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Vegetable Disease Control in the Home Garden

Walter R. Stevenson
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As a home gardener you are confronted at some time during the growing season with plant diseases. In most cases the treatment you decide upon will determine the success of your gardening venture. Control of certain plant diseases can be accomplished in the early planning stages of the garden when you decide to utilize clean seed and clean soil. Control of other diseases throughout the growing season requires your careful observation and recognition and selection of the correct control measure.

This publication is intended to briefly outline available control measures useful for the control of vegetable diseases in Indiana. Supplemental information can be obtained from additional mimeos prepared on specific vegetable diseases.

Vegetable Seed Treatments

Treatments of vegetable seeds are grouped into two general classifications: 1) treatments that eradicate or destroy plant pathogens carried within or on the surface of seeds (eradicative seed treatments). 2) Treatments that protect the seed and developing seedling from soil-borne pathogens responsible for seed decay and damping off (protective seed treatments).

Eradicative Seed Treatments

Hot water treatment, properly used, will kill most disease-causing organisms (plant pathogens) on, or within the seed. The treatment is designed to heat seed to a temperature lethal to plant pathogens, but not lethal to the seed. Obviously the temperature of the water bath and time of exposure is critical to success of this treatment. Improper treatment can result in severe seed injury, particularly on old seed. Seeds of cucurbits can be severely damaged by hot water treatment. A small sample of any seed lot more than 1 year old should be treated and tested for germination to determine the amount of injury, if any, that might occur. To heat-treat seed, place seed loosely in a cloth bag, and soak for 10 minutes in water at 110 degrees F to warm the seed prior to treatment at the prescribed temperature. Then place seed in a water bath at the desired temperature and time of exposure (Table 1). After treatment, seeds should be cooled in cold water and spread out to
Table 1. Hot water treatment of vegetable seeds

<table>
<thead>
<tr>
<th>Seed</th>
<th>Water bath degrees F</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brussels sprouts, cabbage, egg plant, spinach, tomato</td>
<td>122</td>
<td>25</td>
</tr>
<tr>
<td>Broccoli, cauliflower, Chinese cabbage, cucumber, carrot,</td>
<td>122</td>
<td>20</td>
</tr>
<tr>
<td>collard, kale, kohlrabi, rape, rutabaga, turnip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard, cress, radish</td>
<td>122</td>
<td>15</td>
</tr>
<tr>
<td>Pepper</td>
<td>125</td>
<td>30</td>
</tr>
<tr>
<td>Lettuce, celery, celeriac</td>
<td>118</td>
<td>30</td>
</tr>
</tbody>
</table>

Dry. Protective fungicides are generally applied to hot water treated seed after treatment.

Protective Seed Treatment

Protective seed treatments consist of coating the seed surface with organic fungicides effective against soil-borne organisms responsible for seed rot and seedling damping off. Vegetable seed protectants include the following chemicals:

captan -- available as Orthocide 75, Captan 75, Orthocide Garden Fungicide
thiram -- available as Thiram 75, Arasan 75, Arasan 50 Red, Millers
Thiram 75 W, Panoram 75

Seeds in small garden packets may be treated with any of the above by placing a quantity of chemical the size of one or two match heads in the packet with the seed and shaking. Excess protectant may be sifted out before planting.

Vegetable Foliage and Fruit Sprays

1. Benomyl -- available in a 50% wettable powder as Benlate. Approved for use on snap beans for control of white mold and gray mold on cucurbits (cucumbers, summer squash, winter squash, melons) for control of anthracnose, gummy stem blight and powdery mildew and on tomato for control of gray mold, white mold, and leaf mold.

2. Chlorothalonil -- available in a 75% wettable powder as Bravo W75 and a flowable formulation as Bravo 6F. A broad spectrum fungicide approved for most vegetables. Gives good control of major foliar diseases of most vegetables.


4. Fixed or low soluble copper compounds -- available as C.O.C.S., Copper-Hydro, Copper A, Basicop, Cupro-K, Tribasic, Ortho 53, etc. Useful in control of bacterial diseases of vegetables.

5. Karathane -- available as 22% wettable powder. Useful in control of powdery mildew on cucurbits.


7. Zineb -- available in 75% wettable powder as Dithane Z-78, Parzate, Ortho Zineb, etc. Effective when used against many fungus diseases of certain vegetable crops.

