Seed Treatments, In-Furrow Sprays and Granular Fungicide Options

Field Crops

Seed Treatments, In-Furrow Sprays and Granular Fungicide Options for Field Crops

Seed treatments offer potential benefits to ensure desirable crop stands. Although seed treatment will not make poor seed germinate, when the correct treatment is used on certified seed, it may prevent or reduce seed decays, seedling blights, and other diseases. Seed treatments may act in two ways: 1) they may reduce pathogens on seed and 2) they may help protect the seed and seedlings from pathogenic organisms in the soil. In the past, in-furrow sprays or granules were used; however, because of convenience these options have mostly been replaced with seed treatments. Nevertheless, in-furrow and granular fungicides remain effective for many diseases and may be more effective than seed treatments in problem areas.

Corn, Grain Sorghum, Rice, and Wheat

Fungicide seed treatments are commonly applied to large and small grain seed. Depending on the package, fungicides from groups 3, 4, 7, 11, and/or 12 are most commonly applied to seed. Data from LSU AgCenter field trials indicate slight increases in stand or emergence; however, seed-applied fungicides very rarely provide economic benefit in these crops. Producers can save input costs by not treating or over-treating these crops prior to planting. If a field has a history of soilborne seedling disease, fungicide seed treatments may be useful in these situations.

Soybean

Fungicide seed treatments from the same groups listed above are commonly applied to soybean and will provide economic benefit in the event of seedling disease development. Seedling disease issues are more common in soybean than in the crops above. Generally, generic fungicides from groups 3, 4, and/or 11 are sufficient to protect seed and seedlings from pathogens in soybean.

Cotton

Do not plant cotton without a fungicide seed treatment! Do your homework by figuring out what is already on the seed. If there are a minimum of three different modes-of-action present, over-treating likely is not necessary. If the decision is made to over-treat, use a different mode of action. Significant cost savings can be realized depending on the seed company and seed treatment options.

The following table lists labeled available active ingredients commonly used in field crop production, their mode of action, and the targeted organisms listed by companies. This list may not be all-inclusive as many new products are continually developed and multiple online sources were used to compile this information.

Always refer to product labels for rate and use information.

Active Ingredients	FRAC Code	Targeted Pathogens
copper hydroxide, copper oxychloride	M1	*Pseudomonas syringae*, *Xanthomonas translucens*, *Tilletia caries*; damping-off/seedling diseases
thiram, mancozeb	M3	Seed decay, damping-off, and seedling blights caused by many seedborne and soilborne organisms
thiabendazole	1	Seed decay, damping-off, and seedling blights caused by many seedborne and soilborne organisms
iprodione	2	*Rhizoctonia solani*
difenoconazole, imazalil, ipconazole, myclobutanil, prothioconazole, tebuconazole, triticonazole	3	*Alternaria*, *Aspergillus*, *Botrytis*, *Cochliobolus*, *Fusarium*, *Penicillium*, *Sclerotinia*, and *Sphacelotheca* spp.; *Thielaviopsis basicola*, *Tilletia caries*, *Tilletia foetida*, *Urocystis agropyri*, *Ustilago nuda* var. *tritici*, *Rhizoctonia solani*, *Cochliobolus sativus*
mefenoxam, metalaxyl	4	*Pythium* and *Phytophthora* spp.
boscalid, carboxin, fluxapyroxad, penflufen, penthiopyrad, sedaxane	7	*Cochliobolus*, *Fusarium*, and *Pythium* spp.; *Rhizoctonia solani*, *Blumeria graminis*, *Puccinia recondita*, *Septoria tritici*, *Cephalosporium gramineum*, *Ustilago tritici*, *Sphacelotheca reiliana*
azoxystrobin, fenamidone, fluoxastrobin, pyraclostrobin, trifloxystrobin	11	*Aspergillus*, *Cladosporium*, *Colletotrichum*, *Fusarium*, *Penicillium*, *Pythium*, and *Phomopsis* spp.; *Rhizoctonia solani*, *Sclerotinia rolfsii*, *Sclerotium rolfsii*, and *Sphacelotheca reiliana*
fludioxinil	12	Seedborne and soilborne fungi which cause seed decay, damping-off and seedling blights
etridiazole, PCNB, tolclofos-methyl	14	*Pythium*, *Fusarium*, and other *Deuteromycete* species causing seed decay and seedling blights; *Rhizoctonia solani*
ethaboxam	22	Multiple fungal species; *Phytophthora* spp.

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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 plant disease 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 must 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 eliminated completely. 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 seeds, 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

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

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

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

[1] Cucurbit seeds other than cucumbers can be severly damaged by hot-water treatment and should be disinfested using chlorine bleach.

[2] Germination may be delayed by 2-3 days depending on the crop 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 seeds to the disinfectant solution (one pound of seeds 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 seeds in a cold-water bath for five minutes to remove residual disinfectant.
5. Spread seeds evenly on clean paper towel or a sanitized drying screen to dry. Do not dry seeds in areas where fungicides, pesticides or other chemicals are located.
6. Seeds can be treated with a labeled fungicide to protect against damping-off pathogens.

Hydrochloric acid treatment

Tomato seeds 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 seeds. **Do not use HCl treated seeds 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 seeds and rinse seeds 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 a clean paper towel or a sanitized drying screen to dry. Do not dry seeds in areas where fungicides, pesticides or other chemicals are located.
5. Seeds can be treated with a labeled fungicide to protect against damping-off pathogens.

Trisodium phosphate treatment

Tomato seeds can be treated with trisodium phosphate (TSP) to eradicate seed-transmitted *Tobacco mosaic virus*. **Do not use TSP treated seeds 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 seeds for 15 minutes in the disinfectant solution.
3. Rinse the seeds in a cold water bath for five minutes to remove residual disinfectant.
4. Spread seeds evenly on a clean paper towel or a sanitized drying screen to dry. Do not dry seed in areas where fungicides, pesticides or other chemicals are located.
5. Seeds 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 seeds have dried and **before** application of a protectant fungicide, plant the treated and nontreated seeds 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:

$$\frac{\textit{number of seedlings emerged}}{\textit{number of seeds planted}} \; x\ 100$$

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 seeds are uniformly coated. **Do not use Thiram or Captan treated seeds for food or animal feed.**

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, Caulifower	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	-

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

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

[3] See table 4 for dry weight conversions.

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

Fungicide Seed Protectants for Potatoes

Properly treated seed potatoes can increase stand and improve stand uniformity. Proper application of seed potato protectants is essential because excess use of 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 seeds using this mode of application. **Do not use treated seeds for food or animal feed.**

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

Fungicide	Product Name	Rate1/100 lb	Rate/acre	FRAC[2] Group
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

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

[2] Abbreviation for Fungicide Resistance Action Committee.

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

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

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

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

Fungicide	Product Name	Rate1/100 lb	Rate/acre	FRAC[2] Group
dicloran	Botran 75W	-	3.0-5.0 lb[4, 5]	14

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

[2] Abbreviation for Fungicide Resistance Action Committee.

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

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

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

Table 4. Metric conversions for dry weight measures.

Imperial	Metric
1 pound	454 grams
1 ounce	28.4 grams
0.035 ounce	1 gram
1 teaspoon (0.16 ounces)	

The vegetable seed treatment section was revised October 2023 by R. Singh.