Root Crops

(Beets, Carrots, Parsnips, Radishes, Turnips)

Planting and Culture

Beets. Plant in rows 18 to 24 inches apart and ½ inch deep. Seed 8 to 10 pounds per acre for bunching. Seed will germinate between 40° and 85°F. Optimum temperature is 65° to 75°F. Color and quality are best when the plant develops during cool temperatures (50° to 60°F, see Appendix J). The sugar content of beets will be lower when grown in warm weather, and they will have a lighter color. Hot weather produces white bands in the roots. Beets are sensitive to soil acidity and should be grown at a pH between 6.2 and 7.0.

Carrots. Plant in rows 18 to 24 inches apart and ¼ to ½ inch deep. Seed 2 to 4 pounds per acre. Seed are often variable in germination and emergence, resulting in non-uniform stands. Seed germinate slowly, and it is necessary to maintain adequate moisture. Select deep, sandy loam soils for best results. Carrots generally are misshapen when grown on heavy or rocky soils. Prepare soil deeply. Use low raised beds.

Parsnips. Plant in rows 18 to 24 inches apart and ¼ to ½ inch deep. Seed 2 to 3 pounds per acre. Prepare soil similarly to that for carrots. Always use new seed, because germination of seed 1 year or older is poor.

Radishes. Plant seed in rows 15 inches apart and ¼ to ½ inch deep. Plant 12 to 15 seed per foot of row. Seed 10 to 15 pounds per acre. Seed germinate in three to four days at a soil temperature of 65°F or above. Best quality and shape of roots are attained when the crop grows and matures at 50° to 65°F.

Turnips. Plant seed in rows 14 to 18 inches apart with seed 2 to 3 inches apart in the rows and ¼ to ½ inch deep. Plant 1 to 2 pounds of seed per acre. Best quality and yields are obtained under moderately cool temperatures. See also the "Greens" chapter.

Fertilizing

The soil pH should be between 6.0 and 6.8. Boron may become a limiting element for root crops. Apply Borax at the rate of 20 pounds per acre (2 pounds actual Boron) if necessary as indicated by soil test results.

Carrots tend to develop forked roots on heavy or rocky soils.

Harvesting

All root crops should be harvested when mature but before they become woody and tough. Wash roots carefully and package according to market requirements. Store at 32°F and 90 to 95 percent relative humidity.

VARIETIES: *Root Crops*

Variety	Days to Maturity	Comments
BEETS[1]		
Solo (hybrid)	49	Excellent appearance and taste of cooked and raw roots and cooked greens, uniform shape and size, monogerm.
Red Ace (hybrid)	53	Early maturing, attractive, very smooth skin, excellent quality roots and greens, very sweet, heat resistant.
Kestrel (hybrid)	53	Excellent appearance and taste of cooked and raw roots and cooked greens, uniform size and shape.
Red Cloud (hybrid)	53	Excellent appearance and sweet taste raw, good roasted taste, excellent cooked greens.
Red Titan (hybrid)	52-54	Excellent appearance and taste of cooked and raw roots, uniform shape and size.
Merlin (hybrid)	55	Excellent appearance and taste of cooked and raw roots and cooked greens, uniform size and shape, lower Cercospora leaf spot incidence.
Chioggia	55	Attractive red and white zoned interior.
Excalibur	60	Excellent appearance and taste of cooked and raw roots and cooked greens.
Ruby Queen	60	Attractive, excellent quality, very sweet, excellent for processing.
Touchstone Gold	60	Specialty gold fleshed beet, excellent flavor, lower germination percentage, low Cercospora leaf spot incidence.
Taunus	65	Very uniform smooth skinned, attractive long cylindrical beet for slicing, excellent flavor cooked, easy cleaning, low Cercospora leaf spot incidence.
CARROTS[2]		
Choctaw (hybrid)	55	Early, Imperator hybrid, with a deep orange interior.
Nelson (hybrid)	56	Early, Nantes type, very sweet, good for smaller 4 to 6 inch carrots
Navajo (hybrid)	57	Imperator hybrid, widely adapted and uniform.
Sugarsnax (hybrid)	68	Mid-season, Imperator hybrid, with a deep orange interior.
Purple Haze	73	Purple exterior, orange interior, Imperator hybrid good for markets, AAS winner.
PARSNIPS[3]		
Lancer (hybrid)	110	Slim, smooth roots, high quality (for trial).
Harris Model	120	Smooth, white roots.
RADISHES[4]		
Small round types		
Cherry Belle	24	-
Scarlet Globe	24	-
Oriental Radishes		
Fancy Free Altari	30-35	Small; short thin top with bulbous base; tender, fall crop.
Minowase Summer Cross	50	Long white daikon, mild flavor, juicy and tender, fusarium resistant, stands heat, fall crop.
April Cross	60	Long white daikon, slow to bolt.
Misato Rose Flesh or Red Meat	60	Round, 4 inches in diameter, white with light green shoulders and a dark pink interior; very tender, pungent skin, mild and sweet interior, excellent for eating fresh, garnishing, and pickling. Fall production only, plant in August or September.
Tae-Baek	70	Short white barrel-shaped roots with a green shoulder, somewhat pungent, for heavier soils, highly disease tolerant, fall crop.
TURNIPS[5]		
Hakurei (hybrid)	38	Early, all white, best harvested young (2 inch diameter).
Purple Crown	45-50	Smooth, purple topped, globe shaped roots, mild flavor.
Just Right	50-70	All white roots, moderate turnip flavor, excellent tasting greens.

[1] (Chenopodiaceae) goosefoot family: Beta vulgaris Crassa group.
[2] (Apiaceae) carrot family: Daucus carota var. sativa.
[3] Pastinaca sativa.
[4] (Brassicaceae) mustard family: Raphanus sativus.
[5] Brassica rapa Rapifera group.

Common Diseases/Management

Most of the crops covered in this section are not related botanically, and they have few diseases in common. However, fungicide labels often include these minor-use crops as a group or exempt certain crops from the group because they pose similar residue issues, so read labels carefully. See the "Greens" chapter for turnip diseases. For all of these crops, use well-shaped raised beds in sites with good air and soil drainage.

FERTILIZER: *Root Crops*

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-180
Medium	31-60	61-120
High	61-80	1-60
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	101-150
Medium	201-300	51-100
High	301-450	1-50
Very High	>450	0
Nitrogen		**N**
Apply 50 lb of actual nitrogen (N)/A. Broadcast all fertilizer and disk into soil thoroughly before seeding.		

Beets

Damping-off and seed rot. Sow seed in a well-prepared seed bed—raised beds will improve disease control. Purchase seed treated with thiram or dust with 1 level teaspoon per pound of seed. For damping-off diseases caused by *Pythium* and *Phytophthora*, apply a fungicide at planting.

Leaf spots, blights, and rust. Rotate to grasses for three to four years between beet crops. For leaf spots/blights and rust, apply fungicides weekly. Ensure good air movement by keeping tall plants away from beets.

Carrots/Parsnips

Damping-off, seed rot, and root rots. Use fungicide-treated seed or treat seed with Captan WP at 1 teaspoon per pound of seed, then plant into well-drained, well-prepared, raised beds. Apply fungicides to the soil at 0.5 to 1 pound per treated acre for control of *Pythium* diseases (damping-off, forking, cavity spot), and those caused by Rhizoctonia.

Leaf spots and blights. Practice rotation to unrelated crops for two or more years. Spray fixed copper if bacterial blight is involved as part of the complex. If bacterial blight is not involved, apply fungicides at regular intervals. Varieties resistant to some leaf diseases are available.

White mold and southern blight. Long-term crop rotation to corn or grasses for three to four years, deep plowing to bury sclerotia, and pre-emergence weed control are key preventive practices. Soil-applied fungicides can also help suppress southern blight.

Root-knot nematodes. Practice crop rotation to fescue for two years prior to carrots. Avoid fields with high populations of root-knot nematodes. If these fields must be used, preplant fumigation can be helpful (see "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 16).

Aster yellows. Adult leafhoppers are the overwintering host and vector of the aster yellows pathogen. Control leafhoppers by using a recommended insecticide early in the season.

Radish

Black rot. This bacterial disease is seedborne and best controlled by using hot-water seed treatment. See "Vegetable Seed Treatments" in Appendix F. Avoid cole crops in the rotation.

Damping-off. Use Captan 50 WP at 1 teaspoon per pound of seed, or buy fungicide-treated seed. Fungicides are effective when applied to soil before planting.

Leaf spots, downy mildew, white rust. Take steps to ensure good air movement, such as using an open row spacing and avoiding taller plants nearby. A number of fungicide products can be used to manage foliar diseases.

PESTICIDE SAFETY: *Root Crops*

	Signal[1]	Re-entry (hrs)	Harvest (days)				
			Beets	Carrots	Parsnips	Radishes	Turnips
INSECTICIDES							
Actara 25 WDG	C	12	7	7	7	7	7
Admire Pro	C	12	7/21[2]	7/21[2]	7/21[2]	7/21[2]	7/21[2]
Beleaf 50 SG	C	12	3	3	3	3	3
Blackhawk 36 WG	C	4	3	3	3	3	3
Coragen 1.67 SC	-	4	1	1	1	1	1
Intrepid 2 F	C	12	1	1	1	1	1
Knack 0.83 EC	C	12	3	3	3	3	3
Lorsban 75 WG	W	24	-	-	-	AP	30
Lorsban 4 E	W	24	-	-	-	AP	30
Lorsban 15 G	C	12	-	-	-	7	14
Malathion 8	C	12	7	7	7	7	-
Platinum 2 SC	C	12	AP	AP	AP	AP	AP
Radiant SC	C	4	7	3	3	3	3
Sevin XLR	W	12	7	7	7	7	7
Sivanto 1.67 SL	C	12	7	7	7	7	7
Transform 50 WG	DP	24	7	7	7	7	7
Restricted Use							
Asana XL	W	12	-	7	-	7	-
Battalion 1.5 EC	DP	12	3	3	3	3	3
Baythroid XL	W	12	0	0	0	0	0
Brigade 2 EC	W	12	1	21	21	21	21
Diazinon AG500	C	24	14	14	-	14	-
Diazinon 50 W	C	24	3	3	-	3	-
Hero 1.24 EC	C	12	21	21	21	21	21
Lannate 90 SP	DP	48	0/10[2]	1	-	-	-
Leverage 2.7	W	12	7	7	7	7	-
Mustang Max	W	12	1	1	1	1	1
Renounce 20 WP	C	12	0	0	0	0	0

- Indicates crop does not appear on label.
[1] *W: Warning, C: Caution, D: Danger; P: Poison.*
[2] *PHI depends on the method of application.*

PESTICIDE SAFETY: *Root Crops*

	Signal[1]	Re-entry (hrs)	Harvest (days)
FUNGICIDES			
Beets			
Cabrio EG	C	12	0
Fixed coppers[2]	D	12/24	1
Fontelis	C	12	0
Gem	C	12	7
Meta Star 2EC AG	W	48	0
Presidio	C	12	7
Quadris	C	4	0
Ridomil Gold SL	C	48	0
Reason 500 SC	C	12	14
Sulfur[2]	C	24	0
Switch 62.5WG	C	12	7
Tebuconazole[2]	C	12	7
Ultra Flourish	W	48	0
Carrots			
Cabrio EG	C	12	0
Chlorothalonil[2]	D	12	0
Fixed coppers[2]	D	12/24	0
Endura	W	12	0
Fontelis	C	12	0
Gem	C	12	7
Iprodione 4L AG	C	24	0
Meta Star 2EC AG	W	48	0
Meteor	C	24	0
Nevado	C	24	0
Omega	W	48	7
Presidio	C	12	7
Pristine	C	12	0
Propiconazole[2]	W	12	14
Quadris	C	4	0
Quadris Opti	W	12	0
Quadris Top	C	12	7
Quilt	C	12	14

PESTICIDE SAFETY: *Root Crops*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Quilt Xcel	W	12	14
Ridomil Gold Bravo SC	W	48	7
Ridomil Gold Copper	D	48	7
Ridomil Gold SL	C	48	0
Rovral 4 Flowable	C	24	0
Sulfur[2]	C	24	0
Switch 62.5WG	C	12	7
Ultra Flourish	W	48	0
Parsnips			
Cabrio EG	C	12	0
Chlorothalonil[2]	D	12	10
Fontelis	C	12	0
Gem	C	12	7
Meta Star 2EC AG	W	48	0
Presidio	C	12	7
Quadris	C	4	0
Ridomil Gold SL	C	48	0
Switch 62.5WG	C	12	7
Ultra Flourish	W	48	0
Radish			
Cabrio EG	C	12	0
Fontelis	C	12	0
Gem	C	12	7
Meta Star 2EC AG	W	48	0
Presidio	C	12	7
Quadris	C	4	0
Reason 500 SC	C	12	14
Ridomil Gold Copper	D	48	7
Ridomil Gold SL	C	48	0
Switch 62.5WG	C	12	7
Ultra Flourish	W	48	0

[1] *W: Warning, C: Caution, D: Danger; P: Poison*
[2] *Several formulations are marketed. See the general introduction for more details on fungicides.*

