

# Fruiting Vegetables

## Transplants

Eggplant, peppers, and tomatoes are typically started as transplants in greenhouses or artificially lit growing rooms — refer to Transplant Production, page 23.

For rapid seed germination, maintain the temperature of potting mix at 85°F. Grow eggplant seedlings between 70°F and 80°F during the day and 65°F and 70°F at night, and tomatoes and peppers between 65°F and 75°F during the day and 60°F and 65°F at night.

Pepper and eggplant seedlings should be ready for the field in six to eight weeks and tomatoes in five to seven weeks.

Before transplanting, harden seedlings by exposing them for a few days to higher light and temperatures between 60°F and 65°F. Set tomatoes in the field after the danger of frost has passed. For peppers and eggplant, wait until soil has warmed and average daily temperature reach 65°F.

## Production Systems for Fresh Market

Fresh market eggplant, peppers, and tomatoes are often grown on raised beds covered with plastic mulch to promote earliness — see Using Plastic Mulch, page 27. Drip irrigation beneath the mulch provides a uniform water supply and can deliver fertilizer during the growing season. Typical beds are 30 inches across, 4 to 6 inches high, and centered 5 to 6 feet apart.

**Tomatoes and eggplant:** Space 1.5 to 2.5 feet apart in the row.

**Peppers:** Space 1 to 1.5 feet apart. Or, plant a double row of peppers with 1.5 feet between rows and 1 foot between plants.

**Bare ground culture:** Space rows 2.5 to 5 feet apart.

*Tomatoes and eggplants:* space 1.5 to 3 feet apart in the row. *Peppers:* space 1 to 1.5 feet apart in the row.

**Tomatoes** may be left to grow over the ground or may be supported by cages, stakes, strings, or a trellis-weave system. Supported tomatoes produce higher quality fruit than unsupported plants and marketable yield is usually much greater. Tomatoes supported by stakes or trellises are sometimes pruned, which involves removing several or all of the branches up to the branch just below the first flower cluster when the branches are a few inches long. For tomatoes supported by vertical string, only one or two stems are allowed to grow and so pruning continues

throughout the season to remove branches that develop above the first flower cluster. Pruned plants produce larger fruit than unpruned plants, but the quantity of fruit is reduced.

**Peppers and eggplant** may benefit from staking if plants tend to break, lean, or lodge. If peppers are in a double row on a bed, a row of short stakes strung with twine along the outside of each row will support the plants. Peppers and eggplant may also be supported using a trellis-weave system.

## Production Systems for Processing Tomatoes

Select row spacing and bed formation that will work with available harvesting equipment. Double rows 16 to 20 inches apart on 5 to 6 feet centers are common, with plants 1 to 2 feet apart in the row.

Ethephon applications accelerate and concentrate fruit ripening, thus facilitating once-over machine harvesting of processing tomatoes.

**For Machine Harvest:** Apply 3.25 pts. Ethrel® or Cepha® in 5 to 70 gallons of water per acre as a spray over the entire plant when 10 to 30 percent of fruits are ripe. Harvest 15 to 21 days after treatment for optimum ripe fruit accumulation.

## Fertilizing

**Lime:** To maintain a soil pH of 6.0 to 6.8.

**Fresh Market Eggplant, Peppers, and Tomatoes:** Before planting, apply 30 pounds N per acre, 0 to 240 pounds per acre P<sub>2</sub>O<sub>5</sub>, and 0 to 300 pounds K<sub>2</sub>O per acre based on soil test results and recommendations from your state. At transplanting, apply a starter solution containing N and P. If the transplant flat received a heavy fertilizer feeding just prior to setting, eliminate the starter solution. Three to four weeks after transplanting, and then six to eight weeks after transplanting, apply 30 to 40 pounds N per acre as a sidedressing. Sidedressing may be replaced by supplying N through the drip irrigation system at about 1 pound N per acre per day. Reduce the amount of fertilizer N applied by the value of N credits from green manures, legume crops grown in the previous year, compost and animal manures, and soils with more than 3 percent organic matter. The total amount of N

from fertilizer (including starter) and other credits should be 100 to 120 pounds per acre.  $K_2O$  may also be supplied through drip irrigation at a rate of 1 to 1.5 pounds per acre per day for peppers and eggplant, and 1.5 to 2.5 pounds per acre per day for tomatoes. Reduce the amount of  $K_2O$  applied before planting by the amount that will be supplied through drip irrigation.

**Processing Tomatoes:** Before planting, apply 40 pounds N per acre, and  $P_2O_5$  and  $K_2O$  based on soil test results and recommendations from your state. At transplanting, apply a starter solution containing N and P. Four to five weeks after transplanting or after first fruit, set sidedress with 40 to 50 pounds N per acre. Reduce the amount of fertilizer N applied by the amount of N credits from green manures, legume crops grown in the previous year, compost and animal manures, and soils with more than 3 percent organic matter. The total amount of N from fertilizer (including starter) and other credits should be 80 to 100 pounds per acre.

**Calcium:** Tomatoes and peppers are susceptible to calcium deficiency even when adequate calcium levels are present in the soil. Deficiency results in a disorder called “blossom end rot.” It often occurs under conditions of inadequate or excessive watering and/or excessive N fertilization with an ammonium source. Where the soil pH has been adjusted to 6.0 or higher, additional soil-applied calcium does not correct the disorder.

## Environmental Factors

There are a number of tomato problems related to environmental and nutrient factors.

**Sunscald:** Fruit exposed to the sun may overheat and develop sunscald. The affected area turns white and does not ripen. The tissue may shrivel and sink in. It is most common when foliage does not shade fruit exposed to hot afternoon sun. Damage is usually confined to the area of the fruit with greatest exposure to the sun. Tomato variety, mineral nutrition, staking and pruning methods, and disease pressure can all influence the amount of foliage cover. This disorder also is observed on peppers and fruit of other vegetable crops.

**Radial and concentric cracks:** Rapidly growing fruit and fruit exposed to the sun tend to crack more readily. Cracking is more severe under hot, dry conditions followed by rainfall. To defend against growth cracks, select crack-resistant cultivars and carefully manage water availability (through irrigation management and the use of plastic mulch).

**Zipper scars:** These may be caused when the blossom sticks to the developing fruit. Zipper scars are especially common during cool weather. To avoid this problem, select resistant varieties and maintain proper greenhouse temperatures.

**Catfacing:** Flower buds that have been exposed to cold temperatures very early in development have shown a higher proportion of catfaced fruit. Large-fruited varieties tend to be more susceptible to this disorder. In some

heirloom varieties, nearly all fruit is catfaced so it does not detract from the fruit’s marketability. Variety selection is the most practical way to limit this problem. Exposure to some herbicides (2, 4-D or dicamba) can lead to similar fruit deformation.

**Micro-cracks or rain checks:** Very small cracks in the epidermis (called micro-cracks or rain checks) sometimes develop on fruit shoulders under highly humid conditions. Rain check is often more severe on fruit that has been exposed due to poor leaf cover. To minimize the problem, maintain healthy foliage and select varieties with good foliage cover.

## Pesticide Use in Greenhouses

Before using any pesticide, always read the product label for mention of greenhouse restrictions. See Selected Information About Recommended Fungicides (page 79), Selected Information About Recommended Herbicides (page 69), and Selected Information About Recommended Insecticides (page 54).

## Fruiting Vegetables — Eggplant

### Disease Control for Eggplant

#### **Anthracnose**

Use disease-free seed and/or transplants. Practice a 3-4 year crop rotation.

#### **Recommended Products**

**Aprovia Top**® at 10.5-13.5 fl. oz. per acre. Use of a spreader-sticker is recommended. 0-day PHI.

**Cabrio EG**® at 8-12 oz. per acre. 0-day PHI.

**Bravo**®, **Echo**®, and **Equus**® are labeled for use at various rates. 3-day PHI.

**Fontelis**® at 24 fl oz per acre. *Suppression only*. See label for greenhouse uses. 0-day PHI.

**Luna Sensation**® at 7.6 fl. oz. per acre. *Suppression only*. 3-day PHI.

**Quadris Flowable**® at 6.0-15.5 fl. oz. per acre. 0-day PHI.

**Quadris Top**® at 8-14 fl. oz. per acre. 0-day PHI.

#### **Blossom End Rot**

Avoid drastic moisture fluctuations. Mulching plants may help. Avoid excessive nitrogen or potassium fertilization, rapid plant growth, and root pruning during cultivation. Maintain soil pH and calcium levels in desired range. Choose less susceptible varieties.

Blossom end rot is caused by a calcium deficiency in the fruit, although calcium levels in the soil may be sufficient. Wide fluctuations in soil water levels can trigger the disorder.

## Phytophthora Crown Rot

Follow a 4-year rotation with crops outside the tomato/pepper/eggplant and cucurbit families. Choose fields with well-drained soil and avoid low spots. Use raised beds to promote drainage. Do not use irrigation water from a pond that collects runoff from fields infested with Phytophthora. Fungicides are not fully effective against this disease.

### Recommended Products

 Fixed **copper** products may improve efficacy of fungicides against Phytophthora when tank mixed at labeled rates.

**Elumin**® at 8 fl. oz. per acre. 2-day PHI.

**Omega 500F**® at 1-1.5 pts. per acre. First application may be made as a drench at transplanting, followed by foliar applications. 30-day PHI.

**Orondis Gold 200**® at 2.4-19.2 fl. oz. per acre. See label for recommended program and limitations. Do not follow soil applications of Orondis Gold® with foliar applications of Orondis Ultra®.

**Orondis Opti**® at 1.75-2.5 pt per acre. 3-day PHI.

**Orondis Ultra**® at 5.5-8 fl. oz. per acre. Alternate with fungicides that have a different mode of action. 3-day PHI.

**Presidio 4SC**® at 3-4 fl. oz. per acre. Must be tank-mixed with a product of a different mode of action. 2-day PHI.

**Ranman**® at 2.75 fl. oz. per acre. Alternate applications of Ranman® with fungicides that have a different mode of action. 0-day PHI.

**Revus 2.09SC**® at 8 fl. oz. per acre. 1-day PHI.

**Ridomil Gold SL**® treat soil at 1 pt. per acre broadcast (use less for band applications) before transplanting. Subsequent directed sprays may be needed. Phytophthora resistance to Ridomil® has been observed in some locations. 7-day PHI.

**Zampro**® at 14 fl. oz. per acre. Adding a spreading/penetrating adjuvant is recommended. Alternate with fungicides that have a different mode of action. 4-day PHI.

## Rhizoctonia Seedling Rot

Seedlings may develop this disease under rainy conditions, especially in the spring and early summer. Plant crop on well-drained soil.

### Recommended Products

**Aframe**® 0.4-0.8 fl. oz. per 1,000 ft. of row. 0-day PHI.

**Aprovia Top**® at 10.5-13.5 fl. oz. per acre. Make no more than two consecutive applications. 0-day PHI.

## Southern Blight

This disease is normally observed in southern climates or during seasons with above normal temperatures. Crop rotations with small grains and deep plowing crop residue should help to reduce inoculum.

### Recommended Products

**Evito 480SC**® at 2.0-5.7 fl. oz. per acre.

**Fontelis**® at 16-24 fl. oz. per acre. Apply to base of plant as directed spray 5-10 days after transplanting and 14 days later. Follow up with effective fungicide as needed. 0-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. *Suppression only.* 7-day PHI.

## Verticillium Wilt

Avoid fields with a history of Verticillium wilt. Rotate with small grains where possible.

Use of long rotations out of pepper/tomato/eggplant crops will prevent rapid increase of pathogen populations. Consider resistant (such as Irene) or partially resistant varieties.

### Recommended Products

Fumigate with **Vapam HL**® at 37.5-75 gals. per acre under plastic mulch. Allow at least 21 days between application of fumigant and transplanting. Observe the 48-hour REI. See label for important application instructions.

## White Mold

Avoid fields with history of the problem. Pathogen has large host range.

### Recommended Products

**Actinovate AG**® at 3-12 oz. per acre. Use with a spreader-sticker. 0-day PHI.

**Cabrio EG**® at 12-16 oz. per acre. *Suppression only. Not for greenhouse or high tunnel use.* 0-day PHI.

 **Contans WG**® at 1-4 lbs. per acre. Contans® is applied with conventional spray equipment directly to the soil surface at planting. See label for additional treatment information.

