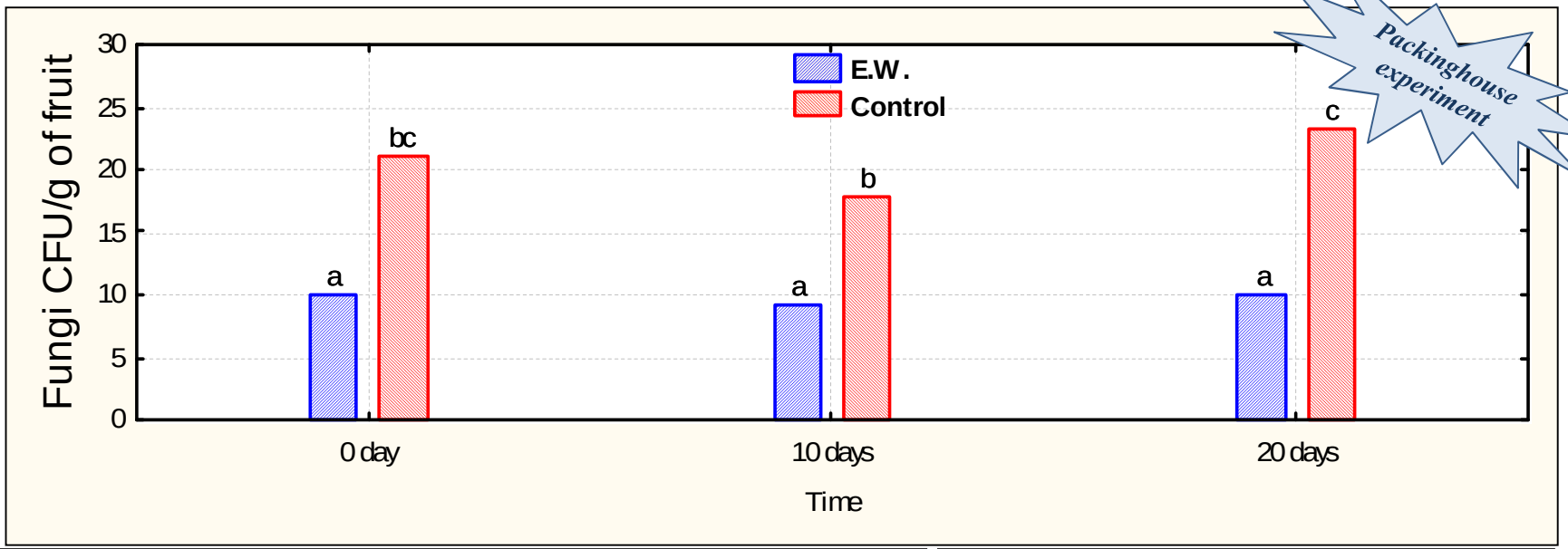
REDUCTION IN PATHOLOGY INCIDENCE …

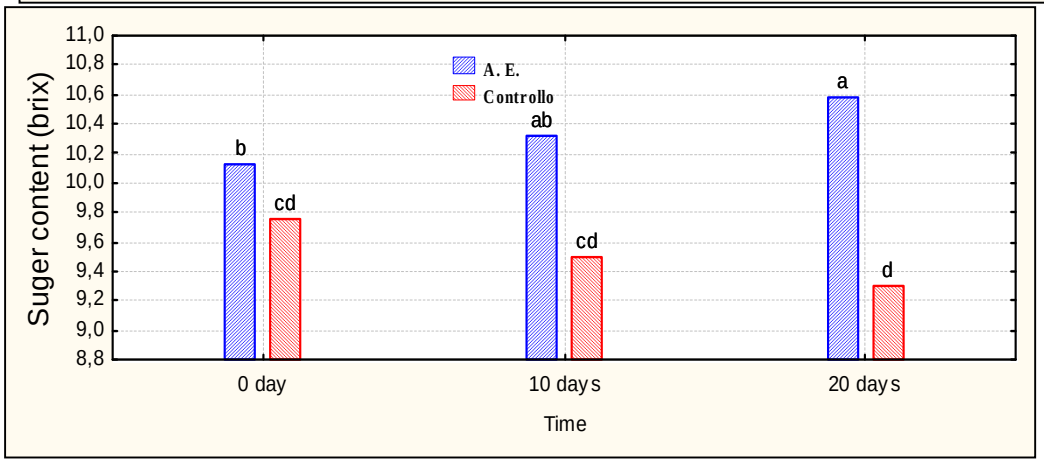


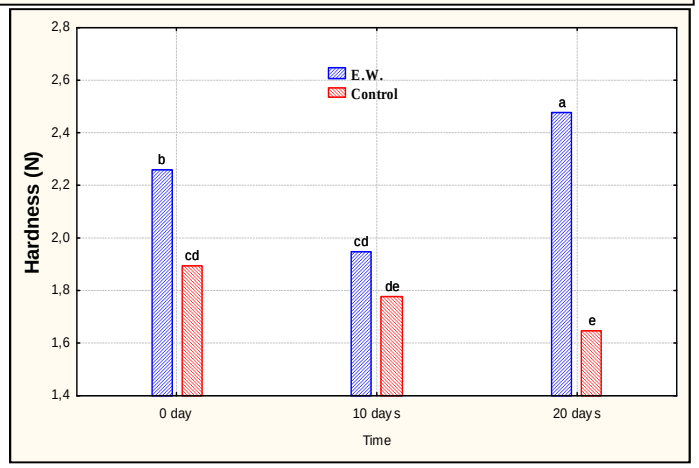


….REDUCTION OF FUNGI AND GOOD CITRUS QUALITY IN HARDNESS AND SUGAR CONTENT

CIHEAM





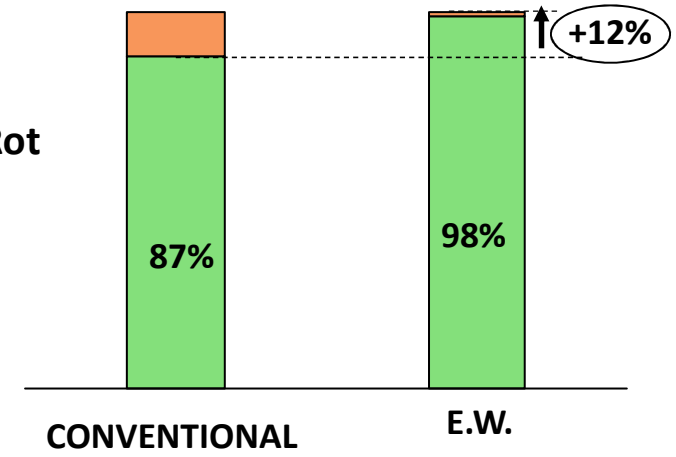


PRE HARVEST APPLICATION OF E.W. ON APPLE CV PINK RESULTED IN A 10 % TO 20% INCREASE OF WHOLESOME PRODUCT AFTER 4 MONTHS OF REFRIGERATION.

CIHEAM

Apples affected / By Gloesporium Rot

Healthy apples



- **E.W. applied from end June every 7-10days up to end of October**
- **STD pesticides applied as usually by farmer from end of June to October**
- **Harvest: 30th October**
- **Preservation: controlled atmosphere and dynamic atmosphere refrigeration**
- **Sampling: 16th March**

E.W

CONVENTIONAL

TREATMENT WITH ELECTROLYZED WATER ALLOW S REDUCTION OF PESTICIDES RESIDUALS, WHILE FRUITS ARE IN HEALTHY CONDITIONS

CIHEAM

2011 • APPLE - PINK LADY

Thesis - Pesticide usually employed by farmer up to half-July, then treatment ONLY with E.W. up to harvesting
survey: multi-residual on 20 fruits

	STANDARD PESTICIDE	E.W.
RESIDUALS	4	1

Active Principle	Quantity mg/kg	Quantity mg/kg
Dithianon	0.199	0.151
Boscalid	0.073	
Pyraclostrobin	0.008	
Captan	0.108	

2011 • PEAR - ABATE FETEL

Thesis - Pesticide usually employed by farmer + E. W from spring
survey: multi-residual on 20 fruits