INSECT CONTROL: *Root Crops*[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Aphids			
Actara 25 WDG	1.5 to 3 oz	8 oz	Allow 7 days between applications.
Admire Pro	1.2 fl oz	3.7 fl oz	Allow 5 days between applications.
Malathion 8	2 pt	3 applications	Allow 7 days between applications.
Tranform 50 WG	0.75 to 1.5 oz	8.5 oz	Allow 7 days between applications.
Sivanto 1.67 SL	7 to 10.5 fl oz	28 fl oz	Allow 10 days between applications.
Armyworms			
Coragen 1.67 SC	3.5 to 5 fl oz	15.4 fl oz	Allow 3 days between applications.
Intrepid 2 F	4 to 10 fl oz	64 fl oz	Allow 14 days between applications.
Lannate 90 SP	0.5 to 1 lb	4 lb	-
Cutworms			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Battalion 1.5 EC	1 to 2.4 fl oz	12 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	14 fl oz	Allow 7 days between applications.
Brigade 2 EC	5.12 to 6.4 fl oz	25.6 fl oz	Allow 7 days between applications.
Mustang Max	1.24 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Flea Beetles			
Actara 25 WDG	1.5 to 3 oz	8 oz	Allow 7 days between applications.
Admire Pro	1.2 fl oz	3.7 fl oz	Allow 5 days between applications.
Asana XL	5.8 to 9.6 fl oz	9.2 fl oz	Radishes only.
Battalion 1.5 EC	1.5 to 2.4 fl oz	12 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	14 fl oz	Allow 7 days between applications.
Blackhawk 36WG	1.7 to 3.3 oz	14.4 oz	Allow 7 days between applications.
Brigade 2 EC	5.12 to 6.4 fl oz	25.6 fl oz	Allow 7 days between applications.
Mustang Max	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sevin XLR	0.5 to 1 qt	6 qt	Limit 6 applications. Allow 7 days between sprays.
Leafhoppers: Treat fields and field margins to control these disease vectors. Beginning when plants are 3 inches tall.			
Actara 25 WDG	1.5 to 3 oz	8 oz	Allow 7 days between applications.
Admire Pro	1.2 fl oz	3.7 fl oz	Allow 5 days between applications.
Battalion 1.5 EC	1.5 to 2.4 fl oz	12 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	28 fl oz	-
Lannate 90 SP	0.5 to 1 lb	7 lb	-
Mustang Max	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sevin XLR	0.5 to 1 qt	6 qt	Allow 7 days between sprays. Limit 6 qt/A.
Sivanto 1.67 SL	7 to 10.5 fl oz	28 fl oz	Allow 10 days between applications.
Tranform 50 WG	1.5 to 2.25 oz	8.5 oz	Allow 7 days between applications.
Stink Bugs, Plant Bugs			
Mustang Max	3.2 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sevin XLR	1 to 2 qt	6 qt	Limit 6 applications. Allow 7 days between sprays.
Tranform 50 WG	0.75 to 1.5 oz	8.5 oz	Allow 7 days between applications.
Crickets, Sowbugs			
Baythroid XL	1.6 to 2.8 fl oz	14 fl oz	Allow 7 days between applications.
Root Maggots			
Lorsban 15 G	3.3 oz/ 1,000 row-feet	-	Furrow application at planting.
Lorsban 4 E	1 oz/ 1,000 row-feet	-	Use at least 40 gallons per acre.

[1] *Generic products available (Appendix E).*

WEED CONTROL: *Root Crops*

Product Amt/A	Lb A.I./A	Comments
0.5-1.6 fl oz Aim 1.9 EW	0.008-0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
6-14 lb Dacthal W-75	4.5-10.5 DCPA	Radish only. For pre-emergence control of annual grasses and small-seeded broadleaves. For radish apply at seeding or up to 3-leaf stage. Soil should be clean-cultivated before application. Apply in 20 to 30 gal water/A. PHI = 25 days.
1pt Fusilade-DX 2E	0.25 fluazifop-p	Carrot only. For selective post-emergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 45 days. Max. rate is 48 fl oz/A.
2-4 pt Gramoxone Inteon	0.67-1.35 paraquat salt	Carrot only. For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
1.5-3 lb Lorox 50 DF	0.75-1.5 linuron	Carrot and parsnip only. For control of annual grasses and broadleaf weeds. Apply post-emergence as a non-directed spray to carrots > 3 inches tall. Apply before annual grasses exceed 2 inches high and before broadleaves exceed 6 inches high. Check label regarding varietal tolerance. Do not apply when temperature is above 85°F. PHI = 14 days.
0.5-2.5 pt Poast	0.09-0.49 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 60 days. Max. rate of 2.5 pt/application and 5 pt/season.
2.0 pt Prowl H2O	0.95 pendimethalin	Carrot only. For pre-emergent control of most annual grasses and some broadleaf weeds. Apply as a broadcast application as a post plant treatment prior to crop and weed emergence. May be applied at layby at 2.0 pt/A as a directed spray between rows. Do not allow to come in contact with plants or severe injury will result. PHI = 60 days.

(continued on next page)

WEED CONTROL: *Root Crops (continued)*

Product Amt/A	Lb A.I./A	Comments
16-22 fl oz Roundup Weather-Max 5.5L	0.69-0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
9-16 fl oz Select Max	0.07-0.12 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 16 fl oz/application. Min. 14 days between applications. PHI = 30 days.
1.25-2 pt Treflan HFP 4 E	0.6-1 trifluralin	Carrot and radish only. For control of annual grasses and broadleaf weeds. Apply and incorporate in spring before planting.
0.3 lb TriCor 75 DF	0.2 metribuzin	Carrot only. For control of annual grasses and broadleaf weeds. Apply broadcast over the tops to plants with 5-6 true leaves but before weeds are 1 inch tall. A second application can be made 3 weeks later. Do not apply within 3 days of stress conditions such as cool, wet and cloudy weather or hot days or after any other chemical to avoid injury. PHI = 60 days.

DISEASE CONTROL: *Root Crops*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
BEETS, RADISH, TURNIPS, PARSNIPS					
Damping-off (Pythium)					
MetaStar 2EC AG	4	0	4 to 8 pt	1 app	Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil mechanically (preplant) or with irrigation (pre- and at-planting) if rainfall is not expected within 24 hours of treatment. Will control white rust on radish.
Ridomil Gold SL	4	0	1 to 2 pt		
Ultra Flourish	4	0	2 to 4 pt		
Presidio	43	7	3 to 4 fl oz	12 fl oz	Can be applied as a drench or through drip irrigation at planting; soil-directed applications can be made during the season.
Downy Mildew					
Chlorothalonil[4]					Parsnip only. Apply before disease onset; continue every 7 to 10 days.
Bravo Ultrex	M	0	1.4 to 1.8 lb	7.3 lb	
Bravo WeatherStik	M	0	1.5 to 2 pt	8 pt	
Fixed coppers					Beets only. Apply every 7 to 10 days when conditions favor disease. See label for mixing instructions and tank-mix precautions.
Basic Copper 53	M	0	2 to 4 lb		OMRI-listed.
C-O-C-S WDG	M	0	3 to 4 lb		-
COC DF	M	0	2 to 4 lb		-
COC WP	M	0	2 to 4 lb		OMRI-listed.
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Kentan DF	M	0	2 to 3.27 lb		-
Nordox 75 WG	M	0	0.66 to 2 lb		OMRI-listed.
Nu-Cop 50 DF	M	0	1 to 2 lb		OMRI-listed.
Leaf Spots (Alternaria, Anthracnose, Cercospora), Rust, White Rust					
Azoxystrobin[4]					Apply before disease onset, continue every 7 to 14 days.
Azoxy 2SC	11	0	6 to 15.5 fl oz[4]	4 apps	
AzoxyStar	11	0	6 to 15.5 fl oz[4]	4 apps	
Quadris	11	0	6 to 15.5 fl oz[4]	4 apps	
Satori	11	0	6 to 15.5 fl oz[4]	4 apps	
Cabrio	11	0	8 to 16 oz	3 apps	Apply before disease onset, continue every 7 to 14 days.
Chlorothalonil[4]					Parsnip only. Apply before disease onset; continue every 7 to 10 days.
Bravo Ultrex	M	0	1.4 to 1.8 lb	7.3 lb	
Bravo WeatherStik	M	0	1.5 to 2 pt	8 pt	
Fixed coppers					Beets only. For control of Cercospora leaf spot, apply every 7 to 10 days after seeding/transplanting or when conditions favor disease. See label for mixing instructions and tank-mix precautions.
Badge SC	M	0	1 to 4 pt		-
Badge X2	M	0	0.75 to 2 lb		OMRI-listed.
Basic Copper 53	M	0	2 to 4 lb		OMRI-listed.
C-O-C-S WDG	M	0	3 to 4 lb		-
Champ DP	M	0	1.33 to 2.67 lb		-
Champ Formula 2 FL	M	0	1.33 to 2.67 pt		-
Champ WG	M	0	2 to 5 lb		OMRI-listed.
COC DF	M	0	2 to 4 lb		-
COC WP	M	0	2 to 4 lb		OMRI-listed.
Copper-Count-N	M	0	3 to 6 pt lb		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 3 lb		-
Kentan DF	M	0	2 to 3.27 lb		-
Kocide 2000	M	0	1.5 to 3.75 lb		-
Kocide 3000	M	0	0.75 to 2 lb		-
Kocide DF	M	0	2 to 5 lb		-
Mastercop	M	0	0.5 to 1.5 pt		-
Nordox 75 WG	M	0	0.66 to 2 lb		OMRI-listed.
Nu-Cop 50 WP	M	0	2 to 5 lb		OMRI-listed.
Nu-Cop 3 L	M	0	1.33 to 6.66 pt		-
Nu-Cop 50 DF	M	0	2 to 5 lb		OMRI-listed.
Nu-Cop 50 HB	M	0	1 to 2.5 lb		-
Fontelis	7	0	16 to 30 fl oz	61 fl oz	Apply before disease onset, continue every 7 to 14 days.
Gem 500SC	11	7	1.9 to 2.9 fl oz	4 apps	Apply before disease onset, continue every 14 days.

(continued on next page)

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Reason 500 SC	11	14	8.2 fl oz	24.6 fl oz	Not for radish. For Alternaria leaf spot, apply before disease onset, continue every 14 days.
Ridomil Gold Copper	4/M	0	2 lb	4 apps	Radish only. For control of white rust, apply 45 to 50 days after preplant application of Ridomil Gold EC or Ultra Flourish. Make up to three additional applications every 14 days.
Sulfur[4]	M				Beets only. Apply every 14 to 30 days, beginning when symptoms are first observed or when conditions favor disease. Phytotoxicity may occur when sulfur is applied when temperatures exceed 90°F.
Switch 62.5WG	9/12	7	11 to 14 oz	56 oz	For Alternaria, apply every 7 to 10 days. Make only two applications on radish.
Tebuconazole[4]		7			Beet and turnip only. Apply preventively for control of Cercospora. Use lowest listed rate of surfactant to improve coverage.
CARROTS					
Damping-off, Seed Rot, Root Rots, Southern Blight					
Azoxystrobin[4]					Post-emergence. Apply broadcast in a 7-inch band with spray directed at lower stems and surrounding soil. In-furrow. Apply in 5 to 15 gal/A, with nozzle directed to spray in-furrow just before seed are covered. In-furrow treatment does not count as a foliar application.
Azoxy 2SC	11	0	0.4 to 0.8 fl oz[3]	4 foliar apps	
AzoxyStar	11	0	0.4 to 0.8 fl oz[3]	4 foliar apps	
Quadris	11	0	0.4 to 0.8 fl oz[3]	4 foliar apps	
Satori	11	0	0.4 to 0.8 fl oz[3]	4 foliar apps	
			0.4 to 0.7 fl oz[3]	1 app	
Presidio	43	7	4 fl oz	12 fl oz	*Pythium* diseases. Can be applied in-furrow or side-dressed after emergence.
MetaStar 2EC AG	4	7	4 to 8 pt	1 app	*Pythium* diseases only. Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil mechanically (preplant) or with irrigation (pre- and at-planting) if rainfall is not expected within 24 hours of treatment.
Ridomil Gold SL	4	0	1 to 2 pt		
Ultra Flourish	4	7	2 to 4 pt		
Ridomil Gold Bravo SC	4/M	7	1.5 to 2.5 pt	4 apps	*Pythium* diseases only. Apply 45 to 50 days after preplant application of Ridomil Gold EC or Ultra Flourish. Make up to three additional applications every 14 days. Observe seasonal limits for chlorothalonil.
Ridomil Gold Copper	4/M	7	2 lb		*Pythium* diseases only. Apply 45 to 50 days after preplant application of Ridomil Gold EC or Ultra Flourish. Make up to three additional applications every 14 days.
Foliar Diseases (Alternaria, Cercospora Leaf Spots, Leaf Blights)					
Azoxystrobin[4]					Apply before disease onset, continue every 7 to 14 days.
Azoxy 2SC	11	0	6 to 15.5 fl oz[4]	4 apps	
AzoxyStar	11	0	6 to 15.5 fl oz[4]	4 apps	
Quadris	11	0	6 to 15.5 fl oz[4]	4 apps	
Satori	11	0	6 to 15.5 fl oz[4]	4 apps	
Cabrio	11	0	8 to 12 oz	3 apps	Apply before disease onset, continue every 7 to 14 days.
Chlorothalonil[4]					Apply before disease onset; continue every 7 to 10 days as needed.
Bravo Ultrex	M	0	1.4 to 1.8 lb	18.2 lb	
Bravo WeatherStik	M	0	1.5 to 2 pt	20 pt	
Endura	7	0	4.5 oz	5 apps	For Alternaria, apply before disease onset, continue every 7 to 14 days.
Fixed coppers					Apply every 7 to 14 days after seeding/transplanting or when conditions favor disease. See label for mixing instructions and tank-mix precautions.
Badge SC	M	0	1 to 1.8 pt		-
Badge X2	M	0	0.75 to 1.5		OMRI-listed.
Basic Copper 53	M	0	2 to 4 lb		OMRI-listed.
C-O-C-S WDG	M	0	2 to 4 lb		-
Champ DP	M	0	1.33 lb		-
Champ Formula 2 FL	M	0	1.33 pt		-
Champ WG	M	0	2 lb		OMRI-listed.
COC DF	M	0	3 to 6 lb		-
COC WP	M	0	3 to 6 lb		OMRI-listed.
Copper-Count-N	M	0	4 to 6 pt		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 lb		-
Kentan DF	M	0	2 lb		-
Kocide 2000	M	0	1.5 lb		-
Kocide 3000	M	0	0.75 lb		-
Kocide DF	M	0	2 lb		-
Mastercop	M	0	0.5 to 1.5 pt		-
Nordox 75 WG	M	0	1.25 to 2.5 lb		OMRI-listed.
Nu-Cop 50 WP	M	0	2 lb		OMRI-listed.
Nu-Cop 3 L	M	0	1.33 to 2.66 pt		-
Nu-Cop 50 DF	M	0	2 lb		OMRI-listed.
Nu-Cop 50 HB	M	0	1 lb		-
Fontelis	7	0	16 to 30 fl oz	61 fl oz	Apply before disease onset, continue every 7 to 14 days.
Omega 500F	29	7	1 pt	4 apps	Apply when conditions favor disease, continue every 7 days.
Pristine	7/11	0	8 to 10.5 oz	6 apps	Apply before disease onset, continue every 7 to 14 days. Will suppress southern blight.
Propiconazole[4]	3	14			Apply before disease onset, continue every 7 to 10 days.
Tilt	3	14	4 fl oz	16 fl oz	
Quadris Opti	11/M	0	2.4 pt	6 apps	Carrot only. Apply before disease onset, continue every 7 to 14 days. Observe seasonal limits for chlorothalonil.

