L’Efficacia delle Soluzioni saline elettrolizzate in Agricoltura

AIDB 2015, 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 Electrolyzed 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
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 water containing 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.
CENTRE INTERNATIONAL DE HAUTES ETUDES AGRONOMIQUES MÉDITERRANÉENNES

Dr. Thaer YASEEN

1962 - General Secretariat, Paris
MAI-Montpellier, MAI-Bari, MAI-Zaragoza, MAI-Chania
CANKER due to *Nectria Galligena*

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

**Block of trunk canker and formation of a scar**

**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

15 September, 2015 – EXPO Milan, Italy
POST HARVEST WASHING BY E.W. DEMONSTRATED REDUCTION IN PATHOLOGY INCIDENCE AND GOOD CITRUS QUALITY

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 ...

5 min EW High concentration

5 min EW Medium concentration

5 min Low concentration

5 min control

Lab experiment

15 September, 2015 – EXPO Milan, Italy
REDUCTION OF FUNGI AND GOOD CITRUS QUALITY IN HARDNESS AND SUGAR CONTENT

**Fungi CFU/g of fruit**

- E.W.
- Control

**Time**

- 0 day
- 10 days
- 20 days

**Sugue content (brix)**

- A.E.
- Control

**Hardness (N)**

- E.W.
- Control

Packinghouse experiment
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.

- E.W. applied from end June every 7-10 days 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
TREATMENT WITH ELECTROLYZED WATER ALLOWS REDUCTION OF PESTICIDES RESIDUALS, WHILE FRUITS ARE IN HEALTHY CONDITIONS

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

<table>
<thead>
<tr>
<th>Active Principle</th>
<th>Quantity mg/kg</th>
<th>Quantity mg/kg</th>
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</thead>
<tbody>
<tr>
<td>Dithianon</td>
<td>0.199</td>
<td>0.151</td>
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<tr>
<td>Boscalid</td>
<td>0.073</td>
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<tr>
<td>Pyraclostrobin</td>
<td>0.008</td>
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<tr>
<td>Captan</td>
<td>0.108</td>
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</table>

2011 • PEAR - ABATE FETEL

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

<table>
<thead>
<tr>
<th>Active Principle</th>
<th>Quantity mg/kg</th>
<th>Quantity mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iprodione</td>
<td>0.319</td>
<td>0.645</td>
</tr>
<tr>
<td>Dithiocarbamate</td>
<td>1.14</td>
<td>0.223</td>
</tr>
<tr>
<td>Tetraconazole</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Captan</td>
<td>0.095</td>
<td></td>
</tr>
<tr>
<td>Kresoxim methyl</td>
<td>0.006</td>
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</table>

2014 • GRAPES

<table>
<thead>
<tr>
<th>Active Principle</th>
<th>Quantity mg/kg</th>
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<tr>
<td>Iprodione</td>
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AFTER TREATMENT WITH E. W. THERE WASN’T EVIDENCE OF FIRE BLIGHT INFECTION (ERWINIA AMYLOVORA) IN PEAR ORCHARD (ABATE FÉTEL)

Field Test on pear cv Abate Fétel - Reggio Emilia (Italy) 2010

Number infected shoots/plot

- Untreated
- E.W. Very Low conc.
- E.W. Low conc.
- Copper oxychloride (Cupravit blu WG)
- Acilbenzolar-s-methyl (Bion)

No Infection appearance

- 21/5 Untreated
- 6/8 E.W. Very Low conc.
GRAPEVINE

A- Control

B- Conventional

C- E.W.

Gray mold
*Botrytis cinerea*

Downy mildew
*Plasmopara viticola*
TREATMENT WITH ELECTROLYZED WATER ALLOW THE REDUCTION OF FUNGI ON VINE LEAFS, DOWNY MILDEW ON BERRIES MAINTAINING QUALITY OF GRAPEVINE

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

15 September, 2015 – EXPO Milan, Italy
TESTS DEMONSTRATED ELECTROLYZED WATER ISN’T TOXIC FOR HONEYBEEN AND IT HASN’T REPELLENT EFFECT

Apis mellifera L.

10 Apis mellifera (5 replicate)

Difference in mortality not significative

Oral Toxicity

<table>
<thead>
<tr>
<th>Mortality %</th>
<th>CONTROL</th>
<th>E.W.</th>
<th>REFERENCE (Dimethoate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>10,42%</td>
<td>93,33%</td>
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</table>

Toxicity from contact

<table>
<thead>
<tr>
<th>Mortality %</th>
<th>CONTROL</th>
<th>E.W.</th>
<th>REFERENCE (Dimethoate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0%</td>
<td>84%</td>
<td></td>
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</table>
Electrolyzed Water for Farming

**REPRODUCTION**

- NURSERY ROOMS
- Weaning

**GROWING**

**FOOD PIPELINE**
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 after): 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

Total Bacteria Charge (TBC)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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</thead>
<tbody>
<tr>
<td>CBT/UFC prima sanificazione</td>
<td>1620,6</td>
<td>1725,4</td>
<td>1375</td>
<td>2536</td>
<td>2050</td>
<td>203</td>
<td>90,8</td>
<td>26,2</td>
<td>365,4</td>
<td>61,2</td>
</tr>
<tr>
<td>CBT/UFC dopo sanificazione</td>
<td>2</td>
<td>3,6</td>
<td>2</td>
<td>11,6</td>
<td>2,4</td>
<td>0,6</td>
<td>1,8</td>
<td>2,6</td>
<td>1,8</td>
<td>5,8</td>
</tr>
</tbody>
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