	STANDARD PESTICIDE	E.W.
RESIDUALS	5	2

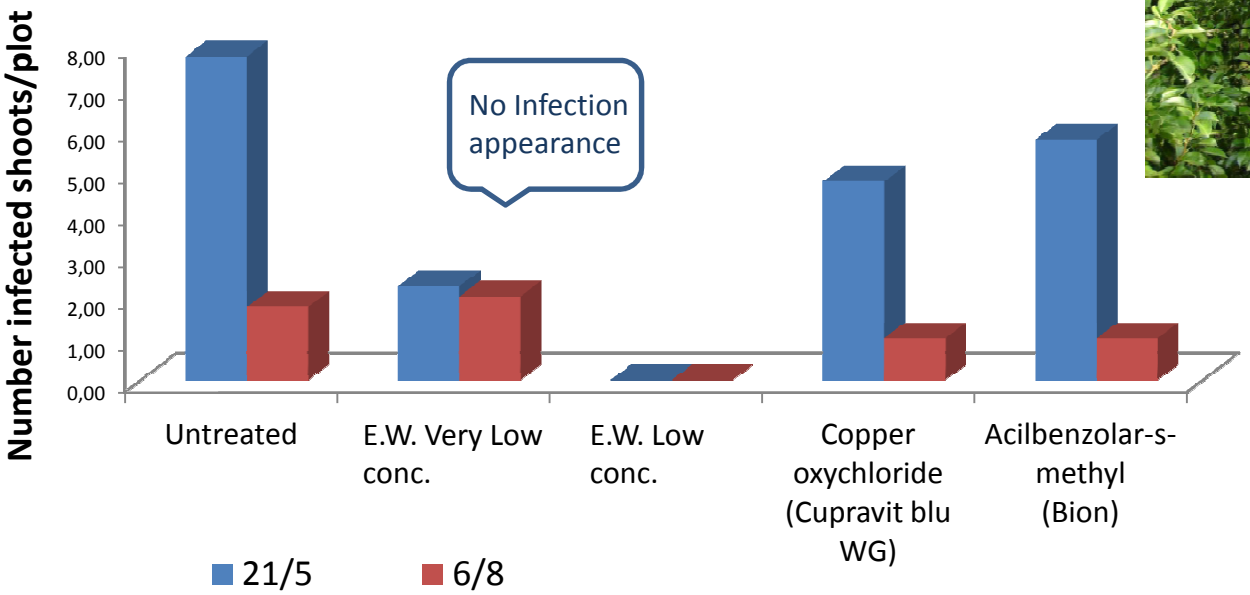
Active Principle	Quantity mg/kg	Quantity mg/kg
Iprodione	0.319	0.645
Dithiocarbamate	1.14	0.223
Tetraconazole	0.005	
Captan	0.095	
Kresoxim methyl	0.006	

2014 • GRAPES

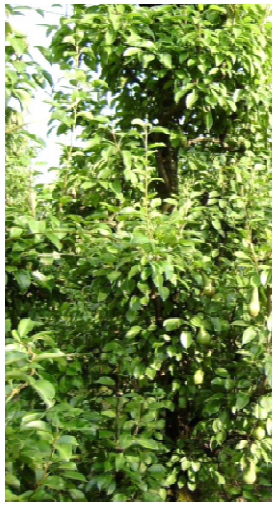
	STANDARD PESTICIDE	E.W.
RESIDUALS	3	2

AFTER TREATMENT WITH E. W. THERE WASN'T EVIDENCE OF FIRE BLIGHT INFECTION (ERWINIA AMYLOVORA) IN PEAR ORCHARD (ABATE FÉTEL)

