Steam Disinfestation with Natural Gas Technology

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GTI Overview

> Not-for-profit (501c3) RD&D organization with 70 year history

> Facilities
  – 18 acre campus near Chicago
  – 200,000 ft²,
    28 specialized labs
  – Other sites in
    California, D.C., Texas, Alabama, Massachusetts

> Staff
  – Approximately 250
  – 170 engineers, scientists covering all fields
Natural Gas Industry Collaboration

Emerging Technology Program

> Gas Technology Institute led, utility supported, **North American collaborative** targeting **residential, commercial, and industrial solutions**

> ETP’s principle goal is to **accelerate** the **market acceptance** of emerging gas technologies

2014 Members Listed Above
The Problem

> Pathogens destroy high-value crops
> Tens of thousands of acres of high-value crops treated with MB (GHG)
> MB regulated out of buffer zones
  — soon to be regulated out completely in CA
> Other chemical alternatives very undesirable (e.g. carcinogens)
> Growers will be without a solution
  — Strawberries, tomatoes, cut flowers, raspberries, blackberries, lettuce, golf courses

<table>
<thead>
<tr>
<th>Value Crops</th>
<th>CA Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strawberries</td>
<td>37,000</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>40,000</td>
</tr>
<tr>
<td>Cut Flowers</td>
<td>9,000</td>
</tr>
</tbody>
</table>
Steam Disinfestation Solution

- Steam boiler solution
- Alpha prototype tested
- Propane fueled
- Easy conversion to CNG
- Bed shaper/steamer
Results – Better Fruit Yield

- Several acres tested
- Two UC Davis strawberry test plots
- Three Reiter (Driscoll’s) strawberry fields
- Steam as good or better than chemicals

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Crop injury 12/15/11</th>
<th>Crop injury 1/31/12</th>
<th>Cumulative weeding time 4/4/12</th>
<th>Weed density</th>
<th>Cumulative fresh weight weeds 4/4/12</th>
<th>Fruit yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam</td>
<td>1.4 a</td>
<td>0.0 b</td>
<td>32.5 b</td>
<td>70.2 b</td>
<td>34 g/50 ft.</td>
<td>248 a</td>
</tr>
<tr>
<td>PicClor 60</td>
<td>0.0 b</td>
<td>0.3 a</td>
<td>39.4 b</td>
<td>107.8 b</td>
<td>311 g/50 ft.</td>
<td>235 a</td>
</tr>
<tr>
<td>Non-treated</td>
<td>0.0 b</td>
<td>0.0 b</td>
<td>88.9 a</td>
<td>331.0 a</td>
<td>872 g/50 ft.</td>
<td>185 b</td>
</tr>
<tr>
<td>Least significant difference</td>
<td>0.5</td>
<td>0.2</td>
<td>22.1</td>
<td>158.7</td>
<td>726 g/50 ft.</td>
<td>26</td>
</tr>
</tbody>
</table>

≤2 = safe, 10 = dead

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<th>Mean (Weed Biomass Dry grams)</th>
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<tbody>
<tr>
<td>Steam</td>
</tr>
<tr>
<td>Control</td>
</tr>
</tbody>
</table>
CNG Opportunity

> $6,000 to treat 1 acre of strawberries with propane steam
> Compared to $3,800 per acre for Methyl Bromide
> Natural gas is about 1/3 the cost of propane
> $3,000 to treat 1 acre of strawberries with NG steam
CNG Infrastructure

> Take advantage of Salinas CNG
> In the heart of strawberry farming land
> Could be used to fill fuel mules
> Transportation to fields for steaming
> Alternatively on-site CNG compressor stations
  ─ Attractive option if farming fleet vehicles were CNG
> Major grower is keen on this concept
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