

Seed Treatments, In-Furrow Sprays and Granular Fungicide Options Vegetables

Seed Disinfestation and Protection

Bacterial, fungal and viral plant pathogens can be introduced into a crop on or within seeds. Generally, the earlier a pathogen comes into contact with the crop, the greater the potential for a disease problem to develop. Seed treatments are an effective means of preventing seedborne bacterial diseases and damping-off diseases. It is important to note that not all seed sanitizers are approved for organic vegetable production by the Organic Materials Review Institute (www.omri.org; 541-343-7600). Organic producers should verify that a seed treatment is OMRI approved prior to applying a seed treatment.

Seed sanitation to eradicate bacterial or viral plant pathogens – When treating vegetable seeds, it is critical to follow the directions exactly, because germination can be reduced by the treatment and/or the pathogen may not be completely eliminated. The effect of a treatment on germination should be determined on a small lot of seeds prior to treating large amounts of seed. Treatments should not be applied to pelleted seed, previously treated seed or old or poor quality seed. A protective fungicide treatment (see below) can be applied to the seed following treatment for bacterial pathogens.

Seed treatments to prevent damping-off diseases – Most commercially available vegetable seeds come treated with at least one fungicide and/or insecticide. Vegetable producers who would like to apply their own seed treatment should purchase nontreated seed. Although many fungicides are labeled for use on vegetable seed, most fungicides are restricted to commercial treatment only and should not be applied by producers. Labeled fungicides can be applied to seed following treatment for bacterial pathogens (see above). **Do not use fungicide treated seed for food or feed.**

Seed Disinfestants

Hot Water Treatment

By soaking seed in hot water, seedborne fungi and bacteria can be reduced, if not eradicated, from the seed coat. Hot water soaking will not kill pathogens associated with the embryo nor will it remove seedborne plant viruses from the seed surface.

1. Place seed loosely in a weighted cheesecloth or nylon bag.
2. Warm the seed by soaking it for 10 minutes in 100 F (37 C) water.
3. Transfer the warmed seed into a water bath already heated to the temperature recommended for the vegetable seed (Table 1). The seeds should be completely submerged in the water for the recommended amount of time (Table 1). Agitation of the water during the treatment process will help to maintain a uniform temperature in the water bath.
4. Transfer the hot water treated seed into a cold-water bath for five minutes to stop the heating action.
5. Remove seed from the cheesecloth or nylon bag and spread them evenly on clean paper towel or a sanitized drying screen to dry. Do not dry seed in areas where fungicides, pesticides or other chemicals are located.
6. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

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Table 1. Recommended temperatures and treatment times for hot-water disinfestation of selected vegetable seeds.

Vegetable Crops	Water Temperature (°F/°C)	Soaking Time (minutes)
Broccoli	122/50	20-25
Brussels sprouts	122/50	25
Cabbage	122/50	25
Carrot	122/50	15-20
Cauliflower	122/50	20
Celery	122/50	25
Chinese cabbage	122/50	20
Collard	122/50	20
Cucumber ¹	122/50	20
Eggplant	122/50	25
Garlic	120/49	20
Kale, Kohlrabi	122/50	20
Lettuce	118/48	30
Mint	112/44	10
Mustard, Cress, Radish	122/50	15
Onion	115/46	60
Pepper	125/51	30
Rape, Rutabaga	122/50	20
Shallot	115/46	60
Spinach	122/50	25
Tomato ²	122/50	25
Turnip	122/50	20

¹Cucurbits other than cucumbers can be severely damaged by hot-water treatment and should be disinfested using chlorine bleach.

²Germination may be delayed by 2-3 days depending on the variety.

Chlorine Bleach Treatment

Treating seeds with a solution of chlorine bleach can effectively remove bacterial pathogens and some viruses (i.e., *Tobacco mosaic virus*) that are borne on the surface of seeds.

1. Add one quart (946 ml) of Clorox® bleach to five quarts (4.7 L) of potable water.
2. Add a drop or two of liquid dish detergent or a commercial surfactant such as Activator 90 or Silwet to the disinfectant solution.
3. Add seed to the disinfectant solution (one pound of seed per four quarts of disinfectant solution) and agitate for one minute. Prepare fresh disinfectant solution for each batch of seeds to be treated.
4. Rinse the seed in a cold-water bath for five minutes to remove residual disinfectant.
5. Spread seeds evenly on clean papertowel or a sanitized drying screen to dry. Do not dry seed in area where fungicides, pesticides or other chemicals are located.
6. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

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Hydrochloric Acid Treatment

Tomato seed can be treated with a dilute solution of hydrochloric acid (HCl) solution to eliminate seedborne bacterial pathogens such as *Xanthomonas* spp. (Bacterial leaf spot), *Pseudomonas syringae* pv. *tomato* (Bacterial speck) and *Clavibacter michiganensis* subsp. *michiganensis* (Bacterial canker). Hydrochloric acid can also be used to remove *Tobacco mosaic virus* from the surface of tomato seed. **Do not use HCl treated seed for food or animal feed.**