CIHEAM



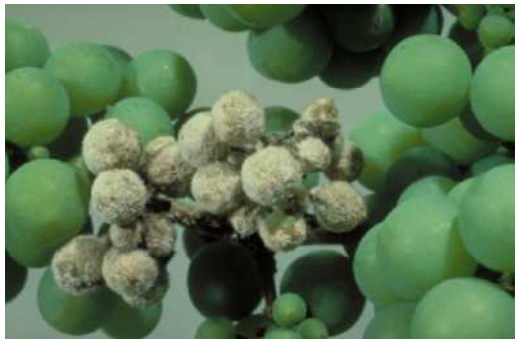
E.W



UNTREATED

GRAPEVINE

Gray mold
Botrytis cinerea



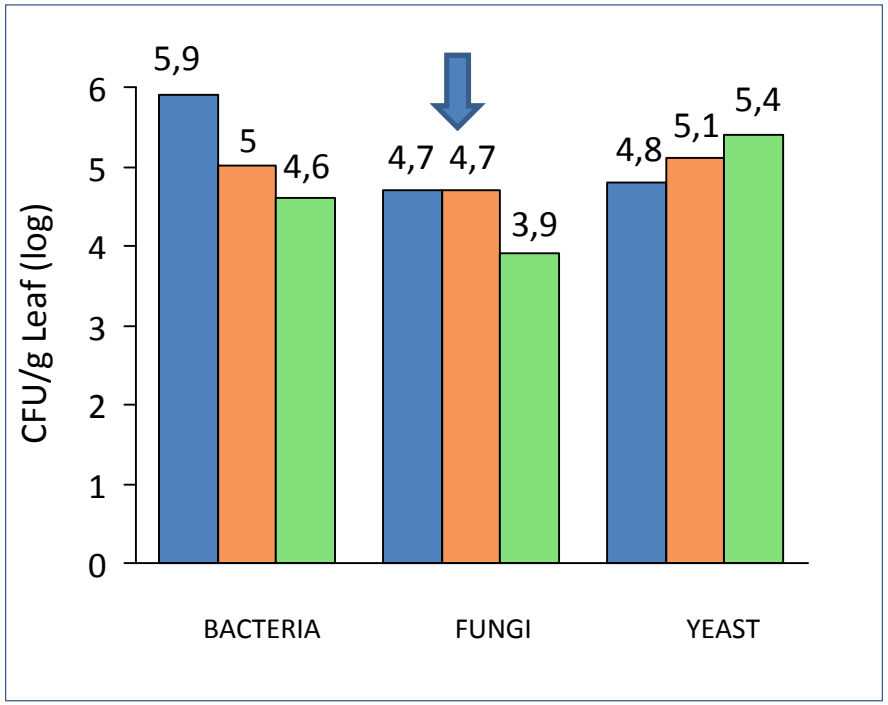
Downy mildew
Plasmopara viticola

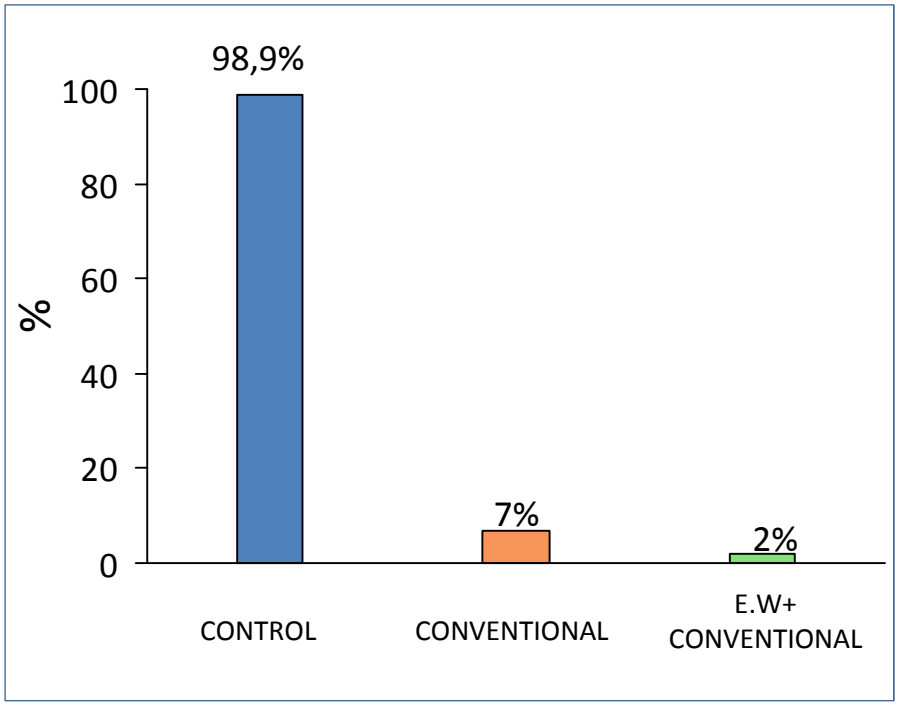
A- Control

B- Conventional

C- E.W.

TREATMENT WITH ELECTROLYZED WATER ALLOW THE REDUCTION OF FUNGI ON VINE LEAFS, DOWNEY MILDEW ON BERRIES MAINTAINING QUALITY OF GRAPEVINE