Fungicidal Dusts for Vegetables

Not generally recommended for use in Indiana because of cost of materials, excess chemical required for reasonable disease control, and lack of retention on plants. Ready to use dust preparations of several fungicides are generally available and useful in small garden plantings.

Vegetables, Their Principal Diseases, and Available Controls

Asparagus

Rust -- Spray with maneb (80% WP) at 1.5 tablespoonsful per gallon of water or
zineb (75% WP) at 1.5 tablespoonsful per gallon, beginning immediately after harvest and continuing every 10 days to mid-August. Start spraying young plantings that will be harvested later than June 1.

Beets

Seed rot, Seedling blight -- Treat seed with captan or thiram.

Leaf spots -- Spray with zineb (75% WP) at 1.5 tablespoonsful per gallon or fixed copper (50% WP) at 1 to 1 1/2 tablespoonsful per gallon at weekly intervals, starting before diseases appear. Do not apply zineb within 7 days prior to harvest if tops are consumed.

Carrots

Seed rot, Seedling blight -- Treat seed with captan or thiram.

Leaf spots -- Spray with mane (80% WP) at 1.5 tablespoonsful per gallon or zineb (75% WP) at 1.5 tablespoonsful per gallon at weekly intervals starting before disease appears. Do not apply mane or zineb within 7 days prior to harvest.

Aster yellows -- Control leafhoppers. Destroy infected plants as soon as they appear.

Rootknot (nematode) -- Fumigate soil in fall at soil temperature above 50 degrees F with Vapam, Verox, Nemagon, or Fumazone. Follow manufacturer’s directions.

Crucifers

Seed rot, Seedling blight -- Treat seed with Captan (75% WP) or thiram (75% WP). Use hot water treated seed.

Wirestem -- Treat seedbed only with Terraclor plus captan -- dust or drench. Follow manufacturer’s directions.

Blackleg, Blackrot -- Use seed grown in western United States, or use hot water treated seed. Follow 4-year rotation. Blackrot resistant cabbage varieties (Guardian and Defender) are available.

Fusarium yellows -- Select a yellows tolerant or resistant variety. Many varieties including the following may be grown successfully in yellows infested soil: Stone Head, Harvester Queen, Little Rock, Harris Resistant Danish, Round Up, Market Prize, etc.

Clubroot -- Use Terraclor in transplanting water only at 3 pounds Terraclor (75% WP) in 50 gallons of water. Use 3/4 pint of solution per plant.

Cucumber

Seed rot, Seedling blight -- Dust seed with captan (75% WP) or thiram (75% WP)

Angular leafspot -- Purchase disease free seed or transplants. Spray with fixed copper (50% WP) at 1 to 1 1/2 tablespoonsful per gallon, or use tolerant varieties such as Victory Hybrid.

Anthracnose -- Spray weekly with mane (80% WP) at 1.5 tablespoonsful per gallon, zineb (75% WP) at 1.5 tablespoonsful per gallon, Bravo at 1.5 tablespoonsful per gallon or Benlate (50% WP) at 1 to 2 teaspoonsful per gallon. Do not apply mane or zineb later than 5 days prior to harvest. Use varieties such as Triumph, Victory, High Mark II, Gemini, and Poinsett.

Downy mildew -- Spray weekly with mane (80% WP) at 1.5 tablespoonsful per gallon or zineb (75% WP) at 1.5 tablespoonsful per gallon. Do not apply mane or zineb later than 5 days prior to harvest.

Bacterial wilt -- Control the striped and spotted cucumber beetles, which transmit the pathogen as they feed on the plant. See publication E-21, Vegetable Insect Control in the Home Garden.

Mosaic -- Use resistant varieties such
as Victory Hybrid, Marketmore 70, Triumph Hybrid, Meridian, and SMR 58.

Powdery mildew -- Spray with Karathane, (1/3 tablespoonful per gallon), usually not more than four times at 10-day intervals. Last application must be no later than 7 days before harvest. Benlate (50% WP) at 1 to 2 teaspoonsful per gallon gives excellent control. Varieties Victory, Gemini, and Poinsett are reported to be resistant to Powdery Mildew.

Eggplant

Seed decay and damping off -- Treat seed with either captan (75% WP) or thiram (75% WP).

