HEAT TREATING SEEDS FOR DISEASE MANAGEMENT

Meg Tuttle McGrath
Cornell University, School of Integrative Plant Sciences
Plant Pathology and Plant-Microbe Biology Section
Long Island Horticultural Research and Extension Center
Riverhead, New York. mtm3@cornell.edu

Cornell University is an equal opportunity, affirmative action educator and employer.
Heat Treatment for Killing Pathogens in Seed

Hot water
Steam
Seed Appropriate for Heat Treatment to Manage Pathogens

• Seed with potential to be harboring pathogen inside.

• Small-sized seed (tomato, crucifers, etc).

• Seed for which a treatment protocol has been developed.

• Seed that has not already been treated with hot-water or fungicide, and is not pelletized.

• Seed that is young and has good vigor.
• Seed that will be planted within a year. Hot-water treatment can advance maturation.
• Seed that is not heavily contaminated; hot-water treatment may not be able to completely control pathogen with seed that has a high percentage of seed that has a high quantity of the pathogen.
• Also, other potential sources of the pathogen can (and will be) managed.
Hot-water Seed Treatment

Relatively easy to do.

Follow protocol precisely. Temperature must be accurate.

Doing yourself voids any seed company guarantees. Best done by seed company.
News Articles/Disease Alerts

All Vegetables (also see specific vegetables plus herbs below)

All Vegetables - Insects

- Key Features of the Adult Brown Marmorated Stink Bug by Peter Jentsch (July 2011)

All Vegetables - Fungicides

- General Guidelines for Managing Fungi Resistance (November 2015)
- Resistance Risk of Fungicides for Vegetables (November 2015)
- Biopesticides labeled for managing disease on vegetable crops (November 2015)

All Vegetables - Other Disease Management & Production Practices

- Controlling Diseases of Vegetable Transplants in The Greenhouse (April 2015)
- What a Greenhouse Grower Needs to Know About Vegetable Diseases (February 2015)
- Managing Pathogens Inside Seed with Hot Water (March 2013)
- Treatments for Managing Bacterial Pathogens in Vegetable Seed (April 2005)
Managing Pathogens Inside Seed with Hot Water

Meg McGrath
Department of Plant Pathology and Plant-Microbe Biology, Cornell University
Long Island Horticultural Research and Extension Center; 3059 Sound Avenue
Riverhead, NY 11901; mtm3@cornell.edu
<table>
<thead>
<tr>
<th>Seed-borne Pathogens</th>
<th>Diseases of Vegetable Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Crucifers</em> (Cabbage, broccoli, cauliflower, Brussels sprouts, kale)</td>
<td><strong>Parsnip</strong></td>
</tr>
<tr>
<td>Alternaria leaf spot</td>
<td>Phoma canker</td>
</tr>
<tr>
<td>Bacterial leaf spot (peppery leaf spot)</td>
<td><strong>Pepper</strong></td>
</tr>
<tr>
<td>Black leg</td>
<td>Anthracnose fruit rot</td>
</tr>
<tr>
<td>Black rot</td>
<td>Bacterial leaf spot</td>
</tr>
<tr>
<td><strong>Carrot</strong></td>
<td>Cucumber mosaic virus</td>
</tr>
<tr>
<td>Alternaria leaf blight</td>
<td>Pepper mild mottle virus</td>
</tr>
<tr>
<td>Bacterial leaf blight</td>
<td>Tobacco mosaic virus</td>
</tr>
<tr>
<td>Cercospora leaf spot</td>
<td>Tomato mosaic virus</td>
</tr>
<tr>
<td>Crater rot and foliar blight</td>
<td><strong>Spinach</strong></td>
</tr>
<tr>
<td><strong>Cucumber</strong></td>
<td>Anthracnose</td>
</tr>
<tr>
<td>Anthracnose</td>
<td>Black spot</td>
</tr>
</tbody>
</table>
Table 1. Hot-Water Seed Treatment Protocols (also available as PDF)

Prepared by Margaret Tuttle McGrath, Cornell University, Long Island Horticultural Research and Extension Center, 3059 Sound Avenue, Riverhead, NY. mtm3@cornell.edu