CONTROL CONVENTIONAL E.W+ CONVENTIONAL

Aida Raio - CNR – Istituto per la protezione delle piante- Firenze

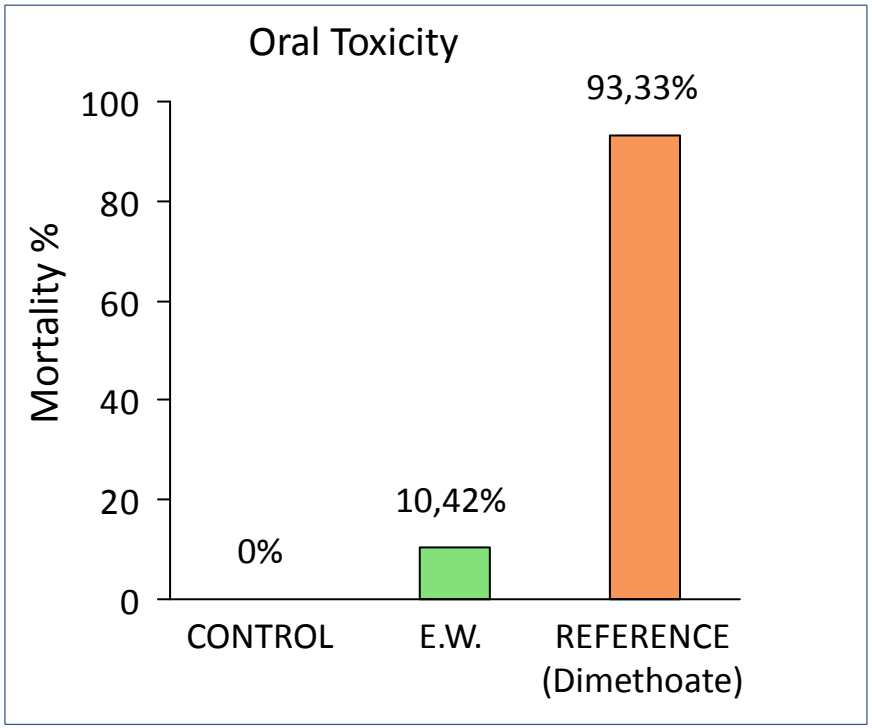
TESTS DEMONSTRATED ELECTROLYZED WATER ISN'T TOXIC FOR HONEYBEEN AND IT HASN'T REPELLENT EFFECT

CIHEAM

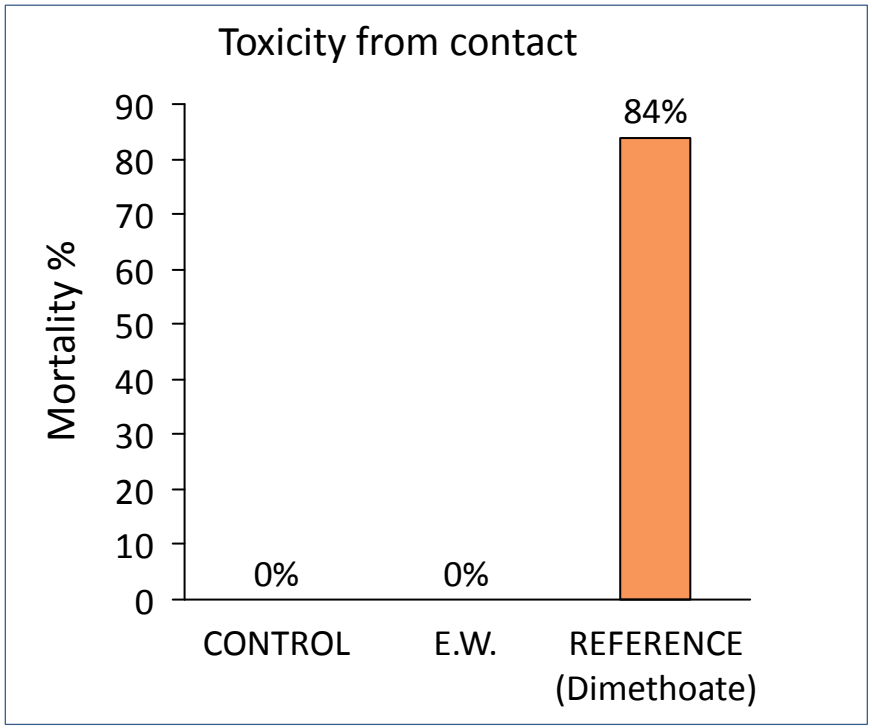
Apis mellifera L.