Phomopsis blight and fruit rot, Gray-mold fruit rot -- Spray weekly with maneB (80% WP) at 1.5 tablespoonsful per gallon or zineB (75% WP) at 1.5 tablespoonsful per gallon. Do not apply maneB or zineB later than 5 days prior to harvest.

Lettuce

Seed decay and damping off -- Treat seed with either captan (75% WP) or thiram (75% WP).

Bottom rot, Drop, Graymold -- Follow 3-year rotation. Plant in well-drained soil.

Downy mildew -- Apply maneB (80% WP) at 1.5 tablespoonsful per gallon or zineB (75% WP) at 1.5 tablespoonsful per gallon at weekly intervals or as needed with last application no later than 10 days prior to harvest.

Mosaic -- Plant only disease-free seed. Aphids transmit virus from infected seedlings to healthy seedlings. Control aphid populations.

Muskmelon

Seed decay and damping off -- Treat seed with captan (75% WP) or thiram (75% WP). Angular leafspot -- Use disease-free seed or transplants. Spray with fixed copper (50% WP) at 1 to 1 1/2 tablespoonsful per gallon.

Alternaria leafspot -- Spray with maneB (80% WP) at 1.5 tablespoonsful per gallon, zineB (75% WP) at 1.5 tablespoonsful per gallon, or Bravo (1.5 tablespoonsful per gallon) once weekly. Do not apply maneB or zineB later than 5 days prior to harvest.

Bacterial wilt -- Control the striped and spotted cucumber beetles, which transmit the disease. See Purdue publication E-21, Vegetable Insect Control.

Powdery mildew -- Spray four times at 10-day intervals with Karathane at 1/3 tablespoonful per gallon or at 21-day intervals with Benlate (50% WP) at 1 to 2 teaspoonfuls per gallon. Do not apply Karathane later than 7 days prior to harvest.

Fusarium wilt -- Purchase disease-free transplants. Rotate with crops other than muskmelon to prevent buildup of high soil populations of Fusarium. Some varieties of muskmelon show good tolerance to Fusarium wilt in Indiana, e.g. Saticoy.

Rootknot nematode -- Fumigate soil in fall with Nemagon, Fumazone, Vapam or Vorlex. Follow manufacturer's directions.

Onion

Seed decay and damping off -- Treat seed with captan (75% WP) or thiram (75% WP).

Blast, Purple Blotch, Downy Mildew -- Weekly applications of maneB (80% WP) at 1.5 tablespoonsful per gallon or zineB (75% WP) at 1.5 tablespoonsful per gallon.

Neck rots, Fusarium bulb rot, Bacterial soft rot -- Control Blast, etc. to prevent wounding of leaf tissue by other pathogens. Cure rapidly and properly. Sort out defective bulbs before storage. Do not expose cured bulbs to rain or excessive humidity.
Pea

Seed decay and root rot -- Treat seed with seed protectant captan (75% WP) or thiram (75% WP).

Fusarium wilt -- Use wilt-resistant varieties such as Alaska, Morse's No. 60, Freezonian, Early Frosty, Perfected Freezer 60, Green Arrow, New Era, New Season, or New Wales.

Virus Diseases -- Grow resistant varieties such as Dark Skin Perfection or Perfected Freezer 60.

Pepper

Seed decay and damping off -- Treat seed with seed protectant captan (75% WP) and thiram (75% WP).

Ripe rot, Anthracnose, Phytophthora Blight -- Spray weekly or as needed after flowering with maneb (80% WP) at 1.5 tablespoonsful per gallon or zineb (75% WP) at 1.5 tablespoonsful per gallon. Do not apply maneb or zineb later than 5 days prior to harvest.

Bacterial Spot -- Purchase disease-free seed. Spray through flowering with fixed copper (50% WP) at 1 to 1.5 tablespoonsful per gallon.

Mosaic -- Plant varieties of pepper resistant to tobacco mosaic virus (TMV) such as California Wonder (300), Emerald Giant, Keystone Resistant Giant, Yolo Wonder B. Control aphids, which transmit cucumber mosaic virus.

Potato

Seed-piece decay -- Dip freshly cut seed in captan 7.5% dust at the rate of 10 ounces per bushel of cut seed pieces (16 ounces captan 7.5% per 100 pounds cut seed pieces). Apply fungicide within 6 hours of cutting.