**Luna Sensation**® at 7.6 fl. oz. per acre. *Suppression only.* 3-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. *Suppression only. Not for greenhouse use.* 0-day PHI.

## Weed Control for Eggplant

The fruiting vegetables are warm-season crops nearly always started as transplants. When growers transplant crops onto black or other opaque plastic mulch, they sometimes use

 This is a biopesticide. See page 37 for details.

 May be acceptable for use in certified organic production. Check with your certifier before use.

herbicides underneath the mulch, depending on the weed pressure and labor available to pull weeds by hand. Weeds between beds are typically controlled with cultivation, hand hoeing, herbicides, or a combination of the three. Weeds along the edge of the plastic mulch can be a particular challenge for cultivation equipment, and shielded or directed herbicide applications can help with control there.

Fresh market crops are also grown without plastic mulch, and similar weed control measures are used. Organic mulches (such as straw) can also provide good weed control in and between rows if applied in a thick enough mat before weeds emerge.

For specific weeds controlled by each herbicide, check Relative Effectiveness of Herbicides for Vegetable Crops (page 68).

Rates provided in the recommendations below are given for overall coverage. For band treatment, reduce amounts according to the portion of acre treated.

### **Burndown or Directed/Shielded Applications**

#### **Broadleaves and Grasses**

##### **Recommended Products**

**Gramoxone SL 2.0**® at 2-4 pts. per acre. Use 1 qt. of COC or 4-8 fl. oz. of NIS per 25 gals. of spray solution.

Broadcast before transplanting, or use lowest rate as a directed spray between rows after crop establishment. RUP.

**Glyphosate** products at 0.75-3.75 lbs. acid equivalent (ae) per acre. Use formulations containing 3 lbs. ae per gal. (4 lbs. isopropylamine salt per gal.) at 1-5 qts. per acre, or formulations containing 4.5 lbs. ae per gal. (5 lbs. potassium salt per gal.) at 0.66-3.3 qts. per acre. Broadcast before transplanting, or apply between crop rows with hooded or shielded sprayers or wiper applicators. Wait at least 3 days before transplanting. Remove herbicide residue from plastic mulch prior to transplanting. Use low rate for annuals and higher rates for perennials. See label for suggested application volume and adjuvants. 14-day PHI.

### **Burndown or Directed/Shielded**

#### **Applications Broadleaves**

##### **Recommended Products**

**Aim EC**® at 0.5-2 fl. oz. per acre. Apply between crop rows with hooded sprayer. Do not allow spray to contact crop. Use COC or NIS. Weeds must be actively growing and less than 4 inches tall. Do not exceed 6.1 fl. oz. per acre per season.

### **Preemergence Broadleaves and Grasses**

#### **Recommended Products**

**Devrinol 50DF-XT**® at 2-4 lbs. per acre. Apply before transplanting. Incorporate 1-2 inches. Use lower rate on coarse sandy soils and higher rate on heavy clay soils.

**Dual Magnum 7.62E**® at 0.5-1.33 pts. per acre. *Michigan only* — applicators must have a 24(c) label. Apply before transplanting or within 48 hours after transplanting. Do not exceed 1 application and 1.3 pts. per acre per year. 60-day PHI.

**Prowl H2O**® at 1-3 pts. per acre Apply to soil before transplanting. Do not apply over the top of transplants. Needs water for activation. 70-day PHI.

**Trifluralin**® products at 0.5-1 lb. a.i. per acre. Apply 4EC formulations at 1-2 pts. per acre. Use low rate on soils with less than 2% organic matter. Broadcast and incorporate before transplanting, or apply directed spray between rows after transplanting and incorporate. Not effective on muck or high organic matter soils. May cause early stunting if growing conditions are unfavorable, especially on eggplant. To minimize injury, dip transplant roots in carbon slurry (2 lbs. per gal.) prior to planting, or include 2 oz. of carbon per gallon of transplant water.

### **Preemergence Broadleaves**

#### **Recommended Products**

**Sandea**® at 0.5-1 oz. per acre. Apply between rows of crop, avoiding contact with crop. Avoid contact with surface of plastic mulch if present. Also controls nutsedge. Use lower rates on coarse soils with low organic matter. Use 0.5-1 pt. of NIS per 25 gals. of spray solution if emerged weeds are present. Not recommended for use under cool temperatures due to potential for crop injury. Do not exceed 2 applications and 2 oz. per acre per crop-cycle per year. 30-day PHI.

### **Preemergence Grasses**

#### **Recommended Products**

**Dacthal W-75**® at 6-14 lbs. per acre, or **Dacthal**

**Flowable**® at 6-14 pts. per acre. Apply 4-6 weeks after transplanting when growing conditions favor good plant growth. May be applied over the top of transplants.

### **Postemergence Broadleaves and Grasses**

#### **Recommended Products**

**Gramoxone SL 2.0**®. See details above for Burndown or Directed/Shielded Applications.

**Glyphosate** products. See details above for Burndown or Directed/Shielded Applications.

### **Postemergence Broadleaves**

#### **Recommended Products**

**Aim**® see details above for Burndown or Directed/Shielded Applications.

**Sandea**® see details above for Preemergence. Also controls nutsedge.

## Postemergence Grasses

### Recommended Products

Clethodim products at the following rates:

**Select Max**® at 9-32 fl. oz. per acre. Use Select Max® with 8 fl. oz. of NIS per 25 gals. of spray solution (0.25% v/v). Do not exceed 64 fl. oz. of Select Max® per acre per season.

**2EC formulations of clethodim products** at 6-16 fl. oz. per acre. Use 2EC formulations with 1 qt. COC per 25 gals. of spray solution (1% v/v). Do not exceed 32 fl. oz. of 2EC formulations per acre per season.

Spray on actively growing grass. Wait at least 14 days between applications. 20-day PHI.

**Poast 1.5E**® at 1-1.5 pts. per acre. Use 1 qt. COC per acre. Spray on actively growing grass. Use high rate on quackgrass. Do not exceed 4.5 pts. per acre per season. 20-day PHI.

## Insect Control for Eggplant

For combined insect control options in fruiting vegetables, see page 153.

## Fruiting Vegetables — Pepper

### Disease Control for Pepper

#### Anthracnose

Use disease-free seed and/or transplants. Practice a 3-4 year crop rotation.

#### Recommended Products

**Aprovia Top**® at 10.5-13.5 fl. oz. per acre. Use of a spreader-sticker is recommended. 0-day PHI.

**Cabrio EG**® at 8-12 oz. per acre. 0-day PHI.

**Bravo**®, **Echo**®, and **Equus**® are labeled for use at various rates. Not all chlorothalonil formulations are labeled for pepper. 3-day PHI.

**Flint**® at 3-4 oz. per acre. *Suppression only*. 3-day PHI.

**Fontelis**® at 24 fl. oz. per acre. *Suppression only*. See label for greenhouse uses. 0-day PHI.

**Luna Sensation**® at 7.6 fl. oz. per acre. *Suppression only*. 3-day PHI.

**Manzate Pro-Stick**® at 1.6-2.1 lbs. per acre. Other mancozeb formulations are also available. 7-day PHI.

**Orondis Opti**® at 1.75-2.5 pt per acre. 3-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. 0-day PHI.

**Quadris Flowable**® at 6.0-15.5 fl. oz. per acre. 0-day PHI.

**Quadris Top**® at 8-14 fl. oz. per acre. 0-day PHI.

**Tanos**® at 8 oz. per acre. 3-day PHI.

#### Bacterial Canker

Bacterial canker can occur in pepper but is relatively rare. However, infected peppers can be a source of inoculum for bacterial canker of tomato. Use disease-free seed and transplants (see comments for bacterial spot/speck management). Transplant facility treatments listed under bacterial spot and speck for tomato (pages 145-146) will help reduce the severity of bacterial canker. However, copper applications in the field are generally ineffective for controlling bacterial canker.

Fields with a history of bacterial canker should be planted to crops other than tomato, potato, pepper, or eggplant for at least three years. Sanitize machinery, seedlings, and plant production materials (transplant trays, greenhouse benches, and wooden stakes) with a disinfectant such as a 10% chlorine bleach or a quaternary ammonium compound solution. Avoid working in wet fields.

#### Recommended Products

**Tanos 50DF**® at 8 oz. per acre. May help suppress bacterial diseases. Tank-mix with copper and mancozeb products.

#### Bacterial Spot/Speck

Resistant varieties are available for bacterial spot. Several races of bacterial spot can affect pepper. Bacterial speck is an emerging disease and resistant varieties have not been developed. There may be some variation in susceptibility of pepper varieties to bacterial speck.

Both diseases are seedborne. Use disease-free seed and/or transplants. Consider seed treatment with dilute Clorox (see Seed Treatments, page 26). Transplant facility treatments listed under bacterial spot and speck for tomato (pages 145-146) will help reduce disease incidence and spread.

**Copper Resistance:** Strains of the bacterium that cause bacterial spot on tomato and pepper that are resistant to copper products are common in the Midwest. Using Actigard®, Agri-mycin 17®, Tanos®, and Serenade Max® as labeled may help manage copper-resistant strains.

#### Recommended Products

##### During transplant production (greenhouse):

Several **copper** products (e.g., Kocide®, Champ®, Cuprofix®) are labeled for greenhouse use at 1 tablespoon (TBSP) per 1,000 square feet rates. Repeat according to label directions. Carefully note re-entry and personal protection warnings.

 May be acceptable for use in certified organic production. Check with your certifier before use.

**Streptomycin sulfate** (e.g., Agri-mycin 17<sup>®</sup>, Firewall 17WP<sup>®</sup>, Harbour Streptrol<sup>®</sup>) at 200 ppm. Make one or two applications to seedlings, alternated with a fixed copper compound beginning at the two-leaf stage. Not labeled for use after transplanting.

**During field production:**

**Actigard<sup>®</sup>** at 0.3-0.75 oz. per acre. Use low rate early in season and increase with time. See label. *Chili pepper only*. Use up to 8 weekly applications. May be effective when used with other labeled pesticides. 14-day PHI.

 **Copper** sprays in the field may reduce the rate of bacterial spread. Avoid consecutive seasons with pepper or tomato in the same field. Avoid working in fields when plants are wet. Strains of copper-resistant bacteria causing bacterial spot are common in the Midwest.

**Mankocide<sup>®</sup>** at 2-3 lbs. per acre. 7-day PHI.

 **Serenade Opti<sup>®</sup>** at 14-20 oz. per acre. May help manage bacterial diseases when copper-resistant strains of the bacterium are present.

**Tanos 50DF<sup>®</sup>** at 8 oz. per acre. Tanos<sup>®</sup> may help suppress bacterial diseases. Tank-mix as described on the label.

**Blossom End Rot**

Avoid drastic moisture fluctuations. Mulching plants may help. Avoid excessive nitrogen or potassium fertilization, rapid plant growth, and root pruning during cultivation. Maintain soil pH and calcium levels in desired range. Choose less susceptible varieties.

Blossom end rot is caused by a calcium deficiency in the fruit, although calcium levels in the soil may be sufficient. Wide fluctuations in soil water levels can trigger the disorder.

**Phytophthora Blight**

Avoid areas of fields where waterlogged root zones persist throughout the season. Pepper is very susceptible to this disease. Use well-drained fields. Planting on raised beds will increase soil drainage. Rotate infested fields with non-host crops for several years.

Pepper varieties with moderate to good resistance to the crown and root rot phase of *Phytophthora* blight include: *Bell*: Paladin, Aristotle, Archimedes, Revolution, Declaration, Intruder, and Vanguard; *Jalapeño*: Hechicero; *Ancho*: Sequoia. These varieties are susceptible to the foliar and fruit rot phases of *Phytophthora* blight. Where this disease is a recurring problem, use a fungicide program combined with *Phytophthora*-resistant pepper varieties.

*Timing is Critical*: Fungicides applied for *Phytophthora* blight are most effective if applied when disease threatens, but before symptoms become severe.

**Recommended Products**

**Agri-Fos 50WP<sup>®</sup>**. See label for rate. 0-day PHI.

 Fixed **copper** products may improve efficacy of fungicides against *Phytophthora* blight when tank mixed at labeled rates.

**Elumin<sup>®</sup>** at 8 fl. oz. per acre. 2-day PHI.

**Omega 500F<sup>®</sup>** at 1-1.5 pts. per acre. First application may be made as a drench at transplanting, followed by foliar applications. 30-day PHI.