10 Apis mellifera
(5 replicate)

Difference in mortality not significative



No mortality



Electrolyzed Water for Farming

REPRODUCTION

NURSERY ROOMS

Weaning

GROWING

FOOD PIPELINE

DE NORA
electrochemistry at your service

Sanitization Test in Nursery room

STANDARD practice for Nursery rooms sanitization is to wash and rinse all in one step; foaming surfactant “Schiuma C66”. High pressure water rinse – Operation time 2.5 – 3 h

Rinsing with Soleva
500 ppm - 6 min

Sample 0
(Before treatment)

Sanitization (day afeter):
Soleva @2000 ppm

Sample 1
(After sanitization)

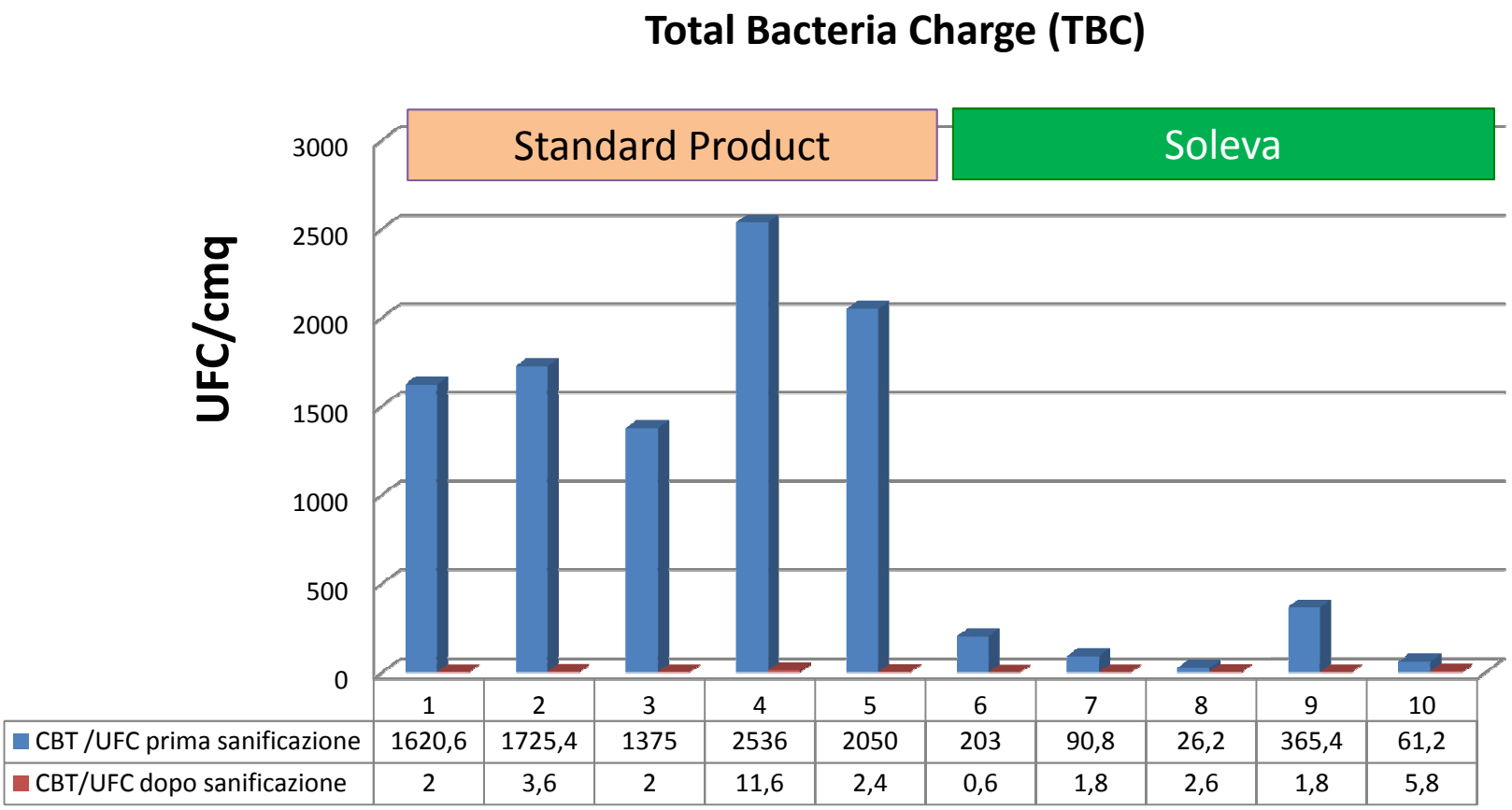
Rinsing with water

Sample 0
(Before treatment)

Sanitization (day after):
Professional 5/1

Sample 1
(After sanitization)

Sanitization Test



	1	2	3	4	5	6	7	8	9	10
CBT /UFC prima sanificazione	1620,6	1725,4	1375	2536	2050	203	90,8	26,2	365,4	61,2
CBT/UFC dopo sanificazione	2	3,6	2	11,6	2,4	0,6	1,8	2,6	1,8	5,8