

HOT WATER SEED TREATMENT; our low-tech approach
Beth Kazmar/ Tipi Produce. Revised January, 2020

Hot water seed treatment is used to kill seedborne pathogens. Refer to the online document “Managing Pathogens Inside Seed with Hot Water” for a list of seedborne diseases of vegetable crops, and temperature/time protocols. It is important to treat your seed at the correct temperature and for the proper length of time. If the temperature is too hot, or the exposure too long, the seed can be damaged. Conversely, pathogens will not be killed if water is too cool, or the exposure is too short.

RESOURCES: Read at least one of these articles.

- “Managing Pathogens Inside Seed with Hot Water,”
<http://vegetableonline.ppath.cornell.edu/NewsArticles/HotWaterSeedTreatment.html>
 Good lists of seedborne pathogens and temperature protocols for a wide variety of crops.
- “Hot Water Treatment of Vegetable Seeds to Eradicate Bacterial Plant Pathogens in Organic Production Systems,”
<http://nwhortsoc.com/wp-content/uploads/2016/01/organicseedtrt.pdf>
- “How & why to treat seeds with hot water,” Growing For Market, January 2015
 This article discusses an efficient way to hot water treat seed using mesh bags and a food dehydrator.

PLANNING. DECISIONS. Let us share our experience treating tomato, pepper and brassica seeds.

- Do not treat pelleted seed.
- At our farm, we do not hot water treat (HWT) seed that has been tested and found free of pathogens. Check your seed packet for testing information, or ask your seed rep about the lot you’ve received, or check the accompanying table for black rot of crucifers. Some pathologists recommend hot water treating seed that has already been tested (and found “clean”) because there may still be low levels of contamination. We choose to not worry about this.
- Do not treat seed that has already been HWT’d. Check the seed packet or call your seed rep for information. Most will be able to tell you if the seed lot you have received has been HWT’d or not.
- Many protocols advise not treating “older seed,” because older seed is more easily damaged by HWT. We do not HWT seed that we’ve had in storage for more than two years. On a practical basis, we have found it difficult to determine the age of freshly-shipped seed. Seed is often produced in large batches and stored for several years by the seed producer. The actual age of freshly-shipped seed is not something we have been able to learn easily from our seed suppliers. For now, we are ignoring this issue. FYI, the germination test date on the seed package does not tell you how old the seed is, just when the most recent germ test was done.
- Many protocols advise testing a small amount of seed first, and to do a small test with each cultivar and each seed lot. This is an excellent idea for your first attempt to HWT seed. We’ve abandoned these time-consuming pre-tests as we’ve gained experience and confidence.
- Fortunately, we have rarely (never?) seen the germination rate of hot-water-treated tomato seed drop below the germination rate on the seed packet. This reflects many years experience with tomato seed. Peppers and brassicas are reputed to be more sensitive to hot water treatment but we have not had problems in five years treating these crops.

Crops	Diseases	Hot water treatment
Peppers	bacterial diseases, viruses	125°F for 30 min.
Tomatoes, eggplant	bacterial diseases viruses	122°F for 25 min.
Brussels sprouts, cabbage	bacterial diseases (eg black rot), Alternaria	122°F for 25 min.
Broccoli, cauliflower collards, kale, kohlrabi, napa, rutabaga, turnip	"	122°F for 20 min.
Mustard greens, radish	"	122°F for 15 min.

Basil or Arugula seed: Do not attempt to HWT basil or arugula seed. Both form gelatinous coats once wet, making the seed almost impossible to handle after HWT treatment. FYT, High Mowing Seeds promises that all their arugula seed has been tested and is free of the black rot pathogen.

Table 1. Hot-Water Seed Treatment Protocols

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

Crop	Temperature and time	Reference
- Brussels sprouts <i>B. o. var gemmitera</i>	122°F 25 minutes	1, 3, 4
- Broccoli <i>B. o. var italica</i>	122°F 20 minutes	1, 2, 3
- Cabbage <i>B. o. var capitata</i>	122°F 25 minutes	1, 3, 4
Carrot	122°F 20 minutes	1, 2, 3
- Cauliflower <i>B. d. var botrytis</i>	122°F 20 minutes	1, 3, 4
Celeriac	118°F 30 minutes	3
Celery	118°F 30 minutes	1, 3
- Chinese cabbage	122°F 20 minutes	1, 4
- Collards <i>B. o. var acephala</i>	122°F 20 minutes	1, 3, 4
Coriander	127°F 30 minutes	4
Cress	122°F 15 minutes	1, 3, 4
Cucumber	122°F 20 minutes	1, 4
Eggplant	122°F 25 minutes	1, 3, 4
- Kale <i>B. oleracea (var capitata) green</i>	122°F 20 minutes	1, 3
- Kohlrabi <i>B. o. var gongyloloides</i>	122°F 20 minutes	1, 3, 4
Lettuce	118°F 30 minutes	1, 3, 4
Mint	112°F 10 minutes	4
- Mustard <i>B. juncea</i>	122°F 15 minutes	1, 3, 4
New Zealand Spinach	120°F 60-120 mins	4
Onion (sets)	115°F 60 minutes	4
Parsley	122°F 30 minutes	5
Pepper	125°F 30 minutes	1, 3, 4
- Radish <i>Raphanus sativus</i>	122°F 15 minutes	1, 3
- Rutabaga <i>B. napus var napobrassica</i>	122°F 20 minutes	3, 4
Shallot	115°F 60 minutes	4
Spinach	122°F 25 minutes	1, 3, 4
Sweetpotato (roots)	115°F 65 minutes	4
(cuttings, sprouts)	120°F 10 minutes	4
Tomato	122°F 25 minutes	1, 3, 4
- Turnip <i>B. rapa var rapa</i>	122°F 20 minutes	1, 3, 4
Yam (tubers)	112°F 30 minutes	4