<table>
<thead>
<tr>
<th>Crop</th>
<th>Temperature and time</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brussels sprouts</td>
<td>122°F 25 minutes</td>
<td>1, 3, 4</td>
</tr>
<tr>
<td>Broccoli</td>
<td>122°F 20 minutes</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Cabbage</td>
<td>122°F 25 minutes</td>
<td>1, 3, 4</td>
</tr>
<tr>
<td>Carrot</td>
<td>122°F 20 minutes</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>122°F 20 minutes</td>
<td>1, 3, 4</td>
</tr>
<tr>
<td>Celeriac</td>
<td>118°F 30 minutes</td>
<td>3</td>
</tr>
<tr>
<td>Celery</td>
<td>118°F 30 minutes</td>
<td>1, 3</td>
</tr>
<tr>
<td>Table 3. Equipment for Hot-Water Treating Seed (Also available as a PDF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepared Feb 2013 by Kris Holmstrom, Rutgers Cooperative Extension Vegetable IPM Program, Blake Hall Rm. 243, 93 Lipman Dr., New Brunswick, NJ 08901 and Margaret Tuttle McGrath, Cornell University, Long Island Horticultural Research and Extension Center, 3059 Sound Avenue, Riverhead, NY. <a href="mailto:mtm3@cornell.edu">mtm3@cornell.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carolina Biological Analog 10L bath: $716 <a href="http://www.carolina.com/laboratry-water-baths/polyscience-water-bath-analog-10-l/707123.pr?catId=&amp;mCat=&amp;sCat=">http://www.carolina.com/laboratry-water-baths/polyscience-water-bath-analog-10-l/707123.pr?catId=&amp;mCat=&amp;sCat=</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher Thermo Scientific Precision Digital 5.5 L bath: $1088 <a href="http://www.fishersci.com/eccom/servlet/itemdetail?storeId=10652&amp;langId=-1&amp;catalogId=29104&amp;productId=3304288&amp;distype=0&amp;highlightProductsItemsFlag=Y&amp;fromSearch=1">http://www.fishersci.com/eccom/servlet/itemdetail?storeId=10652&amp;langId=-1&amp;catalogId=29104&amp;productId=3304288&amp;distype=0&amp;highlightProductsItemsFlag=Y&amp;fromSearch=1</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hot-Water Seed Treatment

Protocol for Tomato Seed:

Preheat seed for 10 min. at 100°F.

Transfer to 122°F for 25 min.

Cool seed immediately and dry completely prior to sowing or re-packaging.
# Anova Water Baths

## Water Bath Specifications:

<table>
<thead>
<tr>
<th>Model</th>
<th>W-6</th>
<th>W-10</th>
<th>W-14</th>
<th>W-22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank Volume:</td>
<td>6 liters</td>
<td>10 liters</td>
<td>14 liters</td>
<td>22 liters</td>
</tr>
<tr>
<td>Tank Dimensions (inches):</td>
<td>11.75x6x5.75</td>
<td>11.75x9.5x5.75</td>
<td>13.55x11.7x6</td>
<td>19.5x11.75x6</td>
</tr>
<tr>
<td>System Dimensions(inches):</td>
<td>13x9x8</td>
<td>13x12x8</td>
<td>15x13.5x8</td>
<td>23x13x8</td>
</tr>
<tr>
<td>Heater Power:</td>
<td>400w</td>
<td>700w</td>
<td>900w</td>
<td>1200w</td>
</tr>
<tr>
<td>Temperature Range:</td>
<td>ambient +10°C to 99°C</td>
<td>ambient +10°C to 99°C</td>
<td>ambient +10°C to 99°C</td>
<td>ambient +10°C to 99°C</td>
</tr>
<tr>
<td>Temperature Stability:</td>
<td>±0.15°C</td>
<td>±0.15°C</td>
<td>±0.15°C</td>
<td>±0.15°C</td>
</tr>
<tr>
<td>Interface:</td>
<td>LED with Keypad</td>
<td>LED with Keypad</td>
<td>LED with Keypad</td>
<td>LED with Keypad</td>
</tr>
<tr>
<td>Safety</td>
<td>adjustable cut-off</td>
<td>adjustable cut-off</td>
<td>adjustable cut-off</td>
<td>adjustable cut-off</td>
</tr>
</tbody>
</table>
Vegetable MD Online
Department of Plant Pathology, Ithaca, NY 14853

Treatments for Managing Bacterial Pathogens in Vegetable Seed

Margaret Tuttle McGrath
Department of Plant Pathology, Cornell University
Long Island Horticultural Research and Extension Center
3059 Sound Avenue, Riverhead, NY; mtm3@cornell.edu

April 2005

For more information on hot-water seed treatment see
Managing Pathogens Inside Seed with Hot Water
Sous Vide cooking technique with precision temperature control

from $96.90
Anova Culinary A2.2-120V-US Sous Vide

from $9.99
EVERIE Collapsible Hinged Sous Vide
Hot-water Treatment Procedures

• Use fiberglass window screen to make seed package for seed that isn’t so small that some could go through holes. Use coffee filter or organza bags for very small seed. Tea infuser ball can also be used (note that it can be challenging to get seed out of the ball after treatment).