**Orondis Gold 200<sup>®</sup>** at 2.4-19.2 fl. oz. per acre. See label for recommended program and limitations. Do not follow soil applications of with foliar applications of Orondis Ultra<sup>®</sup>.

**Orondis Opti<sup>®</sup>** at 1.75-2.5 pt per acre. 3-day PHI.

**Orondis Ultra<sup>®</sup>** at 5.5-8 fl. oz. per acre. Alternate with fungicides that have a different mode of action. 1-day PHI.

 **Phostrol<sup>®</sup>** at 1-2 qts. per acre. 0-day PHI.

**Presidio 4SC<sup>®</sup>** at 3-4 fl. oz. per acre. 2-day PHI.

**Ranman<sup>®</sup>** at 2.75 fl. oz. per acre. 0-day PHI.

**Revus<sup>®</sup>** at 8 fl. oz. per acre. 1-day PHI.

**Ridomil Gold SL<sup>®</sup>** soil treatment at 1 pt. per acre broadcast (use less for band applications) before transplanting. Subsequent directed sprays may be needed. *Phytophthora crown rot only*. Fungicides will not be effective if pepper is planted in poorly drained fields with a history of the disease. 7-day PHI.

**Tanos 50WDG<sup>®</sup>** at 8-10 oz. per acre. *Suppression only*. 3-day PHI.

**Zapro<sup>®</sup>** at 14 fl. oz. per acre. Adding a spreading/penetrating adjuvant is recommended. Alternate applications with fungicides with that have a different mode of action. 4-day PHI.

**Powdery Mildew**

**Recommended Products**

**Aprovia Top<sup>®</sup>** at 10.5-13.5 fl. oz. per acre. Use of a spreader-sticker is recommended. 0-day PHI.

**Cabrio<sup>®</sup>** at 8-16 oz. per acre. 0-day PHI.

**Luna Sensation<sup>®</sup>** at 5-7.6 fl. oz. per acre. 3-day PHI.

**Quadris 2.08EC<sup>®</sup>** at 6-15.5 fl. oz. per acre. Apply at 7-14 day intervals. 0-day PHI.

**Quadris Top<sup>®</sup>** at 8-14 fl. oz. per acre. Make no more than 2 consecutive applications before switching to a product with a different mode of action. 0-day PHI.

**Quintec<sup>®</sup>** at 4-6 fl. oz. per acre. 3-day PHI.

**Rally 40WSP<sup>®</sup>** at 2.5-4.0 oz. 0-day PHI.

## Southern Blight

This disease is normally observed in southern climates or during seasons with above normal temperatures. Crop rotations with small grains and deep plowing crop residue should help to reduce inoculum.

### Recommended Products

**Blocker 4F**® (PCNB) at 4.5-7.5 pts. per 100 gals. water.

Use 0.5 pint of solution per plant.

**Evito 480SC**® at 2.0-5.7 fl. oz. per acre.

**Fontelis**® at 16-24 fl. oz. per acre. *Non-bell peppers only.*

Apply to base of plant as directed spray 5-10 days after transplanting and 14 days later. Follow up with effective fungicide as needed. 0-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. *Suppression only.* 7-day PHI.

## Virus Diseases

Grow resistant varieties. Plant disease-free transplants. Eliminate broadleaf weeds within 150 feet of field before crops are established. Controlling thrips, especially during transplant production, is critical to prevent Tospoviruses (such as tomato spotted wilt virus (TSWV)) from establishing and spreading. Minimize handling seedlings to reduce the risk of spreading the viruses mechanically.

Some broadleaf weeds may be reservoirs for pepper viruses. Eliminate broadleaf weeds within 150 feet of field before crops are established.

## White Mold

Avoid fields with history of the problem. Pathogen has large host range. Avoid tomato after tomato rotations.

### Recommended Products

**Actinovate AG**® at 3-12 oz. per acre. Use with a spreader-sticker. 0-day PHI.

**Cabrio EG**® at 12-16 oz. per acre. *Suppression only. Not for greenhouse or high tunnel use.* 0-day PHI.

**BP**  **Contans WG**® at 1-4 lbs. per acre. Contans® is applied with conventional spray equipment directly to the soil surface at planting. See label for additional treatment information.

**Luna Sensation**® at 7.6 fl. oz. per acre. 3-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. *Suppression only. Not for greenhouse use.* 0-day PHI.

## Weed Control for Pepper

The fruiting vegetables are warm-season crops nearly always started as transplants. When growers transplant crops onto black or other opaque plastic mulch, they sometimes use herbicides underneath the mulch, depending on the weed pressure and labor available to

pull weeds by hand. Weeds between beds are typically controlled with cultivation, hand hoeing, herbicides, or a combination of the three. Weeds along the edge of the plastic mulch can be a particular challenge for cultivation equipment, and shielded or directed herbicide applications can help with control there.

Fresh market crops are also grown without plastic mulch, and similar weed control measures are used. Organic mulches (such as straw) can also provide good weed control in and between rows if applied in a thick enough mat before weeds emerge. Processing peppers are commonly grown in double rows on flat or raised beds. Weeds are controlled with a combination of herbicides and cultivation.

For specific weeds controlled by each herbicide, check Relative Effectiveness of Herbicides for Vegetable Crops (page 68).

Rates provided in the recommendations below are given for overall coverage. For band treatment, reduce amounts according to the portion of acre treated.

## Burndown or Directed/Shielded

### Applications Broadleaves and Grasses

#### Recommended Products

**Gramoxone SL 2.0**® at 2-4 pts. per acre. Use 1 qt. of COC or 4-8 fl. oz. of NIS per 25 gals. of spray solution. Broadcast before transplanting, or use lowest rate as a directed spray between rows after crop establishment. *RUP.*

**Glyphosate** products at 0.75-3.75 lbs. acid equivalent (ae) per acre. Use formulations containing 3 lbs. ae per gal. (4 lbs. isopropylamine salt per gal.) at 1-5 qts. per acre, or formulations containing 4.5 lbs. ae per gal. (5 lbs. potassium salt per gal.) at 0.66-3.3 qts. per acre. Broadcast before transplanting, or apply between crop rows with hooded or shielded sprayers or wiper applicators. Wait at least 3 days before transplanting. Remove herbicide residue from plastic mulch prior to transplanting. Use low rate for annuals and higher rates for perennials. See label for suggested application volume and adjuvants. 14-day PHI.

## Burndown or Directed/Shielded

### Applications Broadleaves

**Aim EC**® at 0.5-2 fl. oz. per acre. Apply prior to transplanting or apply between crop rows with hooded sprayer. Do not apply before direct seeding. Do not allow spray to contact crop. Use COC or NIS. Weeds must be actively growing and less than 4 inches tall. Do not exceed 6.1 fl. oz. per acre per season.

**BP** This is a biopesticide. See page 37 for details.

 May be acceptable for use in certified organic production. Check with your certifier before use.

## Preemergence Broadleaves and Grasses

### Recommended Products

**Command 3ME**® at 0.67-2.67 pts. per acre. *Not for banana pepper except in Ohio and Michigan.* Use lower rate on coarse soils, and higher rate on fine soils. Apply before transplanting. Set plant roots below herbicide. May cause temporary bleaching of crop leaves.

**Devrinol 50DF**® at 2-4 lbs. per acre. Use lower rate on coarse soil. Apply and incorporate before transplanting. After harvest or prior to planting succeeding crops, deep moldboard or disk plow. Do not seed alfalfa, small grains, sorghum, corn, or lettuce for 12 months after application.

**Dual Magnum**® at 0.5-1 pt. per acre. *Indiana, Michigan, and Ohio only — applicators must have a 24(c) label.* Apply before transplanting and do not incorporate, or apply within 48 hours after transplanting. Reduce risk of crop injury by applying after transplanting and by using a directed spray rather than spraying over the top of transplants. Do not exceed 1 pt. per acre or 1 application per crop. 60-day PHI.

**Prowl H2O**® at 1-3 pts. per acre. *Not for use under plastic mulch.* Apply and incorporate before transplanting, apply before transplanting without incorporation, or apply to established transplants as a directed spray. For use under plastic, apply as a band after bed formation and before laying plastic. Avoid any contact with leaves or stems of crop. 70-day PHI.

**Trifluralin**® products at 0.5-1 lb. a.i. per acre. Apply 4EC formulations at 1-2 pts. per acre. Use low rate on soils with less than 2% organic matter. Broadcast and incorporate before transplanting, or apply directed spray between rows after transplanting and incorporate. Not effective on muck or high organic matter soils. May cause early stunting if growing conditions are unfavorable. To minimize injury, dip transplant roots in carbon slurry (2 lbs. per gal.) prior to planting, or include 2 oz. of carbon per gallon of transplant water.

## Preemergence Broadleaves

### Recommended Products

**League**® at 4-6.4 oz. per acre. Apply between rows of crop after peppers are well-established and at least 10 inches tall. Avoid contact with crop and with surface of plastic mulch if present. Also controls nutsedge. 21-day PHI.

**Reflex 2L**® at 1 pt. per acre. *Michigan only — applicators must have a 24(c) label.* Apply before transplanting pepper. For use under plastic, apply after bed formation and before laying plastic. Use only once in twice per year on the same soil. See rotational crop restrictions. 60-day PHI.

**Sandea**® at 0.5-1 oz. per acre. Apply between rows of crop, avoiding contact with crop. Avoid contact with surface of plastic mulch if present. Use lower rates on coarse soils with low organic matter. Use 0.5-1 pt. of NIS per 25 gals. of spray solution if emerged weeds are present. Also controls nutsedge. Not recommended for use under cool temperatures due to potential for crop injury. Do not exceed 2 applications and 2 oz. per acre per crop-cycle per year. 30-day PHI.

**Spartan Charge**® at 4.5-7.6 fl. oz. per acre. *For use only on peppers in Ohio on plastic mulch.* Controls apple of Peru, ALS-resistant lambsquarters, and yellow nutsedge. Apply with directed, shielded sprayer. Before transplanting apply up to shoulders of plastic mulch covered bed, or after transplanting apply to row middles. Do not exceed 7.6 fl. oz. per acre per 12-month period.

## Preemergence Grasses

### Recommended Products

**Prefar 4E**® at 5-6 qts. per acre. Use low rate on soils with less than 1% organic matter. Apply and incorporate before planting.

## Postemergence Broadleaves and Grasses

### Recommended Products

**Gramoxone SL 2.0**®. See details above for Burndown or Directed/Shielded Applications.

**Glyphosate** products. See details above for Burndown or Directed/Shielded Applications.

## Postemergence Broadleaves

### Recommended Products

**Aim**®. See details above for Burndown or Directed/Shielded Applications.

**Sandea**®. See details above for Preemergence. Also controls nutsedge.

## Postemergence Grasses

### Recommended Products

**Clethodim** products at the following rates:

**Select Max**® at 9-32 fl. oz. per acre. Use Select Max® with 8 fl. oz. of NIS per 25 gals. of spray solution (0.25% v/v). Do not exceed 64 fl. oz. of Select Max® per acre per season.

**2EC formulations of clethodim products** at 6-16 fl. oz. per acre. Use 2EC formulations with 1 qt. COC per 25 gals. of spray solution (1% v/v). Do not exceed 32 fl. oz. of 2EC formulations per acre per season.

Spray on actively growing grass. Wait at least 14 days between applications. 20-day PHI.

**Poast 1.5E**® at 1-1.5 pts. per acre. Use 1 qt. of COC per acre. Spray on actively growing grass. Use high rate on quackgrass. Do not exceed 4.5 pts. per acre per season. 20-day PHI.

## Insect Control for Pepper

For combined insect control options in fruiting vegetables, see page 153.

# Fruiting Vegetables — Tomato

## Disease Control for Tomato

### **Anthracnose**

Symptoms usually occur on ripe or over-ripe fruit.

*Winter/Off-season:* Rotate crops at least 2-3 years and practice fall tillage.

*Fruit Set:* Begin fungicide applications at or shortly before fruit set.

*Harvest:* Inspect fruit for lesions.