(continued on next page)

DISEASE CONTROL: *Root Crops (continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Quadris Top	11/3	7	12 to 14 fl oz	56 fl oz	Apply before disease onset, continue every 7 to 10 day schedule.
Quilt	11/3	14	14 fl oz	55 fl oz	Premix of azoxystrobin and propiconazole. Use higher rates for rust and gray leaf spot. Apply before disease onset, continue every 7 to 14 days.
Quilt Xcel	11/3	14			Premix of azoxystrobin and propiconazole. Use higher rates for rust and gray leaf spot. Apply before disease onset, continue every 7 to 14 days.
Iprodione[4]					Carrot only. For control of Alternaria, apply when conditions favor disease. Repeat applications can be made at 7 to 14 days.
Rovral 4 Flowable	2	0	1 to 2 pt	4 apps	
Sulfur[4]	M				Carrot only. Apply every 14 days, beginning when symptoms are first observed or when conditions favor disease. Phytotoxicity may occur when sulfur is applied when temperatures exceed 90°F.
Switch 62.5 WG	9/12	7	11 to 14 oz	56 oz	For Alternaria, apply every 7 to 10 days. Make only two applications on radish.

[1] Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on page 13 for more information on FRAC codes.
[2] Pre-harvest interval.
[3] Per 1,000 row-feet.
[4] Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.

Southernpeas (Cowpeas)

Pea family (Fabaceae): *Vigna unguiculata*

Planting and Culture

Southernpeas (cowpeas) may be grown on a wide variety of soils with good success. Soils should be well drained. Southernpeas require a rather low level of soil fertility more comparable to snap beans and soybeans. Prepare a good seedbed as for other vegetable crops.

Plant seed after danger of frost in the spring and after soil temperature has warmed to 65°F (see Appendix J). Thirty to 40 pounds of seed is required per acre when seeding in rows 36 to 42 inches apart. Space seed 4 inches apart in rows.

There are no known detrimental effects on plant growth associated with inoculating the seed with nitrogen-fixing *Rhizobium* prior to planting. However, there are many different strains of *Rhizobium* and many factors involved in determining if this will increase nitrogen fixation and help your crop. There will be no effect if the field has a recent history of being planted with southernpeas because a large population of *Rhizobium* will already be present in the field.

Fertilizing

A general fertilizer rate would be 500 to 600 pounds per acre of a complete fertilizer such as a 5-20-20 or similar analysis fertilizer; however, a soil test is the best method to determine proper fertilization rate.

FERTILIZER: *Southernpeas*

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	96-145
Medium	31-60	51-95
High	61-80	1-50
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	81-120
Medium	201-300	41-80
High	301-450	1-40
Very High	>450	0
Nitrogen		**N**
Poor soils		50
Fertile soils		20-30

Harvesting and Handling

For fresh market sales, pods should be well filled and harvested before they dry. Varieties differ in their "over" color; some are purple and others are yellow. Harvest when some green has disappeared from the pod. For peas to be stored as dry peas, the pods should be thoroughly dry before harvesting.

Common Diseases/Management

Damping-off, seed rots, and root rots. Rotation away from legumes for two years (mainly to corn, small grains, or grass) is recommended. Purchase treated seed or apply Captan WP at 1 teaspoon per pound of seed. Plant seed into warm, well-drained soils to ensure rapid germi-

VARIETIES: *Southernpeas*

Variety	Days to Maturity	Comments
Top Pick Brown	60	Brown color, bush, a crowder type
Mississippi Silver	64	Peas are large, light green to cream in color; semi-vining; a crowder type.
Mississippi Purple	69	Large seeded disease resistant, a crowder type
Queen Anne	75	A blackeye type; bush type plant.

PESTICIDE SAFETY: *Southernpeas*

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Acramite 50 WS	C	12	3
Admire Pro	C	12	7/21[5]
Assail 30 SG	C	12	7
Avaunt 30 DG	C	12	7
Belt SC	C	12	1/14[5]
Blackawk 36 WG	C	4	3/28[3]
Coragen 1.67 SC	-	4	1
Intrepid 2 F	C	4	7
Movento 2 SC	C	24	1
Radiant 1 SC	C	4	3
Sevin XLR	W	12	3/21[3]
Sivanto 1.67 SL	C	12	7/21[3]
Restricted Use			
Asana XL	W	12	21
Baythroid XL	W	12	3
Brigade 2 EC	W	12	3
Hero 1.24 EC	C	12	3
Mustang Max	W	12	1/21[3]
Proaxis 0.5 EC	C	24	7/21[3]
Warrior II	W	24	7/21[3]
FUNGICIDES			
Aproach	C	12	14
Blocker Flowable/4F	C	12	0
Bravo ZN	W	48	14
Chlorothalonil[2]	D	12	14
Fixed coppers[2]	D	24/48[4]	24
Endura	W	12	7/21[3]
Fontelis	C	12	0
Headline	W	12	21
Meta Star 2EC AG	W	48	0
Priaxor	C	12	7/21[3]
Proline 480 SC	C	12	7
Quadris	C	4	0
Quadris Opti	W	12	14
Quilt	W	12	7/14[3]
Quilt Xcel	W	12	7/14[3]
Ridomil Gold SL	C	48	0
Ridomil Gold/Copper	D	48	3
Sulfur[2]	C	24	0
Tebuconazole[2]	C	12	14
Thiophanate-methyl[2]	C	12	14/28[3]
Tilt	W	12	7

[1] W: Warning, C: Caution, D: Danger; P: Poison
[2] Several formulations are marketed. See the general introduction for more details on fungicides.
[3] Dependent on type of peas, see label.
[4] Re-entry varies by product and formulation.
[5] PHI dependent on type of application.

nation and emergence. See the "Beans" chapter for information on controlling root rots that are common to both beans and southernpeas.

Powdery mildew, rust, and leaf spots. Practice crop rotation to non-legumes for at least two years prior to planting. Fungicides are labeled to control a number of foliar diseases (leaf spots, rust, and powdery mildew). The first spray should be made at early flowering.

INSECT CONTROL: *Southernpeas*[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
PREPLANT INCORPORATED			
Wireworms, Cutworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites. Wireworms can be a potential problem where southernpeas follow grass or grass-legume sod.			
FOLIAR TREATMENTS			
Aphids			
Assail 30 SG	2.5 to 5.3 oz	3 applications	-
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	-
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications.
Sivanto 1.67 SL	7 to 10.5 fl oz	28 fl oz	Allow 10 days between applications.
Plant Bugs, Stink Bugs, Leaf-feeding Caterpillars			
Baythroid XL	2.1 fl oz	10.5 fl oz	Limit 2.1 fl oz per 5-day interval.
Belt 2 SC	2 to 3 fl oz	6 fl oz	For caterpillars only. Allow 5 days between applications.
Blackhawk 36 WG	1.7 to 3.3 oz	20 oz	For caterpillars only. Allow 5 days between applications.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	-
Intrepid 2 F	8 to 16 fl oz	64 fl oz	For caterpillars only.
Mustang Max	2.72 to 4 fl oz	24 fl oz	-
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	-
Sevin XLR	1 to 1.5 qt	4 applications	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	-

[1] *Generic products available (Appendix E).*

WEED CONTROL: *Southernpeas*

Product Amt/A	Lb A.I./A	Comments
0.5-1.6 fl oz Aim 1.9 EW	0.008-0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
5-12 fl oz Assure II 0.88L	0.033-0.08 quizalofop	For selective post-emergence control of annual grasses and suppression of perennial grasses. Apply to actively growing grasses in 10 to 15 gal water/A. Include 1% v/v crop oil concentrate or 0.25% v/v non-ionic surfactant. Preharvest interval is 30 days for succulent peas and 60 days for dry peas. Maximum 14 fl oz/A per season.
1.3-1.7 pt Dual II Magnum 7.6 E	1.3-1.6 s-metolachlor	For control of most annual grasses and certain broadleaves. Apply preplant surface or incorporated or pre-emergence. Small grains may be planted 4½ months following this treatment. See label for other rotational crops.
1.2-2.0 pt Gramoxone Inteon	0.4-0.67 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Can be used as a harvest aid as well. Use with non-ionic surfactant 0.25% v/v. Max. 2 applications/season. PHI = 7 days.
0.5-2.5 pt Poast	0.09-0.48 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. Dry and succulent peas. Max. rate 4 pt/A per year. Include 1% v/v crop oil. PHI = 15 days for succulent peas and 30 days for dry peas.
1.8-3.6 pt Prowl 3.3 E	0.74-1.49 pendimethalin	For control of annual grasses and broadleaf weeds. Apply before planting and incorporate 1 to 2 inches up to 60 days before planting and incorporate within 7 days of application. Do not apply surface pre-emergence, or serious crop injury can result.
4 oz Pursuit 2L	0.07 imazethapyr	For control of annual grasses and broadleaf weeds. Can be applied preplant incorporated within 1 week before planting. Can be applied pre-emergence within 3 days after planting. Can be applied post-emergence to plants at least 3 inches tall but before 5 nodes and before flowering. Add non-ionic surfactant 0.25% v/v.
4 fl oz Raptor 1AS	0.031 imazamox	For control of annual grasses and broadleaf weeds. Some varieties are sensitive and injury can occur. Apply post-emergence to actively growing dry southernpeas with at least 3 pairs of leaves and before bloom. Max. 1 application/season.
16-22 fl oz Roundup WeatherMax 5.5L	0.69-0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
0.5-1 oz Sandea 75 DF	0.023-0.046 halosulfuron	For pre-emergence and post-emergence control of broadleaves and yellow nutsedge. Apply to row middles before or after weeds emerge. PHI = 30 days.
9-32 fl oz Select Max	0.07-0.24 clethodim	For post-emergence control of grasses. Apply higher rate for hard-to-control perennial grasses. Do not apply more than 32 oz/A in a single application or 64 oz/A for a season. Use a non-ionic surfactant at 0.25% v/v. PHI = 30 days.
7.5 lb Sonalan 10G	0.75 ethalfluralin	For pre-emergence control of annual grasses and broadleaves. For use on dry peas only. Apply and incorporate before planting.
1.25-2 pt Treflan HFP 4 E	0.62-1 trifluralin	For pre-emergence control of annual grasses and broadleaf weeds. Apply as preplant soil incorporated.