• Label plastic pot label to go in fiberglass window screen package or write directly on coffee filter. Label with information to indicate what seed is inside.
Hot-water Treatment Procedures

• Put weight in seed package. A quarter is an ideal weight.

• Add seed to partly fill container. Do not fill to the point that water will not be able to easily move into the center of the seed mass or that there will be stress on the seems of the coffee filter.

• Roll top of package over twice to close then staple shut with no gaps that could enable seed to escape.
HOUSWEETY 100pc 5x7 Inches Organza Mixed Colors Jewelry Pouch Bags Display

by Housweety

208 customer reviews  |  19 answered questions

List Price: $29.99

Price: $8.06 & FREE Shipping on orders over $35. Details
Hot-water Treatment Procedures

• Optional: attach a string to the package to facilitate moving the packages as needed in the bath and removing them from bath. String from packages can be tied to a dowel rod. Alternative: use large cooking spoon to remove seed packages from water.

• Treat seed at 100 F for 10 min to pre-heat and then at the treatment temperature for the seed type. Then cool with cold water.
Hot-water Treatment Procedures

• Promptly either plant or dry seed. Large quantities should be spread out on paper towel to dry.

• Once dry, put in a new envelope to hold until planting time. Seed should be put in a new envelope rather than returned to the envelope it came in. Store as usual (eg refrigerate if planting won’t occur for weeks).
Food Dryer

Suitable for drying small packages of seeds.

FEATURES

- Five stackable, interlocking trays are removable for easy cleaning
- Fan only, low, medium, and high settings for dehydrating a wide array of foods
Hot Water Seed Treatment

Benefits of hot water seed treatment: Some plant pathogens are able to penetrate and survive within the seed, out of reach of surface seed treatments. They include many bacterial pathogens of vegetables as well as fungi, oomycetes, and viruses. Tomato, pepper and brassicas are good candidates for hot water seed treatment because there are common bacterial and fungal diseases of these small seeded-crops that can be easily prevented. Even though pathogens do not survive well in soil once infected crop residues have decayed, they can be difficult to manage once established on a farm. Hot water seed treatment also has the beneficial effect of priming seeds resulting in faster germination than untreated seed. Hot water seed treatment is a valuable tool for preventing establishment of seed-borne diseases on the farm, or their reintroduction year after year.

Deciding which seeds to treat: To decide whether to use heat treatment, first determine the likelihood that seeds you are sowing contain seedborne disease. This can be done by testing soil samples for presence of infection at the farm. If the probability of encountering diseased seeds in your crop is high, move on to deciding which seeds to treat. Some crops are easy to treat because they are planted in large quantities and are relatively inexpensive. These crops include corn, soybeans, cotton, and many vegetables.
Fees: Each variety or cultivar will cost $6 for each 0.1 -1oz\(^1\). For example, 0.5oz of cherry tomato seed will cost $6 and 1.6oz of plum tomato seed will cost $12. An additional $5 for each 0.1 – 13oz of seed is charged for shipping.
Routes of active seed infection

A. Penetration through ovary wall

B. Systemic infection via vascular system

C. Penetration through floral parts

E.g.: *Cladosporium variabile* (spinach), *Botrytis* spp. (onion)
E.g.: Vascular wilt fungi, endophytes
E.g.: *Ustilago nuda* (grains) *Cucumber mosaic virus*

From Maude (1996)
Seed-borne Diseases of Tomato

- Bacterial canker
- Bacterial spot
- Bacterial speck
- Septoria leaf spot
Tomato seedlings
Bacterial canker
Bacterial spot
Black Rot – Cabbage + Cauliflower
Black Rot – Ornamental Kale
Black Rot
Ornamental Kale
Black Rot – Ornamental Kale
Tomato Septoria Leaf Spot
Septoria Leaf Spot
Bacterial Canker
Parsley – Septoria Leaf Spot
Lettuce Septoria Leaf Spot
Bacterial Leaf Spot Pepper
Bacterial Leaf Spot - Pepper
Exudate from seed in water complicates hot water treating.
Seed Being Hot-water Treated and Target Diseases

Brassicas: black rot, Alternaria leaf spot
Tomato: bacterial diseases, Septoria leaf spot
Pepper: bacterial leaf spot
Parsley: bacterial diseases
Spinach: Fusarium root rot
Hot-water Treating Seed to Kill Pathogens

Valuable first step in managing disease. Must be part of integrated program.

Make sure seed were not treated.

Follow protocol precisely.

Accurate laboratory thermometer is critical tool.