### **Recommended Products**

**Aprovia Top**® at 10.5-13.5 fl. oz. per acre. Use of a spreader-sticker is recommended. 0-day PHI.

**Cabrio EG**® at 8-12 oz. per acre. See label to avoid practices that could result in crop injury. 0-day PHI.

**Bravo**®, **Echo**®, and **Equus**® formulations are labeled for use at various rates. 0-day PHI.

**Dithane**®, **Manzate**®, and **Penncozeb**® formulations are labeled at various rates. 5-day PHI.

**Fontelis**® at 24 fl. oz. per acre. *Suppression only.* See label for greenhouse uses. 0-day PHI.

**Inspire Super**® at 16-20 fl. oz. per acre. Do not apply to small fruit such as cherry tomato. 0-day PHI.

**Luna Sensation**® at 7.6 fl. oz. per acre. *Suppression only.* 3-day PHI.

**Orondis Opti**® at 1.75-2.5 pt per acre. 3-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. 0-day PHI.

**Quadris Flowable**® at 5-6.2 fl. oz. per acre. 0-day PHI.

**Quadris Opti**® at 1.6 pts. per acre. 0-day PHI.

**Quadris Top**® at 8 fl. oz. per acre. 0-day PHI.

**Revus Top 2.08SC**® at 5.5-7 fl. oz. per acre. Do not use on small-fruited varieties. Use when late blight is also a concern. 1-day PHI.

**Tanos**® at 8 oz. per acre. 3-day PHI.

### **Bacterial Canker**

The bacterium becomes systemic in the plant causing wilt and leaf/fruit/stem lesions.

Use disease-free seed and transplants. The transplant facility treatments listed for Bacterial Spot/Speck (below) will help reduce the severity of bacterial canker. However, copper applications in the field are generally ineffective for controlling canker.

Fields with a history of canker should be planted to crops other than tomato, potato, pepper, or eggplant for at least 3 years. Sanitize machinery, seedlings, and plant production materials (transplant trays, greenhouse benches, and wooden stakes) with a disinfectant such as 10% chlorine bleach or a quaternary ammonium compound solution. Avoid working in wet fields.

*Winter/off-season:* Rotate crops at least 3 years and practice fall tillage. The pathogen is seedborne. Consider seed treatment with hot water or dilute Clorox (see Seed Treatments, page 26).

*Greenhouse:* Inspect seedlings for disease and apply one or two fixed copper product applications. Tank-mix copper product with mancozeb (see bacterial spot/speck below).

*Planting:* Do not plant seedlings that have symptoms of bacterial canker.

*Fruit Set:* Inspect plants for symptoms of bacterial canker.

*Harvest:* Inspect fruit. Avoid saving seed.

### **Recommended Products**

**Tanos 50DF**® at 8 oz. per acre. Tanos® may help suppress bacterial diseases. Tank-mix with copper and mancozeb products.

### **Bacterial Spot/Speck**

Lesions of this disease can be found on leaves, stems, and fruit. Use disease-free seed and/or transplants.

*Copper Resistance:* Strains of the bacterium that cause bacterial spot on tomato that are resistant to copper products are common in the Midwest. Actigard®, Agri-mycin 17®, mancozeb products, Tanos®, and Serenade Max® used as labeled may help manage copper-resistant strains.

*Winter/Off-season:* Rotate crops at least 2 years and practice fall tillage. Purchase seed tested for these diseases. Consider seed treatment with hot water or dilute Clorox (see Seed Treatments, page 26).

*Greenhouse:* Scout and apply fixed copper alternated with streptomycin (Agri-mycin 17®, Firewall 17WP®, Streptrol®).

**Planting:** Do not plant seedlings with symptoms of bacterial spot/speck. Apply fixed copper product tank-mixed with mancozeb on 7-10 day schedule, depending on disease pressure, beginning within 1 week after transplanting.

**Harvest:** Inspect fruit. Avoid saving seed.

### Recommended Products

**Actigard 50WG**® at 0.3-0.75 oz. per acre. Begin season with lower rate and increase as plant canopy increases. Do not exceed 6 oz. per season. 14-day PHI.

**Agri-mycin 17**®, **Firewall 17WP**®, or **Streptrol**® at 1 lb. per 100 gals. of water. Apply one or two times to seedlings, alternated with a fixed copper compound (see below) beginning at the two-leaf stage. Not labeled for use after transplanting (greenhouse only).

Several formulations of **copper** products (Badge®, Champ®, Cueva®, Cuprofix®, Kentan®, Kocide®, Nordox®) are labeled for greenhouse use. Apply according to label directions.

Copper sprays in the field may reduce the rate of bacterial spread. Copper-resistant strains of the bacterial spot pathogen are common in the Midwest. Avoid consecutive seasons with pepper or tomato in the same field. Avoid working in fields when plants are wet. Mancozeb products (e.g., Dithane®, Manzate®, and Penncozeb®) when applied with copper products, allow more copper to become available, so may help manage copper-resistant bacterial spot strains.

**Regalia**® at 1-4 qts. per acre. Use in a program with copper products. 0-day PHI.

Several formulations of **copper** products (Badge®, Champ®, Cueva®, Cuprofix®, Kentan®, Kocide®, Nordox®) are labeled for greenhouse use. Apply according to label directions.

**Tanos 50DF**® at 8 oz. per acre. Tanos® may help suppress bacterial diseases. Tank-mix with copper and mancozeb products.

### Blossom End Rot

Avoid drastic moisture fluctuations. Mulching plants may help. Avoid excessive nitrogen or potassium fertilization, rapid plant growth, and root pruning during cultivation. Maintain soil pH and calcium levels in desired range. Choose less susceptible varieties.

Blossom end rot is caused by a calcium deficiency in the fruit, although calcium levels in the soil may be sufficient. Wide fluctuations in soil water levels can trigger the disorder.

May be acceptable for use in certified organic production. Check with your certifier before use.

### Botrytis Gray Mold

This disease is observed primarily in greenhouses and high tunnels, where it causes dieback of tomato leaves and lesions on fruit.

**Winter/Off-season:** Rotate crops at least 2-3 years and practice fall tillage. Keep up plant's calcium levels.

**Planting:** Begin protective fungicide applications.

**Harvest:** Inspect fruit for symptoms.

**Greenhouse/High tunnel:** Keep temperatures higher than 70°F, and maintain relative humidity less than 90%. Keep plants well pruned to improve air circulation.

### Recommended Products

**Botran 75W**® at 1 lb. per 100 gals. of water. Labeled for the stem phase of gray mold. Apply to stems up to a height of 24 inches. Young plants may be injured. Available for greenhouse use.

Several **chlorothalonil** formulations (e.g., Bravo®, Echo®, Equus®) are available at various rates. *Field use only.* 0-day PHI.

**Cabrio EG**® at 12-16 oz. per acre. *Suppression only.* 0-day PHI.

**Endura**® at 9-12.5 oz. per acre. *Suppression only.* 0-day PHI.

**Fontelis**® at 16-24 fl. oz. per acre. See label for greenhouse uses. 0-day PHI.

**Inspire Super**® at 16-20 fl. oz. per acre. Label is silent on greenhouse use.

**Luna Sensation**® at 7.6 fl. oz. per acre. 3-day PHI.

**Luna Tranquility**® at 11.2 fl. oz. per acre. 1-day PHI.

**Orondis Opti**® at 1.75-2.5 pt per acre. 3-day PHI.

**Pageant Intrinsic**® at 23 oz. per acre. Labeled for greenhouse-/high tunnel-grown tomatoes. Do not apply on seedlings meant for transplanting in the field. 0-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. *Suppression only.* 0-day PHI.

**Scala**® at 7 fl. oz. per acre. May be used in greenhouses (see label for cautions). 1-day PHI.

**Switch 62.5WB**® at 11-14 oz. per acre. 0-day PHI.

### Buckeye Rot and Phytophthora Blight

These diseases are favored by heavy rains and waterlogged soils. Symptoms include discolored fruit and declining plants.

Rotate away from tomato, pepper, vine crops, or snap beans for 3 years. Avoid low areas of fields. Plastic mulch may reduce splash infection.

*Winter/Off-season:* Rotate crops at least every 3 years and practice fall tillage. Avoid poorly drained soils. Use raised beds. Mulch may lessen buckeye rot's impact.

*Planting:* Consider fungicide drench. Regular fungicide schedule may lessen impact of buckeye rot.

### Recommended Products

Fixed **copper** products may improve efficacy of fungicides against *Phytophthora* blight when tank mixed at labeled rates.

**Gavel 75DF**® at 1.5-2 lbs. per acre. 5-day PHI.

**Orondis Gold 200**® at 2.4-19.2 fl. oz. per acre. See label for recommended program and limitations. Do not follow soil applications of with foliar applications of Orondis Ultra®. 0-day PHI.

**Orondis Opti**® at 1.75-2.5 pts. per acre. Alternate with fungicides that have a different mode of action. 0-day PHI.

**Orondis Ultra**® at 5.5-8 fl. oz. per acre. Alternate with fungicides that have a different mode of action. Labeled for greenhouse tomato production. 1-day PHI.

**Presidio 4SC**® at 3-4 fl. oz. per acre. Must be tank-mixed with a product with a different mode of action. 2-day PHI.

**Quadris 2.08EC**® at 5.0-6.0 fl. oz. per acre. 0-day PHI.

**Quadris Opti**® at 1.6 pts. per acre. 0-day PHI.

**Ranman 400SC**® at 2.75 fl. oz. per acre. Apply product to base of plant or in transplant water at transplanting. Do not exceed 16.5 fl. oz. per acre per season. 0-day PHI.

**Ridomil Gold Copper**® at the following rates:

*Processing tomatoes:* 5 lbs. per 3.7 acres tank-mixed with 0.8 lb. active ingredient per acre of maneb or mancozeb.

*Fresh market tomatoes:* 5 lbs. per 2.5 acres tank-mixed with 0.8 lb. active ingredient per acre of maneb or mancozeb. 14-day PHI.

**Ridomil Gold SL**® at 1.0 pts. per acre. Apply at least 4 weeks before harvest.

**Tanos**® at 8 oz. per acre. *Suppression only.* Must be tank-mixed. 3-day PHI.

**Zampro**® at 14 fl. oz. per acre. No more than 3 applications per season. First application may be made at transplanting as a seedling drench. 4-day PHI.

### Early Blight and Septoria Leaf Blight

Both of these diseases initially cause lesions on lower leaves of the tomato plant. Plant resistant varieties. Use wilt resistant “VF” cultivars, and avoid fields with a wilt history. Tomato plants weakened by wilt disease may be more prone to leaf blights. Practice 3-4-year rotation with unrelated crops. Rotate out of fields with a history of early blight or Septoria leaf spot.

*Group 11 Resistance:* Strains of the fungus that causes early blight that are resistant to group 11 fungicides have been observed in Indiana and Ohio. Group 11 products labeled for tomato and early blight include Cabrio® and Quadris®. Tank-mix group 11 fungicides with products that have a different mode of action, or alternate group 11 fungicides with fungicides that have a different group number. See Selected Information About Recommended Fungicides (page 79) for more information.

*Winter/Off-season:* Use crop rotations of at least 2-3 years for Septoria and 3-4 years for early blight.

*Planting:* Begin protective fungicide applications on a 7-14 day schedule.

### Recommended Products

**Aprovia Top**® at 10.5-13.5 fl. oz. per acre. Use of a spreader-sticker is recommended. 0-day PHI.

**Bravo**®, **Echo**®, and **Equus**® are labeled at various rates. 0-day PHI.

**Cabrio EG**® at 8-12 oz. per acre. 0-day PHI.

**Dithane**®, **Mancozeb**®, and **Penncozeb**® are labeled at various rates. 5-day PHI.

**Endura 70WG**® at 2.5-3.5 oz. per acre. *Early blight only.* 0-day PHI.

**Fontelis**® at 16-24 fl. oz. per acre. See label for greenhouse uses. 0-day PHI.

**Gavel 75DF**® at 1.5-2 lbs. per acre. 5-day PHI.

**Inspire Super**® at 16-20 fl. oz. per acre. Do not apply to small-fruited varieties such as cherry tomato. 0-day PHI.

**Luna Sensation**® at 5-7.6 fl. oz. per acre. 3-day PHI.

**Luna Tranquility**® at 11.2 fl. oz. per acre. 1-day PHI.

**Orondis Opti**® at 1.75-2.5 pt per acre. 3-day PHI.

**OSO 5%EC**® at 3.7-13 fl. oz. per acre. *Early blight only.* 0-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. 0-day PHI.