DISEASE CONTROL: *Southernpeas*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Anthracnose, Leaf Spots, Powdery Mildew, Downy Mildew					
Aproach	11	14	6 to 12 fl oz[5]	24 fl oz	Apply before disease onset, continue every 7 to 14 days.
Azoxystrobin[4]					Not for downy or powdery mildew. Apply before disease onset, continue every 7 to 14 days.
Azoxy 2SC	11	0	6 to 15.5 fl oz[5]	4 apps	
AzoxyStar	11	0	6 to 15.5 fl oz[5]	4 apps	
Quadris	11	0	6 to 15.5 fl oz[5]	4 apps	
Satori	11	0	6 to 15.5 fl oz[5]	4 apps	

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DISEASE CONTROL: *Southernpeas (continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Chlorothalonil[4]					Dry pea production only. Apply at early bloom or when conditions favor disease.
Bravo Ultrex	M	14	1.25 to 1.8 lb	7.3 lb	
Bravo WeatherStik	M	14	1.375 to 2 pt	8 pt	
Bravo ZN	M	14	2 to 3 pt	11.5 pt	
Fixed coppers					Downy mildew. Apply every 5 to 10 or 7 to 14 days, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge X2	M	0	0.5 to 1.25 lb		OMRI-listed.
Basic Copper 53	M	0	2 to 4 lb		OMRI-listed.
Champ Formula 2 FL	M	0	0.67 to 2 pt		-
C-O-C-S WDG	M	0	2 to 4 lb		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	0.75 to 2 lb		-
Kentan DF	M	0	2 lb		-
Kocide 3000	M	0	0.5 to 1.25 lb		-
Nordox 75 WG	M	0	0.66 to 2.5 lb		OMRI-listed.
Fontelis	7	0	14 to 30 fl oz[5]	72 fl oz	Apply before disease onset, continue every 7 to 14 days.
Headline	11	21	6 to 9 fl oz[5]	2 apps	Apply before disease onset, continue every 7 to 14 days as needed.
Headline SC	11	21			
Priaxor	7/11	7/21	4 to 8 fl oz[5]	2 apps	Apply every 7 to 14 days.
Quadris Opti	11/M	14	1.6 to 2.4 pt[5]	4 apps	Apply before disease onset, continue every 7 to 14 days.
Quilt	11/3	7/14	14 fl oz	42 fl oz	Premix of azoxystrobin and propiconazole. Make up to three applications every 7 to 14 days.
Quilt Xcel	11/3	7/14	10.5 to 14 fl oz		-
Ridomil Gold/Copper	4/M	3	2 lb	4 apps	Begin treatment at disease onset and continue every 7 days during favorable conditions.
Sulfur[4]	M				Apply when powdery mildew is first observed; continue every 7 to 14 days as needed. Phytotoxicity may occur if applications are made when temperatures exceed 90°F.
Thiophanate-methyl[4]					Apply when 10 to 30% of plants have at least one open bloom OR when conditions favor disease, continue every 4 to 7 days (no later than peak bloom).
Topsin 4.5 FL	1	14/28	20 to 40 fl oz	80 fl oz	
Topsin M 70 WP	1	14/28	1 to 2 lb	4 lb	
Topsin M WSB	1	14/28			
Rust					
Aproach	11	14	6 to 12 fl oz[5]	24 fl oz	Apply before disease onset, continue every 7 to 14 days.
Azoxystrobin[4]					Apply before disease onset, continue every 7 to 14 days.
Azoxy 2SC	11	0	6 to 15.5 fl oz[5]	4 apps	
AzoxyStar	11	0	6 to 15.5 fl oz[5]	4 apps	
Quadris	11	0	6 to 15.5 fl oz[5]	4 apps	
Satori	11	0	6 to 15.5 fl oz[5]	4 apps	
Chlorothalonil[4]					Dry pea production only. Apply at early bloom or when conditions favor disease.
Bravo Ultrex	M	14	1.25 to 1.8	7.3 lb	
Bravo WeatherStik	M	14	1.375 to 2 pt	8 pt	
Bravo ZN	M	14	2 to 3 pt	11.5 pt	
Fontelis	7	0	14 to 30 fl oz[5]	72 fl oz	Apply before disease onset, continue every 7 to 14 days.
Headline	11	21	6 to 9 fl oz[5]	2 apps	Apply before disease onset, continue every 7 to 14 days as needed.
Headline SC	11	21			
Priaxor	7/11	7/21	4 to 8 fl oz[5]	2 apps	Apply every 7 to 14 days.
Proline 480 SC	3	7	5.7 fl oz	17.1 fl oz	Rust. Apply at first symptoms, make up to three applications every 5 to 14 days.
Quadris Opti	11/M	14	1.6 to 2.4 pt[5]	4 apps	Apply before disease onset, continue every 7 to 14 days.
Quilt	11/3	7/14	14 fl oz	42 fl oz	Premix of azoxystrobin and propiconazole. Make up to three applications every 7 to 14 days.
Quilt Xcel	11/3	7/14	10.5 to 14 fl oz		-
Sulfur[4]	M				Apply when rust is first observed; continue every 7 to 14 days as needed. Phytotoxicity may occur if applications are made when temperatures exceed 90°F.
Tebuconazole[4]	3	14			Rust on dry beans only. Apply preventively and repeat every 14 days. Use lowest listed rate of surfactant to improve coverage.
Tilt	3	7	4 fl oz	12 fl oz	Make up to three applications every 7 to 14 days. May cause leaf crinkling or increased greening of leaves.
Pythium Damping-off, Seedling Disease, Root Rot					
MetaStar 2EC AG	4	0	2 to 4 pt	1 app	Apply pre- or post-planting as a broadcast or banded spray (7-inch band) in sufficient water to provide uniform coverage. Incorporate into the upper 2 inches of soil mechanically or by rainfall/irrigation. Can be tank-mixed with azoxystrobin or PCNB to provide additional protection against Rhizoctonia.
Ridomil Gold SL	4	0	0.5 to 1 pt		
Rhizoctonia Damping-off, Seedling Disease, Stem And Root Rot					
Azoxystrobin[4]					At-planting treatment. Apply at planting as an in-furrow spray in 0.3 to 1 gal water/1,000 row-feet (5 to 15 gal/A). Spray should applied to the furrow just before seed are covered. Post-emergence. For post-emergence treatments, apply in a 7-inch (or less) band directed at the soil at the base of the plant. Arrange nozzles to provide good coverage of lower stems and soil at base of plants. Incorporation following application will improve distribution in soil. Foliar contact may occur; post-emergence sprays are considered foliar applications for resistance management purposes.
Azoxy 2SC	11	0	0.4 to 0.7 fl oz[3]	1 app	
AzoxyStar	11	0	0.4 to 0.8 fl oz[3]	4 foliar apps	
Quadris	11	0	0.4 to 0.8 fl oz[3]	4 foliar apps	
Satori	11	0	0.4 to 0.8 fl oz[3]	see label	

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DISEASE CONTROL: *Southernpeas (continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Blocker 4F, Blocker Flowable	14	0	2.2 to 3.3 fl oz[3]	1 app	Use as an In-furrow spray at planting. Actual rate is dependent on row spacing; see label for directions.
Headline	11	21	0.1 to 0.8 fl oz[3]	1 app	Use as an In-furrow spray at planting; see label for directions.

[1] *Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on page 13 for more information on FRAC codes.*
[2] *Pre-harvest interval.*
[3] *Per 1,000 row-feet.*
[4] *Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.*
[5] *Use higher rate when pressure is severe.*

Sweetpotatoes

Bindweed family (Convolvulaceae): *Ipomoea batatas*

VARIETIES: *Sweetpotatoes*

Variety	Days to Maturity	Comments
Beauregard	90	Copper skin, deep orange flesh, slow to sprout, moist flesh, very high yield, must harvest on time or roots will get too large.
Hernandez	90-100	Bright orange skin, orange moist flesh, long tapered root.
O'Henry	90-100	White skin, cream flesh, uniform shape, very high yield.
Covington	110	Rose colored skin, orange flesh, very uniform and high quality roots, strong vines.
Japanese/ Murasaki	100-105	Purple skin, dry-white flesh, good yields, strong skin, for farmers markets.

Planting and Culture

Sweetpotatoes grow best on medium to light sandy soils that are well drained and relatively low in nitrogen, although they can be grown successfully on heavier soils. Regardless, sweetpotatoes should not be grown on the same land more often than once every three years.

Good soil preparation is important for successful production of sweetpotatoes. The soil organic matter content should be maintained by turning under small grain cover crops.

The commercial grower often produces his own transplants (slips) by bedding 10 to 12 bushels of sweetpotatoes for each acre of plants to be set. The sweetpotatoes are usually bedded about seven weeks before the field setting date in early June (see Appendix J). Use only disease-free sweetpotatoes. They should be treated to reduce surface-borne disease problems before being placed in the bed. Do not cut sweetpotato seed pieces as you would potatoes. Cutting will often result in disease and will not result in a greater number of slips.

In preparing the bed, the roots are usually placed by hand so they are close together but not touching. Ordinarily, one bushel will cover 16 to 20 square feet of bed surface. The roots should be covered with 3 to 4 inches of sand or fine soil, then watered.

Soil preparation begins with deep plowing and repeated disking until a fine plant bed is prepared. Sandy soil should be ridged about 10 inches high before planting. On heavier soils that do not drain quickly, the ridges should be 12 to 14 inches high.

The best transplanting results are obtained by using freshly pulled plants. True "slips" will have been pulled from the sweetpotato and may have some roots. Often, to reduce risk of soilborne diseases, cuttings of vines are used instead of slips. Cuttings are taken 1 to 2 inches above the soil line and will have no roots when set. Slips may be set by hand, but most commercial Kentucky growers use a one-row tobacco setter that applies about ½ pint of water with each slip. Large commercial growers use a two-row plant setter. A starter solution is preferred to water. Add 3 pounds of 10-52-17 fertilizer to 50 gallons of water and use about ½ pint of this starter solution per slip (plant).

Rows should be spaced 40 to 44 inches apart and plants should be spaced in the row every 10 to 12 inches. A spacing of 10 inches apart within row and 44 inches between rows requires about 13,400 plants to set an acre. Replace missing plants to avoid oversized roots.

FERTILIZER: *Sweetpotatoes*

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-180
Medium	31-60	61-120
High	61-80	1-60
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	251-275
Medium	201-300	101-250
High	301-450	51-100
Very High	>450	50
Nitrogen		**N**
Apply 30 to 50 lb/A of actual nitrogen (N).		

Fertilizing

Sweetpotatoes grow well at a soil pH of 5.0 to 6.0. Broadcast all fertilizer and disk into soil well before transplanting.

Harvesting

Sweetpotatoes continue to grow until the vines are killed by frost. Therefore, you should harvest the crop when the greatest number of 8- to 10-ounce potatoes are found in the hill. Sample digging will provide this information. A good practice is to mow the vines before harvesting. The crop can then be harvested with less damage to the potatoes. Use a turn plow or a potato digger to expose the roots with the least possible injury. Plow out one row at a time and pick up the potatoes. Grade potatoes in the field and place them in containers that are to be put in storage. For large-scale production, mechanical harvesting machinery can be used economically.

Curing and Storing

Stack crates or baskets in the storage space. Place them 6 to 8 inches off the floor and 12 to 15 inches from the walls to allow for adequate ventilation. Curing requires seven to 10 days if the temperature can be maintained at 80° to 85°F with 70 to 90 percent relative humidity. After curing is completed, the potatoes should be kept in a place as near 55°F as possible with a relative humidity of 85 percent. Higher market prices occur during the winter months and usually permit the grower with a stored crop to increase profits substantially.

Preparing for Market

If the crop is to be sold, the potatoes should be graded to meet the buyer's requirements. They should be prepared for market by cleaning, either by brushing or washing, and waxing before packing in

crates or baskets. A box of sweetpotatoes on the wholesale market often weighs 40 to 44 pounds.

Common Diseases/Management

Transplant production beds

Purchase either certified transplants or produce your own plants. Start with certified, disease-free roots planted in a commercial growing mix or in new sand for best results. If this is not possible, consider the following measures: Sanitize beds or greenhouses; if bedding material is reused or if soil is used, then work up the material to a depth of 8 to 10 inches and steam-sterilize (180°F for 30 minutes) or fumigate. Fumigants for this use include chloropicrin and metam-sodium applied as a drench or injected. See "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 16 for more information.

Before bedding, dip "seed" roots for two minutes into a solution of a labeled seed-treatment fungicide and plant immediately. Soil or media temperatures in the beds should be maintained at around 80°F to encourage rapid plant growth and reduce rotting. Using sprouts that are cut above the soil line is a great aid in reducing certain transplant-borne diseases.

Black rot, Sclerotinia blight, and scurf. Removing slips above the soil line and re-rooting will adequately control scurf but not black rot. Use crop rotations of three to four years away from sweetpotatoes. Carefully handle roots during harvest to avoid bruising. Follow all harvesting and post-harvest handling guidelines, including proper curing, to reduce the incidence of the post-harvest phases of these diseases.

Fusarium wilt. Use resistant varieties and only nitrate forms of nitrogen on problem fields. High soil pH will improve control of Fusarium wilt but will also favor soil pox. Rotation for three years away from sweetpotatoes is also helpful. Use certified, disease-free seed roots and transplants. Sweetpotatoes and tobacco are susceptible to the same strains of *Fusarium*, so avoid growing them in rotation. If they must be grown in rotation, use Fusarium wilt-resistant varieties for both crops and control nematodes.

Nematodes. Use rotation for two or more years to tall fescue. Preplant nematicides are options. See "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 16 for more information.

Post-harvest rot. Harvest and handling conditions greatly influence susceptibility to post-harvest decays. Avoid chilling injury. Roots exposed at any time to temperatures below 50°F can become very susceptible to rots. Follow proper curing protocols to ensure adequate wound healing. Store only blemish-free roots; discard damaged or rotted roots. Botran 75 WP at 1 pound per 100 gallons of water or Scholar SC at 16 to 32 fl ounces per 100 gallons of water is labeled as a post-harvest dip or spray (after cleaning roots but before packing) to control these rots. Calcium hypochlorite 65% at 10 ounces per 100 gallons of water also is labeled as a post-harvest spray for general sanitation.

Pox. To prevent pathogen buildup, practice crop rotation as recommended for black rot and maintain acid soils (below pH 5.5) for fields routinely used for sweetpotatoes. Use disease-free roots and transplants. Soil fumigation may be necessary for serious cases—see "Nematodes" above for information on fumigants.