125°F = 51.5 °C 122°F = 50 °C 118°F = 48 °C
 125.6°F = 52 °C 131°F = 55 °C 132.8°F = 56 °C

Mizuna *B. rapa var japonica*
 Tatsoi *B. rapa var narinosa*
 Yukina *B. rapa* (similar to tatsoi)
 Pae choy *B. rapa var chinensis*
 arugula *ErUCA vesicaria*

Broccoli raab *B. ruvo*
 Kalewicz turnips *B. rapa (var rapifera??)*

SUPPLIES:

- Insulated container (I use a 2 or 3 gallon insulated water jug.)
- A piece of foam insulation to place under the insulated container (optional)
- Probe thermometer (eg., 8" digital $\pm 0.2^{\circ}\text{F}$ thermometer, Traceable Products, item #4352, \$58)
- Wooden spoon
- RECOMMENDED: Mesh bags of fiberglass window screen (See notes at end)
ALTERNATE: new floating row cover, cut in 12-inch squares + twist-ties + small washers
- Small binder clips in mixed colors
- Watch or clock
- Jugs of boiling water and cold water
- Bath towel, to cover jug while treating seeds
- If using mesh bags ... a dry space with fans (eg a greenhouse) OR food dehydrator (See GFM article.)
- If using row cover packets... paper towels to spread seed to dry OR food dehydrator (See GFM article.)
If using a food dehydrator, have the heating element turned off or disconnected
- Clean coin envelopes

RECOMMENDED METHOD, WITH MESH BAGS:

1. *Place seed in the mesh bag, add label, roll the opening shut, and clip with binder clips.
2. Attach the thermometer to the wooden spoon with rubber bands so the thermometer sensor tip is near the depth where the seeds will be.
3. Set up the insulated jug with water about 5-10°F hotter than the temperature you want. Place a piece of foam insulation under the jug to reduce heat loss. Cover and let sit until the temperature stabilizes, at least one hour. Stabilize the temperature at 2°F above your desired temperature. This will allow the water temperature to drop to your desired temperature when you add your seed packets. Stabilize at 1°F above your desired temperature if treating a small amount of seed. Stir occasionally. Add boiling water or cold water to adjust the temperature. Stabilizing the temperature takes time, but is an essential step.
4. Fill a pail with water as hot as you can comfortably submerge your hands in, about 100 - 110°F. Place the pail next to the stabilized hot water jug. Submerge the seed packets in the pail and squeeze to force out air bubbles.
5. Transfer the wet packets into the stabilized hot water jug and squeeze again to fill with hot water. Start the clock as soon as the packets are in the hot water. If necessary, adjust the temperature with small amounts of boiling water or cold water. If your insulated jug or cooler is large, float pieces of styrofoam on the surface to keep the water temperature stable. Put the lid on the insulated jug and cover with a folded towel to slow heat loss. Stir frequently. Monitor the temperature and adjust as needed.
6. As soon as the time is up, take the seed packets out and immediately submerge in cold water to cool the seed. Squeeze out excess water and blot with a towel.
7. *Find a dry place with good air circulation to dry the seed in the mesh bags. Empty benches in your greenhouse will work. Shake the bags occasionally to speed drying. We complete the drying by placing mesh bags in a food dehydrator with the fan running but the heating element turned off. It is possible to skip the greenhouse step and dry the seed completely in the food dehydrator. However, we find this takes longer and limits the number of seed varieties we can treat at one time.
8. Transfer dry seed into clean coin envelopes. Don't return the seed to the original seed packets. Prop coin envelopes open for an extra day to dry.



Back row, from left: boiling water and cold water to adjust the temperature, towel to cover jug during HWT; insulated jug; pail of cold water to submerge seed after treatment.