**Quadris 2.08EC**® at 5.0-6.2 fl. oz. per acre. 0-day PHI.

**Quadris Opti**® at 1.3-1.6 pts. per acre. 0-day PHI.

**Quadris Top**® at 8 fl. oz. per acre. 0-day PHI.

**Reason**® at 5.5-8.2 fl. oz. per acre. *Label indicates suppression only for Septoria.* 14-day PHI.

**Revus Top 2.08SC**® at 5.5-7 fl. oz. per acre. 1-day PHI.

**Rhyme**® at 5-7 fl. oz. per acre. 0-day PHI.

**Scala**® at 7 fl. oz. per acre. *Early blight only.* Use only in a tank-mix with another fungicide effective against early blight. May be used in greenhouses (see label for cautions). 1-day PHI.

**Switch 62.5WB**® at 11-14 oz. per acre. *Early blight only.* Do not apply to small-fruited varieties in the greenhouse. 0-day PHI.

**Tanos**® at the following rates:

*Early blight:* 6-8 oz. per acre.

*Septoria:* 8 oz. per acre.

3-day PHI.

**Zing 4.9SC**® at 36 fl. oz. per acre. 5-day PHI.

**Ziram 76DF**® at 3-4.0 lbs. per acre. *Not for cherry tomato.* Use with effective spreader-sticker. 7-day PHI.

### **Fusarium Crown and Root Rot**

Use long crop rotations. Steam or fumigate soil in the greenhouse prior to transplanting.

### **Fusarium Wilt**

Plant resistant varieties. Avoid fields with a history of root-knot nematode.

### **Late Blight**

The fungus that causes late blight does not overwinter in the Midwest. Thus, the fungus must be transported into the Midwest each time the disease occurs.

*Winter/Off season:* Destroy cull plies and disk under tomato fields at the end of each season.

*Planting:* Apply specialized fungicides when late blight threatens.

*Harvest:* Inspect fruit for symptoms of late blight.

### **Recommended Products**

**BP** Agri-Fos 50WP®. See label for rate. 0-day PHI

**Chlorothalonil** and **mancozeb** products may be used. Higher rates may be required for late blight control. 0-day PHI for chlorothalonil. 5-day PHI for mancozeb. Best used in tank-mixes with other products listed here.

**Curzate 60DF**® at 3.2-5 oz. per acre. Apply Curzate® plus a contact (protectant) fungicide. Use the 5 oz. rate if late blight is present. 3-day PHI.

**Gavel 75DF**® at 1.5-2 lbs. per acre. 5-day PHI.

**Orondis Opti**® at 1.75-2.5 pts. per acre. Alternate with fungicides that have a different mode of action. 0-day PHI.

**Orondis Ultra**® at 5.5-8 fl. oz. per acre. Alternate with fungicides that have a different mode of action. Labeled for greenhouse tomato production. 1-day PHI.

**Previcur Flex**® at 0.7-1.5 pts. per acre. See label for greenhouse instructions. 5-day PHI.

**Presidio**® at 3-4 fl. oz. per acre. 2-day PHI.

**Priaxor**® at 8 fl. oz. per acre. *Suppression only.* 0-day PHI.

**Ranman 400SC**® at 2.1-2.75 fl. oz. per acre. 0-day PHI.

**Reason 500SC**® at 5.5-8.2 fl. oz. per acre. 14-day PHI.

**Revus Top 2.08SC**® at 5.5-7 fl. oz. per acre. 1-day PHI.

**Ridomil Gold Bravo SC**® at 2.5 pt. per acre. Use only when late blight strains in the area are known to be sensitive to Ridomil®. Tank-mix with a penetrating surfactant. Do not use a sticker. 5-day PHI.

**Tanos 50WP**® at 8 oz. per acre. Tank-mix with a contact fungicide with a different mode of action. 3-day PHI.

**Zampro**® at 14 fl. oz. per acre. 4-day PHI.

**Zing! 4.9SC**® at 36 fl. oz. per acre. 5-day PHI.

### **Leaf Mold**

This disease causes yellow lesions on the upper side of the tomato leaf. It is common in greenhouse and high tunnel tomatoes but is less common in open field tomatoes.

*Winter/Off-season:* Rotate crops at least 2-3 years and practice fall tillage. Use sanitation in greenhouse tomatoes.

*Greenhouse:* Scout for disease.

*Planting:* Control relative humidity in the greenhouse by venting and pruning. Labeled fungicides may help control leaf mold.

### **Recommended Products**

**Dithane**®, **Manzate**®, and **Penncozeb**® are labeled at various rates. Label is silent on greenhouse use. 5-day PHI.

**Gavel 75DF**® at 1.5-2 lbs. per acre. Label is silent on greenhouse use. 5-day PHI.

**Inspire Super**® at 16-20 fl. oz. per acre. Do not apply to small-fruited varieties such as cherry tomato. Label is silent on greenhouse use. 0-day PHI.

**Quadris Top**® at 8 fl. oz. per acre. Label is silent on greenhouse use. 0-day PHI.

**BP** This is a biopesticide. See page 37 for details.

 May be acceptable for use in certified organic production. Check with your certifier before use.

**Tanos**® at 8 oz. per acre. Label is silent on greenhouse use. 3-day PHI.

### **Powdery Mildew**

#### **Recommended Products**

**Aprovia Top**® at 10.5-13.5 fl. oz. per acre. Use of a spreader-sticker is recommended. 0-day PHI.

**Cabrio**® at 8-16 oz. per acre. 0-day PHI.

**Inspire Super**® at 16-20 fl. oz. per acre. Do not apply to small-fruited varieties such as cherry tomato. 0-day PHI.

**Luna Tranquility**® at 11.2 fl. oz. per acre. 1-day PHI.

**OSO 5%EC**® at 3.7-13 fl. oz. per acre. 0-day PHI.

**Priaxor**® at 6-8 fl. oz. per acre. 0-day PHI.

**Quadris 2.08EC**® at 5.0-6.2 fl. oz. per acre. 0-day PHI.

**Quadris Opti**® at 1.6 pts. per acre. 0-day PHI.

**Quadris Top**® at 8 fl. oz. per acre. 0-day PHI.

**Quintec**® at 4-6 fl. oz. per acre. Must have supplemental label. 3-day PHI.

**Rally 40WSP**® at 2.5-4.0 oz. 0-day PHI.

**Switch**® at 11 oz. per acre. *Not for small-fruited varieties in the greenhouse.* 0-day PHI.

**Vivando**® at 15.4 fl. oz. per acre. Must have supplemental label. 0-day PHI.

### **Rhizoctonia Seedling Rot**

Seedlings may develop this disease under rainy conditions, especially in the spring and early summer. Plant crop on well-drained soil.

#### **Recommended Products**

**Aframe**® at 0.4-0.8 fl. oz. per 1,000 ft. of row. 0-day PHI.

### **Southern Blight**

This disease is normally observed in southern climates or during seasons with above normal temperatures.

Crop rotations with small grains and deep plowing crop residue should help to reduce inoculum.

#### **Recommended Products**

**Evito 480SC**® at 2.0-5.7 fl. oz. per acre.

**Fontelis**® at 16-24 fl. oz. per acre. Apply to base of plant as directed spray 5-10 days after transplanting and 14 days later. Follow up with effective fungicide as needed. 0-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. Suppression only. 7-day PHI.

### **Tobacco Mosaic Virus**

This disease is more of a problem in fresh market tomatoes than processing tomatoes due to extensive handling. The best control is to use a resistant cultivar. There is no chemical control. If only a few plants are showing

symptoms, remove them carefully so as not to touch other plants. Control weeds around fields, because some weeds are known to harbor the virus.

### **Tomato Spotted Wilt Virus/Impatiens**

#### **Necrotic Spot Virus**

These viruses are carried by thrips and can cause major loss to tomatoes if they infect young plants. Both viruses are more common in greenhouse and high tunnel situations. Since ornamental plants can be a source of thrips, avoid growing ornamental plants such as flowers from plugs with tomatoes either as transplants or with mature tomatoes. Controlling thrips may slow the spread of the virus in greenhouse and field.

#### **Verticillium Wilt**

Many tomato cultivars have host resistance to *Verticillium* wilt. Avoid fields with a history of *Verticillium* wilt. Rotate with small grains where possible. Use of long rotations out of solanaceous crops will prevent rapid increase of pathogen populations. Tomato varieties with resistance are available.

#### **Recommended Products**

Fumigate with **Vapam**® at 37.5-75 gals. per acre under plastic mulch. *Not for greenhouse use.* Allow at least 21 days between application of fumigant and transplanting. Observe the 48-hour REI. See label for important application instructions.

### **White Mold (Timber Rot)**

This disease may be more common in greenhouses and high tunnels than in open fields. The fungus that causes this disease is soilborne and often results in a woody appearance of the lower stem of the tomato plant. Avoid fields with history of the problem. Pathogen has large host range. Avoid tomato after tomato rotations.

*Winter/Off-season:* Use long rotations with corn or small grains. Growers should avoid rotations with tomato, pepper, potato, and snap bean.

*Greenhouse/Planting:* White mold may be common where tomato is grown yearly in the same soil such as under a greenhouse structure.

*Fruit Set:* Inspect plants for symptoms of white mold.

#### **Recommended Products**

**Actinovate AG**® at 3-12 oz. per acre. Use with a spreader-sticker. 0-day PHI.

**Cabrio EG**® at 12-16 oz. per acre. *Suppression only. Not for greenhouse or high tunnel use.* 0-day PHI.

**BP**  **Contans WG**® at 1-4 lbs. per acre. Contans® is applied with conventional spray equipment directly to the soil surface at planting. See label for additional treatment information.

**Luna Sensation**® at 7.6 fl. oz. per acre. 3-day PHI.

**Priaxor**® at 4-8 fl. oz. per acre. *Suppression only. Not for greenhouse use.* 0-day PHI.

# Product/Disease Ratings for All Fruiting Vegetables<sup>1</sup>

Product (REI/PHI) <sup>2</sup>	Common Name MOA or FRAC code: fungicides with a number as the MOA code should be tank-mixed or alternated with a different MOA code according to the label.	Anthraco (tomato)	Anthraco (pepper)	Bacterial Canker	Bacterial Spot/Spot	Botrytis Gray Mold	Buckeye Rot	Early Blight	Septoria Leaf Blight	Late Blight (tomato)	Phytophthora Blight (pepper)	Leaf Mold	White Mold	Comments
Actigard* (12/24)	acibenzolar-S-methyl (P)				F									Not for bell pepper. Do not apply to stressed plants.
Agri-Mycin 17*, Ag Streptomycin*	streptomycin sulfate (25)				F									For use on tomato/pepper seedlings produced for transplanting only.
Aprovia Top* (12/20)	benzovindiflupyr (7), difenconazole (3)	ID	ID			ID		VG	ID			ID		
Botran* (12/10)	2, 6-dichloro-4-nitroaniline (29)					G								Application to seedlings may result in injury.
Bravo*, Echo*, Equus* (12/0)	chlorothalonil (M)	G	G			F		F	G	VG		F		Effective against a wide range of fungal diseases. Not for greenhouse use.
Cabrio* (12/0)	pyraclostrobin (11)	G	VG			F		VG	VG	P			S	
Contans WG* (4/NA)	CON/M/91-08 (NA)												F	Apply with conventional spray equipment directly to soil surface.
copper (many trade names) (24/0)	copper (M)	F	F	P	F	P		F	F	F				Tank-mix with mancozeb products to overcome copper resistance in bacterial spot strains.
Curzate 60DF* (12/3)	cymoxanil (27)									VG				Translaminar systemic activity against tomato late blight.
Dithane*, Manzate*, Penncozeb* (24/5)	mancozeb (M)	F	F					G	G	F		F		Be sure product is labeled on pepper.
Elumin* (12/2)	ethaboxam (22)										G			Same FRAC group as Gavel*
Endura* (3/9)	boscalid (7)					VG		VG						Increase spray volumes as plants grow.
Fontelis* (12/0)	penthiopyrad (7)	S	S			G		VG	VG					
Gavel* (48/5)	mancozeb (M), zoxamide (22)						F	G	G	F		F		May be used with copper products to manage bacterial spot.
Inspire Super* (12/0)	difenconazole (3), cyprodinil (9)	F	F				G	VG	G			G		
Luna Sensation* (12/3)	fluopyram (7), trifloxystrobin (11)	S	S			G		ID	ID				G	
Luna Tranquility* (12/1)	fluopyram (7), pyrimethanil (9)					ID		VG	VG					
Orondis Opti* (4/3)	oxathiapropipilin (U15), chlorothalonil (M)									VG	VG			Apply as tank-mix of both products in multi-pack.
Orondis Ridomil Gold SL* (48/28)	oxathiapropipilin (U15), mefenoxam (4)										VG			Apply as tank-mix of both products in multi-pack to soil.
Orondis Ultra* (4/1)	oxathiapropipilin (U15), mandipropamid (40)									VG	VG			Apply as tank-mix of both products in multi-pack.
Presidio* (12/2)	fluopicolide (43)									VG	G			
Previcur Flex* (12/5)	propamocarb hydrochloride (28)									VG				
Priaxor* (12/0)	fluxapyroxad (7), pyraclostrobin (11)	G	G			F		VG	G	S			S	
Quadris* (4/0)	azoxystrobin (11)	G	VG				P	VG	VG	P				
Quadris Top* (12/0)	azoxystrobin (11), difenconazole (3)	G	VG					VG	VG			G		
Ranman* (12/0)	cyazofamid (21)									VG	G			
Reason* (12/14)	fenamidone (11)							VG	VG	S	S			
Revus Top* (12/1)	mandipropamid (40), difenconazole (3)	G						G	G	G		G		Not labeled on pepper.
Ridomil Gold GR*, Ridomil Gold SL* (48/7)	mefanoxam (4)						G			VG*	G*			*Effective against sensitive isolates only.
Scala* (12/1)	pyrimethanil (9)					G		G						Label includes greenhouse instructions.
Switch* (12/0)	cyprodinil (9), fludioxanil (12)					G		VG						Do not apply to cherry or grape tomatoes in the greenhouse.
Tanos* (12/3)	cymoxanil (27), famoxadone (11)	F	G	S	S	S	S	G	G	G		G		Tank-mix with manzate or other EBDC.
Zampro* (12/4)	amitoctradin (45), dimethomorph (40)									VG	P			
Zing* (48/5)	zoxamide (22), chlorothalonil (M)							G	G	VG				