PESTICIDE SAFETY: *Sweetpotatoes*

	Signal[1]	Re-entry (hrs)	Harvest (days)[2]
INSECTICIDES			
Actara 25 WDG	C	12	14
Admire Pro	C	12	12[3]
Assail 30 SG	C	12	7
Avaunt 30 DG	C	12	14
Belay 21.3 SC	C	12	14
Beleaf 50 SG	C	12	7
Coragen 1.67 SC	-	4	14
Fulfill 50 DF	C	12	14
Intrepid 2 F	C	4	7
Lorsban 4 E	W	24	125
Lorsban 15 G	C	12	125
Lorsban 75 WP	W	48	125
Malathion 8	W	12	3
Miteus 0.42 EC	W	12	7
Movento 2	C	24	7
Oberon 2 SC	C	12	7
Platinum 2 F	C	12	AP
Rimon 0.83 EC	W	12	14
Scorpion 35 SL	C	12	7[4]
Sevin XLR	W	12	7
Sivanto 1.67 SL	C	12	7
Restricted Use			
AgriMek 0.15 Ec	W	12	14
Battalion 1.5 EC	DP	12	3
Baythroid XL	W	12	0
Brigade 2 EC	W	12	21
Hero 1.24 EW	C	12	21
Mustang Max	W	12	1
Renounce 20 WP	C	12	0
Vydate L	DP	48	AP
Warrior II	W	24	7
FUNGICIDES			
Aftershock	C	12	7
Botran 75 W	C	12	0
Botran 5F	C	12	0
Endura	W	12	10
Evito 480 SC	C	12	7
Headline EC/SC	W	12	3
Maxim 4 FS	C	0	0
Mertect 340 F	C	12	0
Meta Star 2EC AG	W	48	0
Presidio	C	12	7
Quadris	C	4	14
Quadris Top	C	12	14
Reason 500 SC	C	12	14
Ridomil Gold EC/SL	C	48	0
Scala SC	C	12	17
Scholar SC	C	0	0
Switch 62.5 WDG	C	12	7
Ultra Flourish	W	48	0

[1] *W: Warning, C: Caution, D: Danger; P: Poison*
[2] *AP: At planting.*
[3] *PHI dependent on application method.*

INSECT CONTROL: *Sweetpotatoes*[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
SOIL APPLICATION			
Wireworms			
Belay 2.13 SC	6 to 12 fl oz	12 fl oz	At transplanting or cultivation.
Brigade 2 EC	3.2 to 9.6 fl oz	32 fl oz	At cultivation.
Brigade 2 EC	9.6 to 19.2 fl oz	32 fl oz	Preplant only.
Lorsban 15 G	13.5 lb	1 application	Preplant incorporated. Note extended PHI.
Lorsban 4 E	4 pt	1 application	Preplant incorporated. Note extended PHI.
FOLIAR APPLICATION			
Flea Beetles, Tortoise Beetles			
Battalion 1.5 EC	1.5 to 2.4 fl oz	12 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Limit 2.8 fl oz per 5-day interval. For flea beetles.

(continued on next page)

INSECT CONTROL: *Sweetpotatoes[1] (continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Brigade 2 EC	2.1 to 6.4 fl oz	32 fl oz	Limit 2 applications. Allow 21 days between applications.
Mustang Max	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sevin XLR	1 to 2 qt	8 qt	Limit 8 applications. Allow 7 days between sprays.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	-
Leafhoppers			
Actara 25 WDG	1.5 to 3 oz	6 oz	Allow 7 days between applications.
Battalion 1.5 EC	1.5 to 2.4 fl oz	12 fl oz	-
Baythroid XL	0.8 to 1.6 fl oz	16.8 fl oz	Limit 2.8 fl oz per 5-day interval.
Malathion 8	1 to 1.75 pt	2 applications	Allow 7 days between applications.
Miteus 0.42 EC	2 pt	4 pt	Allow 7 days between applications.
Mustang Max	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sivanto 1.67 SL	7 to 10.5 fl oz	28 fl oz	Allow 7 days between applications.
Warrior II	0.96 to 1.6 fl oz	7.68 fl oz	-
Sweetpotato Weevil: Prior to planting, dip sweetpotato cuttings in suspension of Sevin XLR at a rate of 2.6 fl oz/gal water.			
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Limit 2.8 fl oz per 5-day interval.

[1] *Generic products available (Appendix E).*

WEED CONTROL: *Sweetpotatoes*

Product Amt/A	Lb A.I./A	Comments
0.5-1.6 fl oz Aim 1.9 EW	0.008-0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 11.6 fl oz/A. PHI = 7 days.
1.3-4 pt Command 3ME	0.48-1.5 clomazone	For preplant incorporated or pre-emergence control of annual grasses and broadleaves. Use a maximum of 1.5 pt/A in a single application after transplanting and before weed emergence. PHI = 95 days, 125 days if more than 3.3 pt was applied.
6-14 lb Dacthal W-75	4.5-10.5 DCPA	For pre-emergence control of annual grasses and small-seeded broadleaves. May be sprayed over transplants (slips). Layby applications can be made up to 6 weeks after transplanting.
2-4 lb Devrinol 50 DF	1-2 napropamide	For control of annual grasses and broadleaf weeds. Apply before transplanting and water-in or incorporate to a depth of 1 to 2 inches in 10 to 50 gal water/A. Can be applied immediately after transplanting. To avoid injury, do not replant with crops not specified on the label for 12 months if using the 4-lb rate. Only herbicide approved for slip (transplant) beds.
1 pt Fusilade-DX 2E	0.25 fluazifop-p	For selective post-emergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 55 days. Max. rate is 48 fl oz/A.
16-22 fl oz Roundup WeatherMax 5.5L	0.69-0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
9-32 fl oz Select Max	0.07-0.24 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. PHI = 30 days.
0.5-1 oz Valor 51DG	0.024-0.032 flumioxazin	For post-emergence control of broadleaf weeds and yellow nutsedge. For use on 'Beauregard' variety only. Apply 2 to 5 days before transplanting. Do not use greenhouse-grown transplants. Max. rate 2.5 oz/A.

DISEASE CONTROL: *Sweetpotatoes*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Damping-off (Pythium)					
MetaStar 2EC AG	4	0	4 to 8 pt	1 app	Apply-soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil mechanically (preplant) or with irrigation (pre- and at-planting) if rainfall is not expected within 24 hours of treatment.
Ridomil Gold SL	4	0	1 to 2 pt		
Ultra Flourish	4	0	2 to 4 pt		
Presidio	43	7	3 to 4 fl oz	12 fl oz	Can be applied as a drench or through drip irrigation at planting; soil-directed applications can be made during the season.
Foliar Diseases					
Aftershock	11	7	2 to 3.8 fl oz	6 apps	Apply before disease onset, continue every 7 to 10 days.
Azoxystrobin[3]					Apply before disease onset, continue every 7 to 14 days.
Azoxy 2SC	11	14	6 to 15.5 fl oz[3]	4 apps	
AzoxyStar	11	14	6 to 15.5 fl oz[3]	4 apps	
Quadris	11	14	6 to 15.5 fl oz[3]	4 apps	
Satori	11	14	6 to 15.5 fl oz[3]	4 apps	
Evito 480 SC	11	7	3.8 fl oz		-
Headline	11	3	6 to 12 fl oz[3]	72 fl oz	Apply before disease onset, continue every 7 to 14 days as needed.
Headline SC	11	3	6 to 12 fl oz[3]	72 fl oz	Apply before disease onset, continue every 7 to 14 days as needed.
Quadris Top	11/3	14	8 to 14 fl oz	55.3 fl oz	Apply before disease onset, continue every 7 to 10 days.
Reason	11	14	5.5 to 8.2 fl oz	16.4 fl oz	Apply before disease onset, continue every 5 to 10 days.
Scala	9	17	7 fl oz	35 fl oz	Apply before disease onset, continue every 7 to 14 days.
Switch 62.5 WG	9/12	7	11 to 14 oz	56 oz	Apply every 7 to 10 days. Make only two applications on radish.
Scurf, Black Rot, Sclerotinia Blight, Post-harvest Rot					
Botran 75 W	14	0	2 lb/15 gal water	1 app	Seed dip. For control of scurf, dip seed in solution for 10 to 15 seconds and plant immediately. Discard unused solution daily.
Botran 5F	14	0	2.4 pt/15 gal water		
Botran 75 W	14	0	4.8 oz/1,000 row-feet	1 app	Plant bed application. For control of Sclerotinia blight, spray or sprinkle solution over bedded seed before covering.
Botran 5F	14	0	5.73 fl oz/1,000 row-feet		

(continued on next page)

DISEASE CONTROL: *Sweetpotatoes (continued)*

Product	FRAC Code	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Botran 75 W	14	0	0.5 to 1 lb/100 gal water	1 app	Post-harvest dip. Dip harvested tubers in solution, or spray; do not rinse after treatment. Use low rate for dip. For suppression of rhizopus rot.
Botran 5F	14	0	1.2 pt/100 gal water		
Endura	7	10	5.5 to 10 oz	20 oz	Sclerotinia. Apply before disease onset, continue every 7 to 14 days.
Maxim 4 FS	12	0	0.08 to 0.16 oz/cwt	1 app	Dip seed pieces in a water-based slurry; spread and allow to dry.
Mertect 340 F	1	0	3.3 qt/100 gal water	1 app	Dip seed pieces in solution for 1 to 2 minutes; plant immediately afterward. Discard solution when it becomes dirty or volume becomes too low to treat.
Scholar SC		0	16 to 32 fl oz/100 gal	1 app	Use as a post-harvest dip and low volume application. Dip for approximately 30 seconds and allow fruit to drain. Add 8 fl oz of Scholar SC to 100 gals. of treating suspension after 500 bushels are treated. After each 1,000 bushels treated, drain and flush the tank. Refill with fresh dip suspension.

[1] Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on page 13 for more information on FRAC codes.
[2] Pre-harvest interval.
[3] Use higher rate when pressure is severe.

Tomatoes

Nightshade family (Solanaceae): *Solanum esculentum*

Planting and Culture

Staked tomatoes for fresh market sales have been most profitable when planted and given protection for the very early market or when planted for a late fall crop and harvested just before frost. Tomatoes are usually transplanted during the latter part of April or early May for the spring crop and in mid-July for the fall crop (see Appendix J). A well-drained soil that warms up quickly in the spring is most desirable. Be careful following corn or soybeans because common herbicides used in these crops can be very damaging to tomatoes (see the "Herbicide Label Restrictions" table on page 10). Also be wary of plantings close to your neighbor's corn, soybeans, or small grains, because tomatoes are very sensitive to herbicide drift from these crops. If possible, avoid low-lying fields subject to late frosts and high humidity.

Think twice about locating your tomato planting on land used for tobacco. Although tobacco ground may represent some of the best land on a farm, it is not advisable to grow tomatoes (or peppers or potatoes) after tobacco for a period of at least three years because these crops are susceptible to many of the same diseases. Tomatoes should also not follow tomatoes on the same land for a period of at least three years. Tomatoes should not be grown in short rotation with crops in the same family (tobacco, peppers, potatoes, eggplant, etc.) nor with any of the vine crops (cucumbers, squash, pumpkins, melons, etc.) as all of these are susceptible to Phytophthora blight. Tomatoes do well when transplanted to fields where fescue sod was plowed under the previous fall. Soil should be plowed 8 to 10 inches deep

VARIETIES: *Tomatoes—Fresh Market*

Variety	Days to Maturity	Comments
LARGE RED (all are determinate hybrids)		
Sunshine	65	Sunshine is among the earliest commercial varieties available, for shipping or local sales. Plants are small and should not be pruned; should receive at least 50 lb preplant nitrogen; early blight susceptible. Fruit quality deteriorates after peak harvest. **Disease resistance:** Fusarium Wilt 1, 2, Verticillium Wilt 1
Red Deuce	71	Very large smooth fruit. Fruit size holds with average fruit weight 1 lb. Good for high tunnels production as well. **Disease resistance:** Fusarium Wilt 1,2, Verticillium Wilt 1, Alternaria stem canker, Gray Leaf Spot.
Rocky Top	76	Large smooth uniform fruit averaging 3/4 lb. Good for high tunnels production as well. **Disease resistance:** Fusarium Wilt 1, 2, 3, and Gray Leaf Spot.
Mountain Spring	72	Earliest of "Mountain" series; crack-resistant fruits; excellent for shipping. Spring and summer planting. Highly susceptible to early blight. **Disease resistance:** Fusarium Wilt 1, 2, Verticillium Wilt 1
Florida 47 R	75	Good yield and nice uniform 10-12 oz fruit. **Disease resistance:** Alternaria stem canker, fusarium wilt race 1 and 2, verticillium race 1, and gray leaf spot.
Mountain Glory	72	Disease resistance: Fusarium Wilt 1, 2, Verticillium Wilt 1, TSWV
BHN 543	72	High yielding but less crack tolerant than "Mountain" series varieties. **Disease resistance:** Fusarium Wilt 1, 2, Verticillium Wilt 1, Nematodes
Phoenix	72	Good for later plantings, sets well in high temperatures. **Disease resistance:** Alternaria stem canker, Fusarium Wilt 2, Verticillum Wilt 1
Amelia	75	Resistant to nematodes and intermediate resistance to tomato spotted wilt virus (TSWV). **Disease resistance:** Fusarium Wilt 1, 2, 3, Verticillium Wilt, TSWV
Crista	75	Good yields, long shelf life, firm 10 to 12 oz fruit. **Disease resistance:** Fusarium Wilt 1, 2, 3, Verticillium Wilt, TSWV
Nico	76	Medium (8 to 9 oz) fruit, midseason beafsteak type, very uniform, produces over a short period of time. **Disease resistance:** Fusarium Wilt 1, 2, Nematodes, Verticillium Wilt 1, TSWV, Alternaria Stem Canker
Mountain Fresh Plus	77	Crack-resistant fruit, mid-season; excellent flavor; for local sales or shipping. resistant. **Disease resistance:** Fusarium Wilt 1, 2, Verticillium Wilt 1, Nematodes, Early Blight tolerance
Red Defender	77	Good midseason variety, mostly large and extra large fruits, uniform. **Disease resistance:** Fusarium Wilt 1, 2, Verticillium Wilt 1, TSWV, Alternaria Stem Canker
BHN 602	77	10-12 oz globe fruit with high yields good mid- and late-season tomato. **Disease resistance:** Fusarium Wilt 1, 2, 3, Verticillium Wilt 1, TSWV
ROMA/PEAR/PASTE		
Pony Express	69	Concentrated early fruit set allows for short harvest window, 4 oz fruit, good performer in Kentucky. **Disease resistance:** Fusarium Wilt 1, 2, 3, Verticillium Wilt, TMV, Nematodes
Plum Crimson	80	Determinate hybrid; contains gene for early dark red interior color, high lycopene content, productive and early blight tolerant. **Disease resistance:** Fusarium Wilt 1, 2, 3, Verticillium Wilt 1
Plum Regal	80	Pear/plum-shaped, high yielding variety, 4 oz. fruits. **Disease resistance:** Fusarium Wilt 1, 2, Verticillium Wilt, TSWV, Late blight, Early Blight
YELLOW/GOLD FRUIT		
Carolina Gold	72	Determinate; large, tangerine-colored, smooth, crack-resistant fruit for shipping or local sales. Early to midseason with resistance to gray wall; also excellent for fried green tomatoes. Tangerine color. **Disease resistance:** Fusarium Wilt 1, 2, Verticillium Wilt 1, susceptible to early blight and bacterial leaf spot.
GRAPE		
Golden Sunshine	59	Yellow color, large indeterminate plant.
Tami G	60	Indeterminate; ½ to ¾ oz oval fruit, vigorous, yields well and picks for an extended season.