Center: digital probe thermometer attached to wooden spoon.

Front row, from left: seed bundled in row cover square; seed in mesh bags; clean envelopes to store dry seed.



Left: Seed in mesh bags sewn from fiberglass window screen. Note the pocket sewn to hold a plant label in place. If you use two sizes of mesh, sew bags with different color thread for easy identification. Clips can be color-coded to identify the treatment time needed for that particular seed. Center: Adjust water temperature with boiling or cold water. Right: Sponge bags dry with a towel, then lay someplace with good air circulation. Shake bags occasionally to speed drying. When our greenhouse benches are full, we put the bags in the black crate at back, and suspend above the benches in front of a fan.

Mesh bags sewn from fiberglass window screen.

Screen is available in several mesh sizes. We initially purchased “window screen” at a hardware store with mesh of 13 x 7 threads per inch. Smaller seeds will pass through window screen, so it’s useful to prepare bags with “no-see-em screen” (20 x 20 threads per inch). Use row cover for the smallest seed.

No-see-em screen is the most broadly useful, with no downside to the finer mesh. It’s worth the extra effort to find. We purchased a roll through Amazon.

Our observations pairing screen size to seed size. M=1000 seeds.

Crop	Window screen (13x7)	No-see-em screen (20x20)	Row cover
Cruciferous (choys, mustards)	less than 137M seeds/lb	172M – 232M seeds/lb	none as yet
Tomatoes (Supersweet 100)	less than 200M seeds/lb	192K – 290M seeds/lb	> 290M seeds/lb

*ALTERNATE METHOD WITH ROW COVER, for very small seed, or if you don’t have mesh bags:

1. Wrap seed in a piece of row cover and close with twist-tie. Include a waterproof label in the packet. We use small pieces of cardstock. Add a bolt or washer to the twist-tie so the package does not float to the surface. You want it to float a few inches off the bottom of the container, so make the end of the twist-tie with the washer a few inches long. 2 – 6 and 8. Same as above.
7. Remove seed from the row cover, spread out on paper towels and dry thoroughly at room temperature. Keep your seed clearly labeled!



Left: Bundle seeds in row cover squares, with attached washers so packets do not float.

Center: Adjust water temperature with boiling or cold water; Right: spread seed on paper towels to dry.

Information confirmed January 2020 for Johnnys Seeds and High Mowing, and February 2016 for Seedway and Osborne.

IS CRUCIFEROUS SEED TESTED FOR BLACK ROT?				
"Yes" indicates seed shipped by the company tests free of the black rot bacterium in a sample of 30,000 sds.				
+ indicates seed is tested for black leg also.				
CROP	JOHNNYS	HIGH MOW'G	SEEDWAY	OSBORNE
broccoli	yes +	yes +		
brussels	yes +	yes +	All Bejo	Information is
cabbage	yes +	yes +	cruciferous seed	available on a
cabbage/napa	yes +	yes +	is tested for	lot-by-lot basis
cauliflower	yes +	yes +	black rot and	because they
collards	yes +	yes +	black leg.	work with
kale/ kalettes	yes +	yes +		a variety of
kohlrabi	yes +	yes +	For all other	seed growers.
lacinato	yes +	yes +	seed, info is	
			available on a	
Asian/mizuna	no	yes +	lot-by-lot basis	
Asian/tatsoi	no	yes +	because they	
Asian/yukina	no	yes +	work with	
chois (bok, pak)	no	yes +	a variety of	
mustard greens	no	yes +	seed growers.	
radish	no	yes +		
radish/daikon	no	yes +		
rutabaga	no	yes +		
turnips	no	yes +		
seeds for sprouting	no	<i>not applicable</i>		lot-by-lot info
cover crops/radish	not yet	yes +	yes	<i>not applicable</i>
cover crops/mustard	not yet	<i>not applicable</i>	yes	<i>not applicable</i>
NOTES	See	All cruciferous	Call	Call
	catalogue	seed sold by	sales rep.	sales rep.
	or call	High Mowing		
	sales rep.	is tested for		
		black rot and		
		for black leg.		

SOUS VIDE

I have not yet explored using a sous vide thermostatic control for hot water seed treatment. It's an appealing option that I will look into the next time I have to replace our digital thermometer. Apparently, reliable models are available for about \$200.

If you decide to use a sous vide apparatus, you will want to HWT your seed in mesh bags as described above. Do not vacuum seal your seed when using a sous vide set-up. The seed needs to be in contact with the hot water for the treatment to work.

CUTTING AND SEWING MESH BAGS FROM A 36-INCH ROLL OF INSECT SCREENING

Use whatever combination of strips suits your needs.

Larger bags are useful for direct-seeded crops like radish that needed to be treated in quantity.

Smaller bags are usually sufficient for greenhouse crops like peppers.