<sup>1</sup>Fungicide rating code: VG=very good. G=good. F=fair. P=poor. S=suppression only. ID=labeled, but insufficient data to allow rating. Based on research and experience of the authors.

<sup>2</sup>REI (re-entry interval) in hours: do not enter or allow workers to enter areas treated during the REI period. PHI (pre-harvest interval) in days: the minimum time that must pass between the last pesticide application and crop harvest.

## Weed Control for Tomato

The fruiting vegetables are warm-season crops nearly always started as transplants. When growers transplant crops onto black or other opaque plastic mulch, they sometimes use herbicides underneath the mulch, depending on the weed pressure and labor available to pull weeds by hand. Weeds between beds are typically controlled with cultivation, hand hoeing, herbicides, or a combination of the three. Weeds along the edge of the plastic mulch can be a particular challenge for cultivation equipment, and shielded or directed herbicide applications can help with control there.

Fresh market crops are also grown without plastic mulch, and similar weed control measures are used. Organic mulches (such as straw) can also provide good weed control in and between rows if applied in a thick enough mat before weeds emerge. Processing tomatoes are commonly grown in double rows on flat or raised beds. Weeds are controlled with a combination of herbicides and cultivation.

For specific weeds controlled by each herbicide, check Relative Effectiveness of Herbicides for Vegetable Crops (page 68).

Rates provided in the recommendations below are given for overall coverage. For band treatment, reduce amounts according to the portion of acre treated.

### ***Burndown or Directed/Shielded***

#### ***Applications Broadleaves and Grasses***

##### ***Recommended Products***

**Glyphosate** products at 0.75-3.75 lbs. acid equivalent (ae) per acre. Use formulations containing 3 lbs. ae per gal. (4 lbs. isopropylamine salt per gal.) at 1-5 qts. per acre, or formulations containing 4.5 lbs. ae per gal. (5 lbs. potassium salt per gal.) at 0.66-3.3 qts. per acre. Broadcast before transplanting, or apply between crop rows with hooded or shielded sprayers or wiper applicators. Remove herbicide residue from plastic mulch prior to transplanting. Do not use row-middle applications for tomatoes grown on sandy soils because crop injury may occur. Use low rate for annuals and higher rates for perennials. See label for suggested application volume and adjuvants. 14-day PHI.

**Gramoxone SL 2.0**® at 2-4 pts. per acre. Use 1 qt. of COC or 4-8 fl. oz. of NIS per 25 gals. of spray solution. Broadcast before transplanting, or use lowest rate as a directed spray between rows after crop establishment. 30-day PHI for tomato. *RUP*.

### ***Burndown or Directed/Shielded***

#### ***Applications Broadleaves***

##### ***Recommended Products***

**Aim EC**® at 0.5-2 fl. oz. per acre. Apply prior to transplanting, or apply between crop rows with hooded sprayer. Do not apply before direct seeding. Do not allow spray to contact crop. Use COC or NIS. Weeds must be actively growing and less than 4 inches tall. Do not exceed 6.1 fl. oz. per acre per season.

### ***Preemergence Broadleaves and Grasses***

##### ***Recommended Products***

**Devrinol 50DF**® at 2-4 lbs. per acre. Use lower rate on coarse soil. Apply and incorporate before seeding or transplanting. After harvest or prior to planting succeeding crops, deep moldboard or disk plow. Do not seed alfalfa, small grains, sorghum, corn, or lettuce for 12 months after application.

**Dual Magnum**® at 1-2 pts. per acre. Use lower rate on coarse soils. Apply prior to transplanting, or as a directed spray after transplanting. Crop injury may occur under unfavorable growing conditions. 30- to 90-day PHI depending on rate.

**Prowl H2O**® at 1-3 pts. per acre. Apply and incorporate before transplanting, apply before transplanting without incorporation, or apply to established transplants as a directed spray. For use under plastic, apply as a band after bed formation and before laying plastic. Avoid any contact with leaves or stems of crop. 70-day PHI.

**Trifluralin**® products at 0.5-1 lb. a.i. per acre. Apply 4EC formulations at 1-2 pts. per acre. Use low rate on soils with less than 2% organic matter. Broadcast and incorporate before transplanting, or apply directed spray between rows after transplanting and incorporate. Not effective on muck or high organic matter soils. May cause early stunting if growing conditions are unfavorable. To minimize injury, dip transplant roots in carbon slurry (2 lbs. per gal.) prior to planting, or include 2 oz. of carbon per gal. of transplant water.

## Preemergence Broadleaves

### Recommended Products

**Sandea**® at 0.5-1 oz. per acre. Use lower rates on coarse soils with low organic matter. Use 0.5-1 pt. of NIS per 25 gals. of spray solution if emerged weeds are present. Apply to soil surface after final soil preparation or bed shaping and just before applying plastic mulch. Wait 7 days after application and laying mulch before transplanting. Or apply between rows of crop, avoiding contact with crop and surface of plastic mulch, if present. For tomatoes on bare ground only, apply over the top of well-established, actively growing plants no sooner than 14 days after transplanting and before first bloom. Also controls nutsedge. Not recommended for use under cool temperatures due to potential for crop injury. Do not exceed 2 applications and 2 oz. per acre per crop-cycle per year. 30-day PHI.

Products containing **metribuzin** at the following rates:

*4F formulations:* 0.5-1 pt. per acre

*75DF formulations:* 0.33-0.66 lb. per acre.

Broadcast and incorporate before transplanting, or broadcast after transplants are established. Or, use 4F formulations at up to 2 pts. per acre, or 75DF formulations at 1.33 lbs. per acre and apply a directed spray between crop rows after transplants are established. May be applied preplant incorporated with trifluralin products for improved weed control. Crop injury may occur if applied over the top of plants within 3 days of cool, wet, or cloudy weather. Wait at least 14 days between applications. Do not exceed 2 pts. of 4F formulations, or 1.33 lbs. of 75DF formulations per acre per season. 7-day PHI.

**Reflex 2L**® at 1 pt. per acre. *Michigan only — applicators must have a 24(c) label.* Apply before transplanting. For use under plastic, apply after bed formation and before laying plastic. Use only once in two years on the same soil. See rotational crop restrictions. 70-day PHI.

**Spartan 4F** at 2.25 to 8 fl. oz. per acre. Apply before transplanting as a broadcast or banded application. Will also control nutsedge. Do not use on soils classified as sand, which have less than 1% organic matter. Maximum per acre per 12 months is 12 fl. oz.

## Preemergence Grasses

### Recommended Products

**Dacthal W-75**® at 6-14 lbs. per acre, or **Dacthal**

**Flowable**® at 6-14 pts. per acre. Apply 4-6 weeks after transplanting when growing conditions favor good plant growth. May be applied over the top of transplants.

## Postemergence Broadleaves and Grasses

### Recommended Products

**Glyphosate** products. See details above for Burndown or Directed/Shielded Applications.

**Gramoxone Inteon 2L**®. See details above for Burndown or Directed/Shielded Applications.

## Postemergence Broadleaves

### Recommended Products

**Matrix**® 25SG at 1-2 oz. per acre. Use 0.5 pt. of NIS per 25 gals. of spray solution if emerged weeds are present. Apply when weeds are less than 1 inch tall. Soil activity requires rainfall within 5 days of application. If crop is stressed, chlorosis may occur. Do not exceed 4 oz. per acre per year. 45-day PHI.

Products containing **metribuzin**. See details above for Preemergence.

**Sandea**®. See details above for Preemergence. Also controls nutsedge.

## Postemergence Grasses

### Recommended Products

**Clethodim** products at the following rates:

**Select Max**® at 9-32 fl. oz. per acre. Use Select Max® with 8 fl. oz. of NIS per 25 gals. of spray solution (0.25% v/v). Do not exceed 64 fl. oz. of Select Max® per acre per season.

**2EC formulations of clethodim products** at 6-16 fl. oz. per acre. Use 2EC formulations with 1 qt. COC per 25 gals. of spray solution (1% v/v). Do not exceed 32 fl. oz. of 2EC formulations per acre per season.

Spray on actively growing grass. Wait at least 14 days between applications. 20-day PHI.

**Poast 1.5E**® at 1-1.5 pts. per acre. Use 1 qt. COC per acre. Spray on actively growing grass. Use high rate on quackgrass. Do not exceed 4.5 pts. per acre per season. 20-day PHI.

## Insect Control for Tomato

For combined insect control options in fruiting vegetables, see page 153.

## Herbicides for All Fruiting Vegetables<sup>1</sup>

Products (REI/PHI)	Common Name	Timing and Application Location Relative to Crop <sup>2</sup>			Incorporated	Timing Relative to Weeds		Weed Groups Controlled			Crops <sup>3</sup>		
		Before Transplanting	After Transplanting, between rows only	Postemergence		Preemergence	Postemergence	Annual Grasses	Small-seeded Broadleaves	Broadleaves	Tomato	Pepper	Eggplant
Aim EC <sup>®</sup> (12h/-)	carfentrazone	X	X				X		X	X	X	X	X
Command 3ME <sup>®</sup> (12h/-)	clomazone	X				X		X	X	X		X	
Dacthal W-75 <sup>®</sup> , Dacthal Flowable <sup>®</sup> (12h/-)	DCPA			X		X		X			X		X
Devrinol 50DF <sup>®</sup> (12h)	napropamide	X			Yes	X		X	X		X	X	X
Dual Magnum <sup>®</sup> (24h/30-90d)	s-metolachlor	X	X			X		X	X		X	X	
Gramoxone <sup>®</sup> (12h to 24h)	paraquat	X	X				X	X	X	X	X	X	X
Matrix <sup>®</sup> (4h/ 45d)	rimsulfuron	X		X		X	X	X	X	X	X		
Poast <sup>®</sup> (12h/20d)	sethoxydim			X			X	X			X	X	X
Prefar 4E <sup>®</sup> (12h/-)	bensulide	X			Yes	X		X				X	
Prowl H2O <sup>®</sup> (12h/70d)	pendimethalin	X	X			X		X	X		X	X	X
Roundup <sup>®</sup> , others (12h/14d)	glyphosate	X	X				X	X	X	X	X	X	X
Sandea <sup>®</sup> (12h/30d)	halosulfuron	X	X	X		X	X		X	X	X	X	X
Select Max <sup>®</sup> , others (12h/20d)	clethodim			X			X	X			X	X	X
Spartan 4F <sup>®</sup> (12h/-)	sulfentrazone	X				X			X	X	X		
Treflan <sup>®</sup> , others (12h/-)	trifluralin	X	X		Yes	X		X	X		X	X	X
Tricor <sup>®</sup> , others (12h/7d)	metribuzin	X	X	X		X	X		X	X	X		

<sup>1</sup>For effectiveness against specific weeds, see Relative Effectiveness of Herbicides for Vegetable Crops (page 68), and read label. This table does not include all label information. Be sure to read and follow all instructions and precautions on the herbicide label. Herbicides can cause serious crop injury and yield loss if not used properly.