(continued on next page)

VARIETIES: *Tomatoes—Fresh Market (continued)*

Variety	Days to Maturity	Comments
Smarty	68	Small 1/2 to 1 oz fruit, compact plant. **Disease resistance:** Fusarium Wilt 1, Verticillium Wilt
CHERRY		
BHN 268	65-68	1 oz fruit, good shipper and shelf life. **Disease resistance:** Fusarium Wilt 2, Verticillium Wilt
Cherry Grande	65	Strong determinate—1¼ inch diameter, very sweet fruit. Shipping and local sales. **Disease resistance:** Fusarium Wilt, Verticillium Wilt
Sweet Chelsea	65	Indeterminate—1½ inch diameter very sweet fruit. Shipping and local sales. **Disease resistance:** Fusarium Wilt 1, 2, Verticillium Wilt, Nematodes, TMV
Mountain Magic	72	Larger saledette type, indeterminate, excellent flavor. **Disease resistance:** Fusarium Wilt 1, 2, Early Blight, Late Blight, Verticillium Wilt
HYDROPONIC		
Big-Beef (see comments)	70	Not a true hydroponic variety, but successfully grown for spring-early summer hydroponic production, not for full season (10 month) production (yields decline after 6 months). **Disease resistance:** Fusarium Wilt 2, Verticillium Wilt, Nematodes, Alternaria Stem Canker
Trust	78	The most popular hydroponic tomato grown, very reliable, will split in adverse conditions. Disease resistance: Fusarium Wilt 1, 2, Verticillium Wilt, Fusarium Crown and Root Rots, TMV, leaf mold races A-E (may not adequately control disease, see page 99).
Geronimo	78	Extremely vigorous plants, high yields, small stem scar, good performer. **Disease resistance:** Fusarium Wilt 2, Verticillium Wilt, TMV
Big Dena	73	Large to extra-large fruit, uniform shape, good shelf life. **Disease resistance:** Leaf mold, Fusarium wilt 0,1, ToMV, and TMV
Arbason	76	7-9 oz fruit with good yields and quality. **Disease resistance:** Fusarium wilt 1,2, Verticillium wilt, ToMV
INDETERMINATE, SPECIALTY, AND HEIRLOOM[1]		
Better Boy	72	Indeterminate, large fruit. On-farm and local sales only. Spring planting. **Disease resistance:** Fusarium Wilt 1, Verticillium Wilt, Root-knot Nematode
Buck's County Hybrid	72	Hybrid; for local sales. Deep red, round fruit.
Lemon Boy	72	Yellow, indeterminate F1 hybrid for local sales; spring and summer planting. **Disease resistance:** Verticillium Wilt 1, Fusarium Wilt, Nematodes
Pink Girl	76	Hybrid; for local sales. **Disease resistance:** Verticillium Wilt 1, Fusarium Wilt 1
Odoriko	76	Pink hybrid; great taste but susceptible to cracking. **Disease resistance:** Verticillium Wilt 1, Fusarium Wilt 1, Nematodes
Delicious	77	Very large 1 1/2 to 2 1/2 lb fruit; solid red with small seed cavities; resists cracking.
San Marzono	78	Hybrid, small oblong 5 to 6 oz fruit, meaty flesh, good for canning, high quality fruit. **Disease resistance:** Fusarium Wilt 2, Verticillium Wilt
Mortgage Lifter	85	Large 1 lb fruit, pink, smooth and uniform in size, very meaty with few seeds; very heavy producer.
Arkansas Traveler	85	Medium 1/2 lb fruit, pink, smooth and uniform, good producer in hot weather.
Kentucky Beefsteak	90	Medium 1/2 lb fruit, yellow-orange with deep ridges at stem end; retains green shoulders on stem end when ripe.
Giant Belgium	90	Large 1 to 2 lb and larger fruit; solid dark pink flesh; very sweet; less cracking than other heirlooms; heavy producer.
German Johnson	80-90	Large-fruited "heirloom;" for local sales. Susceptible to cracking and roughness.
Big Rainbow	90-100	Large 1 to 2 lb fruit, meaty, golden orange-yellow with red stripes radiating from blossom end; prone to cracking.

[1] *"Heirloom" tomato varieties have become popular for farm market and local sales. Growers should be aware that seed of some of these varieties may have become contaminated with TMV, clavibacter (canker), and Xanthomonas (bacterial spot), and should not be grown adjacent to plantings of other commercial varieties. Indeterminate varieties are best grown using wider in-row spacings of 24 to 36 inches and longer stakes (6 feet) or cages. UK trials of two popular varieties, "Brandywine" and "Cherokee Purple," have shown that fruit quality and appearance are highly variable from year to year; this variability likely stems from different seed sources. Growers are encouraged to test varieties from different sources before large-scale plantings.*

Figure 1a.

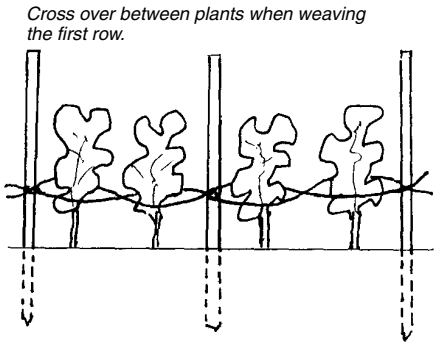


Figure 1b.

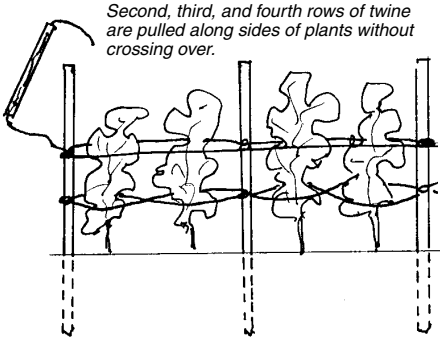
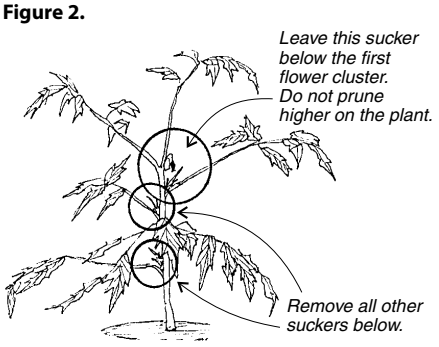


Figure 2.



and disked well in the spring to produce a firm plant bed.

Stocky, container-grown plants are most desirable for transplanting. Although it is possible to use bare root plants on bare ground plantings, higher early yields will be obtained from container-grown plants. Larger cell trays or containers (up to 3 inches) produce higher early yields than small containers or bare root plants. Early tomatoes generally command higher prices, which usually more than offset the higher cost of good quality, container-grown plants. During transplant production, the greenhouse temperature should not be allowed to drop below 60°F, or the fruit in the first few clusters may become cat-faced.

Most growers use approximately 4,200 to 5,000 plants per acre. Plants are usually grown in rows 6 feet apart with plants 18 to 22 inches apart in the row. Most varieties should be pruned, staked, and trellised to obtain higher and earlier yields. A satisfactory trellis (Figures 1a and 1b) may be constructed using 1-inch-square, 5-foot-long stakes driven 10 to 12 inches into the soil between every other plant (approximately 2,100 to 2,500 stakes per acre). A simple, hand-operated stake-driving tool can be made from a 36-inch length of 2 ½-inch galvanized pipe with a cap screwed or welded on one end. Slide the pipe down over the stake, striking down repeatedly with force to drive stakes.

The first stringing should be about 10 inches above the soil and should be done when the plants are 12 to 15 inches high. A simple stringing tool can be made by drilling holes in each end of a short length of broomstick. Tomato twine is passed though the holes in the tool, which is used to pass the string along one side of the row, looping the string around each stake. It is important to keep the twine pulled tight. Proceed to the end of the row and return on the opposite side passing the string along the other side of the plants, again looping each stake. It is helpful at the first stringing to cross the string

between plants (Figure 1a). To maintain a well-trained system, subsequent strings should be put up as the plants grow. Three to four stringings are desirable, each about 6 to 10 inches higher than the preceding one. "Crossing over" or weaving with twine between plants, is not necessary after the first stringing (Figure 1b).

Pruning will help maintain the desired balance between vegetative growth and fruit production. Little or no pruning results in more vine growth with a heavier load of smaller fruit. Moderate pruning results in a smaller vine and larger fruit that mature earlier. Except for small-vined, very early-maturing tomato varieties such as 'Sunshine' (which should not be pruned at all), remove all suckers up to the one immediately below the first flower cluster (Figure 2). Leave this lateral shoot to form a fork just below the first fruit cluster. A single pruning when basal suckers are no longer than 3 or 4 inches will usually be adequate (especially on large fruited cultivars).

At transplanting, apply ½ pint of a starter fertilizer to each plant. Prepare the starter fertilizer by mixing 3 pounds of a 10-52-17 or similar analysis fertilizer in 50 gallons of water.

Higher yields and profits will be obtained using a system of producing tomatoes on 6- to 8-inch raised beds covered with black plastic mulch with drip irrigation and fertigation. Most growers prefer embossed plastic mulch, which seems to be more durable and tear-resistant than smooth plastic. When using the plasticulture system, it is extremely important to monitor moisture levels under the plastic. Many Kentucky growers have substantially reduced their yields and fruit size by incorrectly assuming that if the field is muddy between the rows, there is sufficient moisture beneath the plastic. Use tensiometers to monitor soil moisture levels and check them daily to determine irrigation intervals. Two tensiometers are recommended, one at a 6-inch depth and one at 12 inches. Contact your county Extension agent or irrigation supply sales representative for more information on setting up a drip irrigation/fertigation system.

Efficient Fertilizing

Growing a high-investment, high-dollar crop such as staked tomatoes requires that the best information available be used whenever possible. Soil testing is an important tool that should always be used to determine fertilizer needs. Apply lime if needed to raise the pH to 6.5 to 6.8. Apply phosphate, potash, magnesium, and calcium as required based on soil test results. Soil test magnesium levels should be at least 200 pounds per acre (see Appendix B). Potassium and especially phosphorus are likely to accumulate in most Kentucky soils following several years of heavy applications for vegetable crops or tobacco.

Consider the previous crop when deciding how much N to apply; there will probably be some residual N following a crop that received heavy doses of N fertilizer during the previous season. Apply 50 pounds of N per acre preplant regardless of the type of irrigation system used. Simple, handheld electronic meters are available that growers can use to quickly determine the nitrogen status of soils and plants. These Cardy meters can be used to determine residual nitrate levels in soils prior to planting as well as measure N levels in plant sap in order to assess the efficiency of fertigation.

The fertigation recommendations have worked well for growers in Kentucky when tomatoes are grown on black plastic mulch with drip irrigation. This schedule is based on a standard plant population of 4,200 plants per acre (five-row blocks, beds on 6-foot centers and 18 inches between plants within rows) using the 'Mountain Spring' variety. Fertigation should begin about 10 days after transplanting and continue throughout the season. A grower may need to modify the recommendations slightly depending on length of harvest period, soil type, previous crop, weather conditions, etc.

Calcium nitrate and potassium nitrate are commonly used water-soluble sources of nitrogen. The simplest system that has worked well on medium-textured soils in Kentucky uses calcium nitrate or potassium nitrate injected into the drip irrigation water.

Soil tests and ripening disorders. A soil test should always be done prior to planting for every site used for fresh market tomatoes. The University of Kentucky soil test reports for tomatoes now also include a Hartz ratio calculation. Based on the nutrient balance in your soil, the Hartz ratio indicates if your site is at risk for certain types of fruit-ripening disorders

FERTILIZER: *Tomatoes*

The following fertilizer rates are to be used only as guidelines. Research at the University of Kentucky and at the University of Tennessee indicates that there is no yield increase from using more than 60 lb/A K_2O or 60 lb/A of P_2O_5 when soil test P and K levels are high.

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	181-240
Medium	31-60	61-180
High	61-80	1-60
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	121-250
Medium	201-300	61-120
High	301-450	1-60
Very High	>450	0
Basal nitrogen where tomatoes:		**N**
1. follow grass-legume or legume sod		30
2. follow grass sod		50
3. are grown on continually cropped land		60

Supplemental applications: On bare ground plantings, apply an additional 30 lb of nitrogen/A as a sidedressing when the first fruits are golfball size. A second sidedress application of 30 lb N may also be desirable two or three weeks later, depending on the crop's growing condition. For plasticulture with drip on medium-textured soils, apply all recommended phosphorus and potassium requirements prior to laying plastic mulch. See "Fertigation" table for N application rates.