1. Prepare a 5% solution of HCl by adding one part acid to 19 parts potable water. Prepare the acid solution in a well ventilated area and avoid direct skin contact with the acid.
2. Soak seeds for six hours with gentle agitation.
3. Carefully drain the acid off of the seed and rinse seed under running potable water for 30 minutes. Alternatively, rinse the seeds 10-12 times with potable water to remove residual acid.
4. Spread seeds evenly on clean paper towel or a sanitized drying screen to dry. Do not dry seed in area where fungicides, pesticides or other chemicals are located.
5. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

Trisodium Phosphate Treatment

Tomato seed can be treated with trisodium phosphate (TSP) to eradicate seed-transmitted *Tobacco mosaic virus*. **Do not use TSP treated seed for food or animal feed.**

1. Prepare a 10% solution of TSP (one part TSP in nine parts potable water). Trisodium phosphate is available at most home supply or paint stores. Avoid direct skin contact with the TSP solution.
2. Soak seed for 15 minutes in the disinfectant solution.
3. Rinse the seed in a cold water bath for five minutes to remove residual disinfectant.
4. Spread seeds evenly on clean paper towel or a sanitized drying screen to dry. Do not dry seed in area where fungicides, pesticides or other chemicals are located.
5. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

Procedure for Testing Seed Germination after Seed Disinfecting Treatments

1. Randomly select 100 seeds from each seed lot.
2. Treat 50 seeds using one of the sanitizers described above.
3. After the treated seed has dried and **before** application of a protectant fungicide, plant the treated and nontreated seed separately in flats containing planting mix according to standard practice. Label each group as treated or nontreated.
4. Allow the seeds to germinate and grow until the first true leaf appears (to allow for differences in germination rates to be observed).
5. Count seedlings in each group separately.
6. Determine the percent germination for each group:

$$\frac{\text{number of seedlings emerged}}{\text{number of seeds planted}} \times 100$$

7. Compare percent germination between the treated and nontreated groups. Percent germination should be within 5% of each other.

Seed Protectants

Fungicide label registrations are always changing, thus the information provided in this publication may become invalid at anytime. Always read the entire, most recent label carefully and follow all directions and restrictions before using one of the recommended seed protectants.

Thiram and Captan

Thiram is the most commonly used seed-protectant fungicides for vegetable crops however Captan is also labeled as a seed protectant for many vegetables (Table 2). Purchase treated seed, or coat seed by placing seed and fungicide in a closed container and shaking until seed is uniformly coated. **Do not use Thiram or Captan treated seed for food or animal feed.**

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Table 2. Recommended seed treatment dosage rates for selected vegetable seeds

Vegetable Crop	Thiram ¹ 50WP Ounces (dry wt ³)/100 lb seed	Captan ² Fluid ounces/100 lb seed
Beans (Lima)	3	- ⁴
Beans (Snap)	2	2.5
Broccoli, Brussels sprouts, Cabbage, Cauliflower	8	1.5
Cantaloupe, Cucumber	4.5	2.5
Carrots	8	-
Cowpeas	2	2.5
Endive	8	-
Eggplant	6	-
Kale, Kohlrabi	8	-
Leafy greens (collard, lettuce, mustard, spinach, Swiss chard, turnip)	8	1.5
Okra	6	-
Pea	3	2.5
Peppers	8	2.5
Pumpkin, Squash, Watermelon	4.5	1.5
Radish	8	1.5
Tomato	6	-
All other vegetable seed	8	-

¹Thiram belongs to the Fungicide Resistance Action committee (FRAC) group M3.

²Captan belongs to the Fungicide Resistance Action committee (FRAC) group M4.

³See table 4 for dry weight conversions.

⁴The dash indicates that the fungicide is not labeled for and/or recommended for the specified vegetable seed.

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Fungicide Seed Protectants for Potatoes

Properly treated seed potatoes can increase stand and improve stand uniformity. Proper application of seed potato protectants is essential as too much chemical can result in phytotoxicity and inadequate coverage can result in poor stand. **Dip treatments are not recommended** as pathogens can easily be spread from treated to nontreated seed using this mode of application. **Do not use treated seed for food or animal feed.**

Table 3. Recommended seed treatment dosage rates and Fungicide Resistance Action Committee (FRAC) group for potatoes

Vegetable Crop	Fungicide	Rate ¹ /100 lb	Rate/acre	FRAC ² Group
Irish potato	fludioxonil + mancozeb (Maxim MZ)	0.5 lb	- ³	12, M
	penflufen + prothioconazole (Ernesto Silver)	0.37 oz	-	7, 3
	flutolanil + mancozeb (MonCoat MZ)	0.75 lb	-	7,M
	flutolanil (Moncut DF)	-	0.71-1.1 lb ⁴	7
Sweetpotato	dicloran (Botran 75W)	-	3.0-5.0 lb ^{4, 5}	14

¹Apply as a dust. See Table 4 for dry weight conversions.

²Abbreviation for Fungicide Resistance Action Committee.

³The dash indicates that the fungicide is not labeled for and/or recommended for the specified application.

⁴Apply uniformly over and around the seed as an in-furrow spray. Refer to label for detailed application instructions.

⁵Do not plant tomatoes as a follow-up crop.

Table 4. Metric conversions for dry weight measures.

1 ounce = 28.4 g
1 gram = 0.035 ounces
1 pound = 454 grams
1 teaspoon = 0.16 ounces

The vegetable seed treatment section was revised October 2022 by R. Singh.