<sup>2</sup>X=permitted for at least one crop.

<sup>3</sup>X=may be used for that crop.

## Insect Control for All Fruiting Vegetables

### Aphids

Conserve natural enemies by avoiding broad-spectrum insecticide applications.

Limiting the use of some insecticides will conserve predators and parasites that help control aphid populations.

### Recommended Products

**Actara<sup>®</sup>** (25 WDG) at 2-3 oz. per acre. 0-day PHI.

**Admire Pro<sup>®</sup>** (4.6F) at the following rates:

*Soil-applied to pepper:* 7-14 fl. oz. per acre. 21-day PHI.

*Soil-applied to all others:* 7-10.5 fl. oz. per acre. 21-day PHI.

*Foliar applications:* 1.3-2.2 fl. oz. per acre. 0-day PHI.

**Assail<sup>®</sup>** (30SG) at 2-4 oz. per acre. 7-day PHI.

**Beleaf<sup>®</sup>** (50SC) at 2-4.28 fl. oz. per acre. Aphids only. 0-day PHI.

**Dimethoate 400<sup>®</sup>** or **Dimethoate 4E<sup>®</sup>** at the following rates:

*Pepper only:* 0.5-0.6 pt. per acre. 0-day PHI.

*Tomato only:* 0.5-1 pt. per acre. 7-day PHI.

**Fulfill<sup>®</sup>** (50WDG) at 2.75 oz. per acre. 0-day PHI.

**Lannate LV<sup>®</sup>** (2.4 WSL) at 0.75-3 pts. per acre. 1-day PHI for tomato. 3-day PHI for pepper. 5-day PHI for eggplant. *RUP.*

**Malathion 5EC<sup>®</sup>** at 1.5 pts. per acre. 1-day PHI for tomato. 3-day PHI for pepper and eggplant.

**Movento<sup>®</sup>** (2SC) at 4-5 fl. oz. per acre. 1-day PHI.

 **M-Pede<sup>®</sup>** at 1-2% by volume. Must contact aphids to be effective. 0-day PHI.

**Orthene**® (97S) on *peppers only* at the following rates:

*Bell pepper*: 0.5-1 lb. per acre.

*Other peppers*: 0.5 lb. per acre.

7-day PHI.

**Platinum**® (75SG) at 1.66-3.67 oz. per acre applied to soil.  
30-day PHI.

**Sivanto Prime**® (1.67) at the following rates:

*Foliar applications*: 7-12 fl. oz. per acre. 1-day PHI.

*Soil applications*: 21-28 fl. oz. per acre. 45-day PHI.

**Vydate L**® (2WSL) at 2-4 pts. per acre. 7-day PHI for pepper.  
1-day PHI for eggplant. 3-day PHI for tomato. *RUP*.

### Colorado Potato Beetles

Practice crop rotation. Plant as far away as possible from last season's potato, tomato, or eggplant fields to reduce damage.

Regular (weekly) scouting will allow you to determine the need for insecticides and to improve application timing.

### Recommended Products

**Actara**® (25WDG) at 2-3 oz. per acre. 0-day PHI.

**Admire Pro**® (4.6F) at the following rates:

*Soil applications for eggplant*: 7-14 fl. oz. per acre. 21-day PHI.

*Soil applications for tomato*: 7-10.5 fl. oz. per acre. 21-day PHI. *Foliar applications*: 1.3-2.2 fl. oz. per acre. 7-day PHI.

**Agri-Mek 0.15EC**® at 8-16 fl. oz. per acre, or **Agri-Mek SC**® at 1.75-3.5 fl. oz. per acre. 7-day PHI. *RUP*.

**Ambush 2EC**® at 3.2-12.8 fl. oz. per acre. 3-day PHI for eggplant. 0-day PHI for tomato. *RUP*.

**Asana XL**® (0.66EC) at 5.8-9.6 fl. oz. per acre. 1-day PHI for tomato. 7-day PHI for eggplant. *RUP*.

**Assail**® (30SG) at 1.5-2.5 oz. per acre. 7-day PHI.

**Baythroid XL**® (1EC) at 1.6-2.8 fl. oz. per acre. 0-day PHI for tomato. 7-day PHI for eggplant. *RUP*.

**Brigade**® (2EC) at the following rates:

*Pepper and eggplant*: 2.1-6.4 fl. oz. per acre. 7-day PHI.

*Tomato*: 2.1-5.2 fl. oz. per acre. 1-day PHI.

*RUP*.

**Coragen**® (1.67SC) at 3.5-5 fl. oz. per acre. 1-day PHI.

 **Entrust**® (2SC) at 3-6 fl. oz. per acre. Observe resistance management restrictions. 1-day PHI.

**Exirel**® (0.83SE) at 7-13.5 fl. oz. per acre. 1-day PHI.

**Kryocide**® (96D) at 8-16 lbs. per acre for larvae control.  
*Tomato and eggplant only*. 14-day PHI.

**Mustang Maxx**® (0.8EC) at 2.24-4.0 fl. oz. per acre. 1-day PHI. *RUP*.

**Permethrin**® (3.2EC) at the following rates:

*Eggplant*: 6 fl. oz. per acre. 3-day PHI.

*Tomato*: 2-8 fl. oz. per acre. 0-day PHI.

*RUP*.

**Platinum**® (75SG) at 1.66-3.67 oz. per acre applied to soil.  
30-day PHI.

**Prokil Cryolite**® (50D) as a spray or dust at the following rates:

*Pepper*: 15-23 lbs. per acre.

*Tomato and eggplant*: 15-30.5 lbs. per acre.

14-day PHI.

**Prokil Cryolite 96**® (WP) at 8-12 lbs. per acre as a spray or dust. *Peppers only*. 14-day PHI.

**Radiant**® (1SC) at 5-10 fl. oz. per acre. 1-day PHI.

**Rimon**® (0.83EC) at 9-12 fl. oz. per acre for larvae control.  
1-day PHI.

**Sivanto Prime**® (1.67SL) at 10.5-14 fl. oz. per acre. 1-day PHI.

  **Trident**® (14.32% a.i.) at 3-6 qts. per acre for young larvae control. 0-day PHI.

**Venom**® (70SG) at 1-4 oz. per acre. 1-day PHI.

**Verimark**® (1.67SC) via drip chemigation or soil injection at 5-10 fl. oz. per acre. 1-day PHI.

**Vydate L**® (2WSL) at 2-4 pts. per acre. 3-day PHI for tomato. 1-day PHI for eggplant. *RUP*.

**Warrior II**® (2.08CS) at 1.28-1.92 fl. oz. per acre. 5-day PHI. *RUP*.

### Flea Beetles

#### Recommended Products

**Actara**® (25WDG) at 2-3 oz. per acre. Do not exceed 11 oz. per acre per season. 0-day PHI.

**Admire Pro**® (4.6F) for soil application at the following rates:

*Eggplant and tomato*: 7.0-10.5 fl. oz. per acre. Do not exceed 10.5 fl. oz. per acre per season.

*Pepper*: 7.0-14 fl. oz. per acre. Do not exceed 14 fl. oz. per acre per season.

21-day PHI.

**Ambush**® (2EC) at 6.4-12.8 fl. oz. per acre. *Pepper and eggplant only*. 3-day PHI. *RUP*.

**Asana XL**® (0.66EC) at 5.8-9.6 fl. oz. per acre. Do not apply more than 67.2 fl. oz. per acre per season. 1-day PHI for tomato. 7-day PHI for eggplant and pepper. *RUP*.

**Baythroid XL**® (1EC) at 2.8 fl. oz. per acre. Do not exceed 16.8 fl. oz. per acre per season. Allow 7 days between applications. 0-day PHI for tomato. 7-day PHI for eggplant and pepper. *RUP.*

**Brigade**® 2EC at the following rates:

*Pepper and eggplant:* 2.1-6.4 fl. oz. per acre. Do not exceed 12.8 fl. oz. per acre per season. 7-day PHI.

*Tomato:* 2.1-5.2 fl. oz. per acre. Do not exceed 25.6 fl. oz. per acre per season. 1-day PHI.

*RUP.*

**Mustang Maxx**® (0.8EC) at 2.24-4.0 fl. oz. per acre. Do not exceed 24 fl. oz. per acre per season. Allow 7 days between applications. 1-day PHI. *RUP.*

**Permethrin**® (3.2EC) at the following rates:

*Eggplant only:* 4-6 fl. oz. per acre.

*Bell pepper only:* 4-8 fl. oz. per acre.

3-day PHI. *RUP.*

**Platinum**® (75SG) at 1.66-3.67 oz. per acre. 30-day PHI.

**Sevin XLR PLUS**® (4F) at 0.5-1 qt. per acre. Do not exceed 8 qts. per acre per crop. 3-day PHI.

**Venom**® (70SG) at 1-4 oz. per acre as foliar spray (1-day PHI), or 5-7.5 oz. per acre as a soil application (21-day PHI).

**Warrior II**® (2.08CS) at 1.28-1.92 fl. oz. per acre. Do not exceed 23 fl. oz. per acre per season. 5-day PHI. *RUP.*

## **Mites (Spider Mites, Russet Mites, and Broad Mites)**

### **Recommended Products**

**Acramite**® (50WS) at 0.75-1 lb. per acre. *Spider mites only.* Do not exceed 1 application per season. 3-day PHI.

**Agri-Mek SC**® (0.7SC) at 1.75-3.5 fl. oz. per acre (do not exceed 48 fl. oz. per acre per season), or **Agri-Mek**® (0.15EC) at 8-16 fl. oz. per acre (do not exceed 10.25 fl. oz. per acre per year). 7-day PHI. *RUP.*

**Kanemite**® (15SC) at 31 fl. oz. per acre. *Spider mites only.* 1-day PHI.

**Movento**® (2SC) at 4-5 fl. oz. per acre. *Russet mites and broad mites only.* 1-day PHI.

**Nealta**® (1.67SC) at 13.7 fl. oz. per acre. *Spider mites on tomato only.* Do not exceed 27.4 fl. oz. per acre per crop. 3-day PHI.

**Oberon**® (2SC) at 7-8.5 fl. oz. per acre. Do not exceed 25.5 fl. oz. per acre per season. 1-day PHI.

**Portal XLO**® (0.4EC) at 2 pts. per acre. Do not exceed 2 applications per season. 1-day PHI.

**Vydate L**® (2L) at 2-4 pts. per acre. *Eggplant only.* 1-day PHI. *RUP.*

**Wettable sulfur** (84-95%) at 5-30 lbs. per acre. *For tomato only. For control of russet mite.* Sulfur as dust is also effective. Thorough coverage is required. Do not apply when temperatures are above 95°F or during a heavy dew.

**Zeal**® (72WSP) at 2-3 oz. per acre. *Spider mites only. Pepper and eggplant only.* Limit 1 application per season. 7-day PHI.

## **Cutworms, Hornworms, Fruitworms, Pinworms, European Corn Borers, and Loopers**

### **Recommended Products**

**Ambush**® (2EC) at 3.2-12.8 fl. oz. per acre. 3-day PHI for eggplant and pepper. 0-day PHI for tomato. *RUP.*

**Asana XL**® (0.66EC) at 2.9-9.6 fl. oz. per acre. *Not for European corn borer on pepper.* 1-day PHI for tomato. 7-day PHI for eggplant and pepper. *RUP.*

**Avant**® (30WDG) at 2.5-3.5 oz. per acre. *Not for cutworms.* Use higher rate for fruitworms and armyworms. *Can control European corn borer in bell pepper only.* Do not exceed 14 oz. per acre per season. 3-day PHI.

Various *Bacillus thuringiensis* products (Agree®, Biobit®, Crymax®, Deliver®, Dipel®, Javelin®, Xentari®). Follow label directions. *Not for cutworms or pinworms.* 0-day PHI.