FERTIGATION: *Staked Tomatoes*[1]

Moderate Rate	
Actual N/week:	7 lb 8 oz/A
Calcium Nitrate	48 lb 6 oz/A 11 lb 8 oz/1,000 plants
High Rate	
Actual N/week:	10 lb/A
Calcium Nitrate	64 lb 8 oz/A 15 lb 6 oz/1,000 plants
AT-RISK SITES	
Moderate Rate	
Actual N/week:	7 lb 8 oz/A
Potassium Nitrate	57 lb 11 oz/A 13 lb 12 oz/1,000 plants
Potassium Nitrate: K provided	25 lb 6 oz/A 6 lb 1 oz/1,000 plants
High Rate	
Actual N/week:	10 lb/A
Potassium Nitrate	76 lb 15 oz/A 18 lb 5 oz/1,000 plants
Potassium Nitrate: K provided	33 lb 14 oz/A 8 lb 1 oz/1,000 plants

Total amount/season:	125 lb/A (moderate rate) 150 lb/A (high rate)
Preplant amount:	50 lb/A
Fertigated amount:	75 lb/A (moderate rate) 100 lb/A (high rate)
Growing season:	10 weeks

Fertigation can begin 10 to 14 days after transplanting.

The doses for 1,000 plants are based on a plant population of 4,200 plants/A (i.e., rows on 6 foot centers in 5-row blocks and plants 18 inches apart).

For harvest seasons extending beyond 10 weeks from transplanting, a maintenance dose of 1 to 1.5 N (6.5 to 9.7 lbs of calcium nitrate, or 11.5 lbs of potassium nitrate for "at risk" sites) per week is adequate.

IMPORTANT: If a UK soil test indicates your site is "at risk" for ripening disorders (Hartz ratio), you should alternate the fertigations listed above with those listed at left.

Potassium nitrate supplies both nitrogen and potassium and can be used as a substitute for calcium nitrate.

[1] *All recommendations assume starter fertilizer was used.*

such as blotchy ripening, yellow shoulder, and internal white tissue. This information helps determine the type of fertigation program that should be followed to help reduce your risk of having these disorders.

More often than not, ripening problems are associated with low levels of soil potassium and occur most often on soils with low cation exchange capacities (CECs). If the Hartz ratio indicates your soil is at risk, we recommend fertigation with a potassium source such as water-soluble muriate of potash (0-0-60) or potassium nitrate (14-0-45). See the "Fertigation" table for recommended rates. This is in addition to any preplant potassium.

Ripening disorders have also been associated with excess nitrogen and any conditions that restrict the tomato plant's root system (soil compaction, waterlogging, drought, etc.). During hot, dry years every other fertigation should contain potassium nitrate. More blotchy ripening occurs after extended periods of cloudy weather. Some tomato varieties are much more susceptible to blotchy ripening than others. Typically varieties recommended in this publication, while not immune to blotchy ripening, are less susceptible.

Magnesium deficiencies. Mild magnesium deficiencies sometimes appear at midseason on plants with very heavy fruit loads. A typical symptom is yellowing between the veins (veins remain green) on the lower leaves of the plant. Magnesium deficiency problems are more likely to occur on sandstone-derived soils and in very dry years. High rates of ammonium nitrate during fertigation also contribute to Mg deficiency.

Frequent fertigations with potassium or calcium nitrate could make the problem worse by competing with and displacing magnesium in soils. Mild symptoms are not generally a problem, and corrective measures are not necessary; however, symptoms may become severe and appear on the entire lower portion of the plant. In such cases, and especially on low CEC soils, preventive and/or corrective measures are required.

In general, it is recommended to have at least 200 pounds per acre of magnesium on soil tests for staked tomatoes prior to planting. Magnesium sources include dolomitic lime (11 to 12% Mg), epsom salts (= magnesium sulfate, 10 to 16% Mg), magnesium nitrate (6.3% Mg), and magnesium oxide (45 to 55% Mg). Epsom salts and magnesium oxide can be fertigated through the drip system: make weekly applications of 1 to 2 pounds actual magnesium per acre (10 to 20 pounds per acre epsom salts or 2 to 4 pounds per acre magnesium oxide). Application rates may vary with solubility of the materials (check with the manufacturer). A better long-term solution is to raise soil test magnesium levels with dolomitic lime prior to planting.

Harvesting, Grading, and Marketing

Tomatoes are easily damaged and should be handled as carefully as possible in all picking, grading, packing, and hauling operations. Tomatoes should be grasped in the hand with the thumb and

PESTICIDE SAFETY: *Tomatoes*

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Acramite 50 WS	C	12	3
Actara 25 W	C	12	0
Admire Pro	C	12	0/21[3]
Assail 30 SG	C	12	7
Avaunt 30 DG	C	12	3
Azera	C	12	0
Belay 2.13 SC	C	12	7/21[3]
Beleaf 50 SG	C	12	0
Belt SC	C	12	1
Bt products	C	4/12	0
Closer 2 SC	C	12	1
Confirm 2 F	C	4	7
Coragen 1.67 SC	-	4	1
Courier 40 SC	W	12	1
Dimethoate 4 E	W	48	7
Entrust 2 SC	C	4	1
Exirel 0.83 SE	C	21	1
Fulfill 50 DF	C	12	0
Grandevo 30 W	C	12	1
Intrepid 2 F	C	4	1
Kanemite 15 SC	C	12	1
Knack 0.86 EC	C	12	1
Malathion 8	C	12	1
Movento 2	C	24	1
Nealta 1.67 SC	C	12	3
Oberon 2 SC	C	12	1
Platinum 2 SC	C	12	30
Portal 0.4 EC	W	12	1
Pyganic 5 EC	C	12	0
Radiant SC	C	4	1
Requiem 25 EC	C	4	0
Rimon 0.83 EC	W	12	1
Scorpion 3.5 SL	C	12	1/21[3]
Sevin XLR	W	12	3
Sivantop 1.67 SL	C	12	1/45[3]
Trigard 75 WP	C	12	0
Venom 70 SG	C	12	1/21[3]
Restricted Use			
AgriMek 0.15 EC	W	12	7
Asana XL	W	12	1
Battalion 1.5 EC	DP	12	1
Baythroid XL	W	12	0
Brigade 2 EC	W	12	1
Brigadier 2	W	12	1
Danitol 2.4 EC	W	24	3
Diazinon AG 500	C	24	1
Diazinon 50 W	C	24	1
Endigo ZC	W	24	5
Hero 1.24 EC	C	12	1
Lannate 90 SP	DP	48	1
Leverage 2.7	W	12	0
Mustang Max	W	12	1
Permethrin 3.2 EC	C	12	0
Proaxis 0.5 EC	C	24	5
Proclaim 5 WDG	C	48	7
Renounce 20 WP	C	12	0
Voliam xpress	W	24	5
Vydate L	DP	48	3
Warrior II	W	24	5

PESTICIDE SAFETY: *Tomatoes*

	Signal[1]	Re-entry (hrs)	Harvest (days)
FUNGICIDES			
Actigard 50 WG	C	12	14
Aftershock	C	12	3
Ag Streptomycin, Agri-Mycin 17, Harbour	C	12	n/a
Aliette WDG[5]	C	12	14
Ariston	C	12	3
Blocker Flowable/4F	C	12	0
Botran 75 W	C	12	10
Cabrio EG	C	12	0
Chlorothalonil[2]	D	12	0
Fixed coppers[2]	D	24/48[4]	0
Curzate 60 DF	W	12	3
Endura	W	12	0
Evito 480 SC	C	12	3
Flint	C	12	3
Fontelis	C	12	0
Forum SC	C	12	4
Fracture	C	4	0
Gavel 75 DF	C	48	3
Inspire Super	C	12	0
Mancozeb[2]	C	24	5
ManKocide	D	24	5
Meta Star 2EC AG	W	48	28
Priaxor	C	12	7
Quadris	C	4	0
Quadris Opti	W	12	0
Quadris Top	C	12	0
Presidio	C	12	2
Previcur Flex	C	12	5
Rally 40 WSP	W	24	0
Ranman	C	12	0
Reason 500 SC	C	12	14
Revus	C	4	1
Revus Top	C	12	1
Ridomil Gold Bravo SC	W	48	14
Ridomil Gold SL/GR	W	48	28
Ridomil Gold GR	C	48	7
Ridomil Gold Copper	D	48	14
Ridomil Gold MZ	C	48	5
Scala	C	12	1
Switch 62.5 WG	C	12	0
Tanos	C	12	3
Ultra Flourish	W	48	28
Vivando	C	12	0
Zampro	C	12	4
Zing!	C	12	5
Ziram[2]	D	48	7

[1] *W: Warning, C: Caution, D: Danger; P: Poison*
[2] *Several formulations are marketed. See the general introduction for more details on fungicides.*
[3] *Dependent on application rates and types, see label.*
[4] *Varies by formulation; consult labels carefully.*
[5] *The use of Aliette in the following Kentucky counties has certain restrictions to protect endangered freshwater mollusks and their habitat, so read labels carefully: Campbell, Green, Hart, Kenton, Logan, Marshall, Rockcastle, Todd, Warren, and Wayne.*

forefinger pressing against the stem, forcing the stem from the fruit.

When to harvest depends on what market you are growing for. "Vine-ripe" tomatoes that are to be shipped moderate distances are usually harvested at the "breaker" stage or at the "turning" stage. The breaker stage occurs when pink color first becomes noticeable, that is, when the white "star" at the blossom end of the fruit has turned pink, tannish-yellow, or red. In this case, 10 percent or less of the fruit surface shows the color change. Fruits harvested at the breaker stage can be handled and shipped with less damage than those with more color. "Turning" tomatoes are those with more than 10 percent but less than 30 percent of the fruit surface showing a color change from green to tannish-yellow, pink, or red.

Vine-ripe tomatoes must be harvested often (normally twice a week) to avoid having too many red fruit. Tomatoes for local markets should be harvested with much more color, according to customer preferences. Mature green tomatoes for distant markets are picked when the white "star" first appears on the blossom end. This indicates that seed are mature and that fruit will develop normal color when exposed to ethylene gas in a ripening room. Mature green tomatoes are normally harvested only three or four times during the season. Mature green tomatoes should be stored at 55° to 70°F and 85 to 90 percent relative humidity. Firm, ripe fruit should be stored at 45° to 50°F and 85 to 90 percent relative humidity.

All tomatoes must be sorted or graded before going to market. Tomatoes received at Kentucky's larger markets are often graded in the presence of a federal inspector. The USDA's Agricultural Marketing Service has established precise standards for grades of tomatoes. These are available on the Internet at ams.usda.gov/AMSv1.0/freshmarketvegetablestandards. Size classifications for both No. 1 and No. 2 grade tomatoes are shown in the table above (the USDA "small" category is not shown because there is little market for tomatoes of this size). Growers should be aware that some buyers may have their own size classifications that differ from these. "U.S. Combination" grade consists of a combination of Nos. 1 and 2, provided that at least 60 percent by count meet the requirements of No. 1 grade.

All grades must be free from decay, freezing injury, and sunscald and be reasonably well formed. No. 2 grade tomatoes differ from No. 1 grade in that they may be "slightly rough" and "reasonably well formed," whereas No. 1's must be "well formed" and "smooth." Some buyers will also consider fruits with 60 percent or more color a No. 2 grade.

Pack in the type and size container your market requires. Tomatoes are usually packed in 20 or 25 pounds cardboard cartons and are packed as tightly as possible without bruising. Packs must be of uniform size, color, and quality.

Growers should evaluate their marketing opportunities before the first seed is sown. Roadside stands, U-pick, delivery to local grocers, cooperatives, farmers' markets, and independent buyers are potential channels for selling produce. Contacts need to be made before planting. Beginners should consider the low-volume retail sales opportunities at farmers' markets or roadside stands. Large-scale production usually requires knowledge of wholesale marketing channels that can handle larger volumes of produce. Research at the University of Kentucky has shown that all marketing channels in the state are currently underused.

TOMATO SIZE CLASSES
The numbers in parentheses after each category indicate the number of rows and columns of fruit in a box: 6 x 7, for example indicates that in most cases a box of tomatoes in this size category will consist of an arrangement of 6 rows by 7 columns of fruits in one layer.

Size Class	Minimum Diameter[1] (in)	Maximum Diameter[2] (in)
Medium (6 x 7)	2 1/4	2 17/32
Large (6 x 6)	2 1/2	2 25/32
Extra Large (5 x 5)	2 3/4 and above	
Maximum Large/ Jumbo[3] (4 x 4 or 4 x 5)	3 1/2 and above	

[1] Will not pass through a round opening of this diameter when tomato is placed with its greatest traverse diameter across the opening.
[2] Will pass through a round opening of this diameter in any position.
[3] The USDA no longer lists the Maximum Large or Jumbo classification, however, many buyers require this size pack (4 x 4's or 4 x 5's). The old USDA Extra Large class had a range of 2 7/8 minimum to 3 15/32 maximum.

Common Diseases/Management

General Practices

Control of foliar and stem diseases requires routine sprays of both bactericides and fungicides for most of the season. Timing of sprays and good coverage are critical to disease control (see Introduction for tips on sprayer setup and calibration). A sample fungicide spray program is included below. In addition to regular sprays, start with disease-free transplants and locate production fields away from potatoes and tobacco. Choose sites that have good air and soil drainage and have been rotated out of solanaceous (nightshade family) and cucurbit crops to grasses (fescue, small grains, or corn).