Scab -- Several varieties show satisfactory resistance in Indiana. Superior and Haig show very good resistance, Norchip and Norland show good resistance and Kennebec and Katahdin show fair resistance. Adjust soil to pH 5.2 to 5.5.

Early and late blight -- Spray weekly or more often with maneb (80% WP) at 1.5 tablespoonsful per gallon or zineb (75% WP) at 1.5 tablespoonsful per gallon, particularly when disease threatens. Delay harvest until all vines are dead. Cut all tubers showing tuber infection prior to storage.

Virus diseases (mosaic, leafroll, rugose mosaic) -- Use certified seed. Control aphids throughout summer (aphids transmit several virus diseases infecting potatoes).

Storage rots -- Avoid bruising and injuring at harvest. Sort before storing. Cure in storage at 60 degrees F before dropping to lower temperature. Provide good ventilation.

Radish

Seed decay and damping off -- Treat seed with seed protectant such as captan (75% WP) or thiram (75% WP).

Black root -- Avoid infested soil for radishes. Avoid long or icicle types in infested soil.

Rhubarb

Crown rot -- Use disease-free plants. Plant only on well-drained soil.

Snap Beans

Bacterial Diseases -- Common blight, halo blight, brown spot. Bacterial diseases may be introduced by planting infected seed.
Do not save seed from infected plants. Purchase seed preferably grown in arid western states. Do not cultivate when plants are wet. If disease appears spray foliage with fixed or low soluble copper (50% WP) at 1 - 1.5 tablespoonsful per gallon.

**Rust** -- Recognized by distinct reddish brown circular lesions usually on the undersides of leaves. When rust first appears spray with maneber (80% WP) or zineb (75% WP) at 1.5 tablespoonsful per gallon. Do not use within 7 days of harvest. After harvest, destroy all plant debris to reduce opportunity for overwintering of disease causing fungus.

**Seed Decay and Damping Off** -- Treat seed with seed protectant such as captan (75% WP) or thiram (75% WP).

**Spinach**

Seed decay and damping off -- Treat with seed protectant such as captan (75% WP) or thiram (75% WP).

**Downy Mildew (blue mold)** -- Spray weekly with maneber (80% WP) at 1.5 tablespoonsful per gallon or zineb (75% WP) at 1.5 tablespoonsful per gallon no later than 10 days prior to harvest, or grow tolerant varieties such as Savoy Hybrid 621.

**Sweet Corn**

Seed decay -- Treat seed with seed protectant such as captan (75% WP) or thiram (75% WP).

Bacterial wilt -- Control flea beetles, which transmit bacteria when feeding. See Purdue publication E-21, Vegetable Insect Control in the Home Garden.

Foliage blights -- Generally not economically important. Use of fungicides not generally feasible. Use varieties with normal (N) cytoplasm.

**Smut** -- No good control. The removal of infected plants and destruction of smut galls at the end of season may help to reduce amount of inoculum available during successive years.

**Tomato**

Seed decay and damping off -- Treat seed with a seed protectant such as captan (75% WP) or thiram (75% WP).

**Bacterial canker** -- Canker is seed transmitted and once introduced into a garden is devastating. Buy seed or transplants only from a reputable dealer. There is no effective control for canker after it reaches the garden.

**Bacterial spot** -- Soak seed for 1 hour in 2 ounces of copper sulfate per gallon of water. Spray plants weekly in field during flowering with fixed copper compound.

**Fungi causing leaf spots, defoliation, and/or fruit rots (anthracnose, buckeye rot, early blight, late blight, gray leafspot, leaf mold, Septoria blight)** -- Spray weekly with maneber (80% WP) at 1.5 tablespoonsful per gallon or Bravo (1.5 tablespoonsful per gallon). Treat with maneber no later than 5 days prior to harvest. Treat 5 to 15 sprays during season depending upon weather.

**Virus diseases** -- Avoid contact of tomatoes with potatoes to prevent double infection of tomatoes with potato viruses and tobacco mosaic virus. Wash hands thoroughly with soap and water before handling plants. Do not use tobacco when working with plants.

**Wilts (Fusarium and Verticillium)** -- Use tolerant or resistant varieties such as Spring Set, Spring Giant, Campbell 17, Heinz 1350, Heinz 1439, Burpee VF, Ace VF, etc.

*** The mention of trade names is not an endorsement by Purdue CES. ***