**Baythroid XL**® (1EC) at 1.6-2.8 fl. oz. per acre. Do not exceed 16.8 fl. oz. per acre per season. Allow 7 days between applications. 0-day PHI for tomato. 7-day PHI for eggplant and pepper. *RUP.*

**Brigade**® (2EC) at the following rates:

*Pepper and eggplant:* 2.1-6.4 fl. oz. per acre. Do not exceed 12.8 fl. oz. per acre per season; 7-day PHI.

*Tomato:* 2.1-5.2 fl. oz. per acre. Do not exceed 25.6 fl. oz. per acre per season; 1-day PHI. *RUP.*

**Coragen**® (1.67SC) at 2.0-7.5 fl. oz. per acre. Coragen® can be applied as either a foliar application or via drip chemigation. Chemigation will provide up to 30 days control. Do not exceed 15.4 fl. oz. per acre per season. 1-day PHI.

**Danitol**® (2.4EC) at 10.67 fl. oz. per acre. *Not for cutworms or European corn borers.* Do not exceed 42.67 fl. oz. per acre per season. 3-day PHI. *RUP.*

**Diazinon AG500**® (4EC) at 2-4 qts. per acre. Apply to soil before planting. *Cutworms on tomato only.* Do not exceed 1 application per season. *RUP.*

 May be acceptable for use in certified organic production. Check with your certifier before use.

 This is a biopesticide. See page 37 for details.

 **Entrust®** (2SC) at 3-8 fl. oz. per acre. *Not for cutworms.* Do not exceed 29 fl. oz. per acre per season. Observe resistance management restrictions. 1-day PHI.

**Exirel®** (0.83SE) at 7-13.5 fl. oz. per acre. 1-day PHI.

**Intrepid®** (2F) at 4-16 oz. per acre. *Not for cutworms or pinworms.* Do not exceed 64 fl. oz. per acre per season. 1-day PHI.

**Lannate LV®** (2.4WSL) at 1.5-3 pts. per acre. 1-day PHI for tomato. 3-day PHI for pepper. 5-day PHI for eggplant. *RUP.*

**Mustang Maxx®** (0.8EC) at 2.24-4.0 fl. oz. per acre. Do not exceed 24 fl. oz. per acre per season. Allow 7 days between applications. 1-day PHI. *RUP.*

**Orthene®** (97S) at 0.75-1 lb. per acre. *Bell pepper only.* 7-day PHI.

**Permethrin®** (3.2EC) at the following rates:

*Eggplant:* 4-6 fl. oz. per acre. Do not exceed 24 fl. oz. per acre per season. 3-day PHI.

*Pepper:* 4-8 fl. oz. per acre. Do not exceed 32 fl. oz. per acre per season. 3-day PHI.

*Tomato:* 2-8 fl. oz. per acre. Do not exceed 24 fl. oz. per acre per season. 0-day PHI.

*RUP.*

**Radiant SC®** (1SC) at 5-10 fl. oz. per acre. *Not for cutworms.* Do not exceed 34 fl. oz. per acre per season. 1-day PHI.

**Rimon®** (0.83EC) at 9-12 fl. oz. per acre. 1-day PHI.

**Sevin XLR PLUS®** (4F) at 1-2 qts. per acre. Do not exceed 8 qts. per acre per season. 3-day PHI.

**Verimark®** (1.67SC) via drip chemigation or soil injection at 5-10 fl. oz. per acre. Use maximum rate for European corn borer. 1-day PHI.

**Warrior II®** (1.08CS) at 0.96-1.92 fl. oz. per acre. Do not exceed 23 fl. oz. per acre per season. 5-day PHI. *RUP.*

## **Stink Bugs (including Marmorated Stink Bug)**

### **Recommended Products**

**Actara®** (25WDG) at 3-5.5 oz. per acre. 0-day PHI.

 **Azera®** at 1-3.5 pts. per acre. 0-day PHI.

**Baythroid XL®** (1EC) at 1.6-2.8 fl. oz. per acre. Do not exceed 16.8 fl. oz. per acre per season. Allow 7 days between applications. 0-day PHI for tomato. 7-day PHI for pepper and eggplant. *RUP.*

**Brigade®** (2EC) at the following rates:

*Pepper and eggplant:* 2.1-6.4 fl. oz. per acre. Do not exceed 12.8 fl. oz. per acre per season. 7-day PHI.

*Tomato:* 2.1-5.2 fl. oz. per acre. Do not exceed 25.6 fl. oz. per acre per season; 1-day PHI.

*RUP.*

**Danitol®** (2.4EC) at 10.67 fl. oz. per acre. Do not exceed 42.67 fl. oz. per acre per season. 3-day PHI. *RUP.*

**Lannate LV®** at 1.5-3 pts. per acre. *Pepper and tomato only.* 3-day PHI for pepper. 1-day PHI for tomato. *RUP.*

**Mustang Maxx®** (0.8EC) at 3.2-4.0 fl. oz. per acre. Do not exceed 24 fl. oz. per acre per season. Allow 7 days between applications. 1-day PHI. *RUP.*

**Venom®** (70SG) at 1-4 oz. per acre. 1-day PHI.

**Warrior II®** (2.08CS) at 1.28-1.92 fl. oz. per acre. Do not exceed 23 fl. oz. per acre per season. 5-day PHI. *RUP.*

## **Thrips**

Regular (weekly) scouting will allow you to determine the need for insecticides and to improve timing of applications. Thorough coverage of all plant parts, especially leaf undersides, is important to maximize efficacy of insecticide applications. Always rotate insecticides with different modes of action to mitigate the potential for thrips populations to develop resistance. Thrips are more likely to become a problem in greenhouse or high tunnel situations. Thrips may transmit tomato spotted wilt virus and/or impatiens necrotic spot virus; see page 149 in disease section.

### **Recommended Products**

**Admire Pro®** (imidacloprid) at 7-14 fl. oz. per acre (soil application). 21-day PHI.

**Agri-Mek SC® (abamectin)** at 1.75-3.5 fl. oz. per acre (foliar application). 7-day PHI for field-grown tomatoes and 1-day PHI for commercially-grown greenhouse tomatoes.

**Assail 70WP® (acetamiprid)** at 0.075 lbs. per acre or 1.7 fl. oz. per acre (foliar application). 7-day PHI.

**Aza-Direct® (azadirachtin)** at 1-2 pts. per acre (foliar application). 0-day PHI.

**Azera® (azadirachtin + pyrethrins)** at 2-3.5 pts. per acre (foliar application). 0-day PHI.

**Baythroid XL® (β-cyfluthrin)** at 2.1-2.8 fl. oz. per acre (foliar application). 0-day PHI.

**Brigade 2EC® (bifenthrin)** at 2.1-5.2 fl. oz. per acre (foliar application). 1-day PHI.

**Closer® (sulfoxaflor)** at 4.25-4.50 fl. oz. per acre (foliar application). 1-day PHI.

**Entrust® (spinosad)** at 1.25-2.5 oz. per acre (foliar application). 1-day PHI. Can be used in organic production systems.

- Exirel® (cyantraniliprole)** at 13.5-20.5 fl. oz. per acre (foliar application). 1-day PHI.
- Grandevo® (*Chromobacterium subsugae* strain PRAA4-1)** at 2-3 lbs. per acre (foliar application). 0-day PHI.
- Minecto Pro® (cyantraniliprole + abamectin)** at 10.0 fl. oz. per acre (foliar application). 1-day PHI.
- Movento® (spirotetramat)** at 4-5 fl. oz. per acre (foliar application). 1-day PHI.
- M-Pede® (potassium salts of fatty acids)** at 1-2% by volume (foliar application). 0-day PHI.
- Mustang MAXX® (zeta-cypermethrin)** at 3.2-4.0 fl. oz. (foliar application). 1-day PHI.
- Platinum® (thiamethoxam)** at 5-11 fl. oz. per acre (foliar application). 30-day PHI.
- Radiant® (spinetoram)** at 6-10 fl. oz. per acre (foliar application). 1-day PHI.
- Rimont 0.83EC® (novaluron)** at 12.0 fl. oz. per acre (foliar application). 1-day PHI.
- Venerate® (heat-killing *Burkholderia* spp. strain A396)** at 1-8 qts. per acre (foliar application). 0-day PHI.
- Venom® (dinotefuran)** at 1-4 oz. per acre (foliar application) and 5-7.5 oz. per acre (soil application). 1-day PHI (foliar application) and 21-day PHI (soil application).
- Warrior II® (lambda-cyhalothrin)** at 1.28-1.92 fl. oz. per acre (foliar application). 5-day PHI. Not for use against western flower thrips.

## Whiteflies

### Recommended Products

- Actara® (25WDG)** at 3.0-5.5 oz. per acre. Do not exceed 11.0 oz. per acre per season. 0-day PHI.
- Admire Pro® (4.6F)** at the following rates:
- Soil-applied to pepper:* 7.0-14 fl. oz. per acre. Do not exceed 14 fl. oz. per acre per season.
  - Soil-applied to eggplant and tomato:* 7.0-10.5 fl. oz. per acre. Do not exceed 5 fl. oz. per acre per season.
  - Foliar applications:* 1.3-2.2 fl. oz. per acre.
- 21-day PHI for soil applications. 0-day PHI for foliar applications.
- Asana XL® (0.66EC)** at 5.8-9.6 fl. oz. per acre. *Not for eggplant or pepper.* Do not apply more than 67.2 fl. oz. per acre per season. 1-day PHI for tomato. RUP.
- Assail® (30SG)** at 2.5-4 oz. per acre. Do not exceed 4 applications per season. 7-day PHI.

**Brigade® (2EC)** at the following rates:

- Pepper and eggplant:* 2.1-6.4 fl. oz. per acre. Do not exceed 12.8 fl. oz. per acre per season. 7-day PHI.
  - Tomato:* 2.1-5.2 fl. oz. per acre. Do not exceed 25.6 fl. oz. per acre per season. 1-day PHI.
- RUP.

- Closer SC® (2SC)** at 4.25-4.5 fl. oz. per acre. 1-day PHI.
- Coragen® (1.67SC)** at 5.0-7.5 fl. oz. per acre. Can be applied as a foliar application or via drip chemigation. Chemigation will provide up to 30 days control. Do not exceed 15.4 fl. oz. per acre per season. 1-day PHI.
- Exirel® (0.83SE)** at 13.5-20.5 fl. oz. per acre. 1-day PHI.
- Knack® (0.86EC)** at 8-10 fl. oz. per acre. Do not exceed 2 applications per acre per season. 1-day PHI.
- Movento® (2SC)** at 4-5 fl. oz. per acre. 1-day PHI.
-  **M-Pede®** at 1-2% by volume. Must contact whiteflies to be effective. 0-day PHI.
-  **Neemix 4.5®** at 4-16 fl. oz. per acre. For larvae and nymph control. 0-day PHI.
- Oberon® (2SC)** at 7-8.5 fl. oz. per acre. Do not exceed 25.5 fl. oz. per acre per season. 1-day PHI.
- Platinum® (75SG)** at 1.66-3.67 oz. per acre applied to soil. No more than 1 application per season. 30-day PHI.
- Portal XLO® (0.4EC)** at 2 pts. per acre. 1-day PHI.
- Sivanto Prime® (1.67)** at the following rates:
- Foliar applications:* 10.5-14 fl. oz. per acre. 1-day PHI.
  - Soil applications:* 21-28 fl. oz. per acre. 45-day PHI.
- Venom® (70SG)** at the following rates:
- Foliar applications:* 1-4 oz. per acre. 1-day PHI.
  - Soil applications:* 5-7.5 oz. per acre. 21-day PHI.
- Verimark® (1.67SC)** via drip chemigation or soil injection at 6.75-13.5 fl. oz. per acre. 1-day PHI.

## Fruit Flies and Vinegar Flies (*Drosophila* spp.)

Starting 2 weeks before harvest, place bait fruits in fields in late afternoon, and examine next morning. If half of the baits show eggs, spray fields immediately at 4-6 day intervals with Malathion® 57% at 2.5 pts. per acre (1-day PHI). Treat harvested fruit and hampers as soon as filled with a dust containing 0.1% stabilized pyrethrins plus 1.0% piperonyl butoxide (such as Evergreen Pro 60-6®), and move hampers to processing plant as soon as possible.

 May be acceptable for use in certified organic production. Check with your certifier before use.