Anthracnose (ripe rot). The following recommendations for anthracnose are written for processing crops. With fresh-market tomatoes, the program used for early blight should be sufficient to control anthracnose. Susceptibility increases rapidly in over-mature fruit, especially after applications of ethephon or other fruit ripening agents. Hot-water seed treatment will reduce the potential for anthracnose. A two- to four-year rotation to crops not related to tomatoes, together with good weed control during the rotation, will prevent pathogen buildup in soil. Fungicide sprays are needed on a seven- to 10-day schedule from fruit set through harvest.

Bacterial canker. Canker is difficult to control; no single, effective control measure is available. Management of this disease requires an integrated approach. Prevention is the only practical control strategy. The keys to prevention are avoidance, rotation, sanitation, and slowing the buildup of epiphytic populations (those present on plant surfaces) of the canker pathogen.

- **Avoidance, sanitation, and rotation.** In fields where bacterial canker has occurred, all items associated with tomato production (transplant and field operations), such as stakes, twine, and tools, should be either discarded, sanitized with steam, or washed with a 10% bleach solution. Fields with a history of canker should be planted for at least three years to crops other than tomatoes, tobacco, eggplant, peppers, or potatoes. Control broadleaf weeds (especially members of the nightshade family) during the rotation and around field borders. Chop or disk all crop residues into the soil promptly after harvest to encourage more rapid decline of the bacterium.

SAMPLE FUNGICIDE PROGRAM:
Staked Tomatoes

Refer to the "Fungicide" table in this chapter for product rates; read product labels carefully before application.

WEEKS AFTER TRANSPLANTING	
1	mancozeb + copper + Actigard 50W
2	mancozeb + copper
3	Quadris or Cabrio + mancozeb + Actigard 50W
4	mancozeb + copper
5	Priaxor or Fontelis + mancozeb + Actigard 50W
6	mancozeb + copper
7	Quadris or Cabrio + mancozeb + Actigard 50W
8	mancozeb + copper
WEEKS DURING HARVEST	
9	chlorothalonil + copper
10	Priaxor or Fontelis + copper
11	chlorothalonil + copper
12	Priaxor or Fontelis + copper
13	chlorothalonil + copper
14	chlorothalonil + copper

Finish season with chlorothalonil + copper

Plants with canker should be carefully rogued out and destroyed, avoided, or worked last when conducting field operations. Removal of infected plants is helpful in reducing spread if disease incidence is low (about 100 plants per acre or fewer); little benefit occurs when the incidence is higher. Less disease develops in fields where suckers are removed when very small or in those where no pruning has been practiced. Avoid working in fields while foliage is wet, especially early in the season.

- **Seeds and transplants.** Setting infected transplants is the main cause of canker epidemics in Kentucky; therefore, planting clean transplants is the most important control measure. Buy transplants from certified, disease-free operations. If producing your own plants, follow sanitary practices. All greenhouse materials (flats, tables, containers, hoses, etc.) should be disinfected prior to use. Use only sterilized potting mix. Handle items only when dry and do not clip plants. Check plants regularly for symptoms. If canker is found in even one seedling in the greenhouse, it is very likely that many more are infected—even if they show no symptoms. *In these cases, all transplants in the affected house should be destroyed*. If symptomatic plants are culled, and the remaining, asymptomatic plants are planted or sold, an epidemic of canker in the field will be the likely outcome. Do not water excessively, as the splash will favor dispersal and development of the canker bacterium and other pathogens.
- **Use certified, disease-free seed.** Hot-water treatment of seed will reduce seed populations of the canker bacterium (see Appendix H). In the greenhouse, use a spray program with fixed coppers one to two weeks after emergence. Mancozeb can be added to the mix for older plants.

  If transplants are being produced in an outdoor bed, agricultural streptomycin (Agri-Mycin 17) at 1.25 teaspoons/gallon of water can be alternated with or substituted for copper. *Streptomycin is not labeled for greenhouse use*. It is, however, possible to make at least one application (24-hour re-entry) after transplants have been removed from the greenhouse, but before transplanting (during the hardening-off period, for example).
- **Fixed coppers.** In staked tomatoes, begin applications of fixed copper + mancozeb immediately after transplanting and continue at seven-day intervals during wet weather.

Bacterial speck, bacterial spot. The incidence and severity of bacterial diseases (spot, speck, and canker) have markedly increased recently. Follow the steps listed previously under bacterial canker for control of these diseases in transplant production. Use only disease-free seedlings and plant into land that has been actively rotated away from solanaceous crops for at least 2 years. Actigard 50WG has performed well in the control of bacterial speck and spot in many tests around the country. Actigard can be applied on a seven- to 14-day schedule (eight applications maximum) beginning one week after transplanting or emergence. Use the lowest rate on smaller plants and increase the dosage as plants grow; apply in a minimum of 30 gallons per acre of water initially and increase volume as the rate increases (see label for specifics). A 14-day interval will provide acceptable disease control with fewer negative effects on plant growth or yields. Fixed coppers are effective against bacterial populations that are still sensitive to these materials. In addition, copper is needed on most tomato crops for prevention of bacterial canker. Coppers are more effective when combined with mancozeb. Premixed materials such as ManKocide and Cuprofix Disperss MZ are available. Maneb (Maneb 80, Manex) is no longer produced and existing supplies cannot be used legally on tomato.

Blossom end rot. The most effective control is to maintain uniform soil moisture conditions throughout the growing season and to avoid damaging roots during cultivation, fertilization, or by diseases. Foliar calcium sprays are not an effective treatment as a rule, but proper soil calcium levels should be maintained.

Buckeye fruit rot (*Phytophthora*), Phytophthora root and stem rot, and Pythium stem and fruit rot. Avoid low areas and fields with poor drainage or heavy soils. Use well-shaped, raised beds with plastic mulch to reduce surface moisture and stake plants to reduce contact with soil. Rotate at least three years away from crops in the nightshade family (tobacco, peppers, potatoes, eggplants, and cucurbits). Fungicides can be helpful in control of this disease if applied preventively.

Damping-off and stem rots of transplants. Transplants (greenhouse or outside plant beds) should be grown in commercial soilless mixes or in fumigated or sterilized soil. Avoid excessive watering and maintain adequate ventilation. Most commercial seed is pretreated with fungicides for damping-off; if not treated (dust, pellet, slurry as per label), use Captan WP at 1 teaspoon per pound of seed. Pre-fungicide treatment with hot water, bleach, or trisodium phosphate (TSP) may also improve disease control. Several fungicides can be used in the greenhouse for stem rots caused by *Botrytis* and *Sclerotinia*. Mefenoxam or metalaxyl can be used in the field to control seedling diseases caused by *Pythium*. Ranman and Previcur Flex can be used in transplant production for control of *Pythium*.

Early blight, leaf mold (gray leaf mold), gray leaf spot, Septoria leaf spot. Management of foliar diseases begins with disease-free transplants. A sound foliar fungicide program is essential for control of these diseases during wet years. Varieties with some resistance or tolerance will reduce, but not eliminate, the need for fungicides. In general, early maturing varieties are more susceptible to early blight than later maturing ones. It is possible to lengthen spray intervals from seven days to 10 days for early blight control with resistant varieties such as 'Mountain Fresh Plus' (see "Varieties" table) assuming *Septoria* is not also active. Rotate away from solanaceous crops for two or more years, and control weeds during the rotation. A routine fungicide program is needed in most years to manage Early blight and Septoria leaf spot. Rotation of certain protectant fungicides (chlorothalonil, mancozeb, or fixed copper) is a must. During wet seasons or with fall crops, start sprays within three days of transplanting and repeat at seven- to 10-day intervals; closer intervals are needed during wet seasons or with high disease pressure. During dry seasons, it is possible to wait until first symptoms before starting sprays; however, applications should be started by mid- to late June for spring plantings, regardless of weather conditions. Maintain rapid growth through proper fertilization to minimize disease. Crop rotations used for other diseases are an aid to control.

Fusarium wilt, Verticillium wilt. Plant varieties with "VF" resistance (see "Varieties" table). Avoid fields with a history of Verticillium wilt. Preplant soil fumigation is economical only with high-value, fresh-market tomatoes (see "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 16). If wilt disease occurs in a resistant variety, have it correctly diagnosed by the UK Diagnostic Lab.

Late blight. This disease is an infrequent problem; however, notable outbreaks occurred in 2009, 2010, and 2013. A fungicide program designed for early blight should be adequate to manage late blight. Under very strong disease pressure, chlorothalonil will perform better than fixed coppers and mancozeb. Forum, Gavel, Presidio, Ranman, Revus, Tanos, or Zampro may be needed under severe disease pressure.

Mefenoxam-resistant (tolerant) strains of the late blight fungus have been found in Kentucky, so products containing this active ingredient (Ridomil Gold Bravo, Ridomil Gold/Copper, and Ridomil Gold MZ) are less likely to be effective than some of the other materials that are available.

Nematodes. Some root-knot-resistant varieties are available. Rotate away from tomatoes and related crops frequently; two years to tall fescue provides excellent control of root-knot. Soil samples can be submitted for quantification of nematode populations where nematode problems have been diagnosed. Submit samples to either a commercial lab or a university lab in another state, as this service is not provided by the University of Kentucky (diagnostic services only are available). Use preplant soil fumigation where nematode populations are moderate to high and where rotation is not practical. See "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 16 for more information.

Sclerotinia stem rot (timber rot) and Botrytis fruit and stem rot. Avoid setting infected transplants into the field, and do not use fields with a history of *Sclerotinia.* Take steps to improve air movement in the planting. Cabrio and Priaxor are labeled for suppression of of timber rot. Endura and Fontelis are labeled for *Botrytis* but have significantly reduced *Sclerotinia,* too, in some tests when used soon after transplanting.

Powdery mildew. This disease is most likely to occur in greenhouses and high tunnels, but can be found on field-grown tomatoes in drought years. Fungicide programs typically suppress powdery mildew.

Southern blight. Avoid fields with a history of this disease and rotate problem fields with sod crops. *Sclerotium rolfsii,* the causal agent, has a wide host range and is common in Kentucky on tobacco, soybeans, white clover, peppers, and tomatoes. Deep plow to bury sclerotia and crop debris. Remove and destroy infected plants promptly. Fungicides may be applied to soil before planting or at planting, or as a stem-directed spray after planting depending on the product.

Viruses. The virus diseases commonly seen in Kentucky in tomato are tomato spotted wilt, tobacco mosaic, tomato mosaic, Potato Virus X, tobacco etch, cucumber mosaic, Potato Virus Y, and alfalfa mosaic. Viruses can be difficult to control, but the following guidelines are helpful in managing virus diseases. Produce transplants in isolation from thrips and their weed and ornamental crop hosts. Control weeds in tomato fields and maintain a weed-free zone around fields. To prevent spread of TMV, do not use tobacco products during seedling production or transplanting. Washing hands with soap and water before handling tomatoes should be mandatory. Production of heirloom tomatoes in conjunction with other fresh market cultivars increases the chances of TMV infection, since some heirloom seed sources are contaminated with TMV. Planting TMV-resistant tobaccos will greatly reduce the amount of available inoculum on farms where tomato and tobacco are grown together. Plant certified disease-free seed. Questionable seed lots should be treated with 10% trisodium phosphate (TSP) or bleach (see Appendix H). To avoid PVX in greenhouses, do not handle potatoes before working with tomato plants. Control weeds around fields or plant into sites surrounded by small grains or corn. Do not plant tomatoes near or adjacent to tobacco, potatoes, or peppers—the farther away, the better. Great disease reduction can be achieved by planting at least 200 yards away from these crops. The risk of TEV, PVY, and CMV is higher for fall plantings.

Greenhouse Tomato Diseases

Foliar Diseases

Bacterial diseases, powdery mildew, leaf mold (gray leaf mold), Botrytis gray mold, early blight, and late blight. A number of foliar diseases common in field-grown tomatoes also occur in the greenhouse. Maintain temperatures of at least 65°F in the greenhouse, along with good ventilation (air movement). Water plants so as to avoid long periods of leaf wetness. Scout plants regularly for symptoms. Resistant varieties are available for leaf mold, but results are variable because of the ability of the leaf mold pathogen to mutate and no longer be affected by host resistance. Growers should rely on cultural practices and fungicides to control leaf mold. A spray program is necessary at the onset of the first symptoms of disease or during cool, overcast, or foggy conditions. See the table on page 18 for a list of greenhouse fungicides.

Stem Diseases

Botrytis stem canker and Sclerotinia timber rot. Ensure adequate ventiliation, and spray fungicides when conditions favor disease. Botran 75W at 1 pound per 100 gallons of water per treated acre, sprayed on the stems from the ground up to a height of 24 inches, can be used to control cankers caused by *Botrytis.* This treatment will also suppress stem cankers caused by *Sclerotinia.* Fontelis will also suppress these diseases. See the table on page 18 for a list of greenhouse fungicides.

Fusarium crown and root rot. Control of *Fusarium* is achieved primarily through the use of sanitation and planting resistant varieties (see "Varieties" table). Sanitize the greenhouse and everything in it by solarization, steam, or fumigation. Bleach treatment of seed will reduce seed-borne inoculum. This disease is worse on stressed tomato plants.

Tobacco/tomato mosaic virus. See "Viruses" heading under field tomatoes for more details. Use bleach-treated seed as indicated in Appendix H. On known TMV suspects, use the TSP treatment. Dip hands in milk before handling plants. Use resistant varieties.

Root Diseases

Pythium and Phytophthora root rots. These diseases are common in hydroponic systems, and can be difficult to control once established. Sanitation is crucial in avoiding the introduction of *Pythium* and *Phytophthora* into the production system, and keeping field soil out is perhaps the most important consideration. Previcur Flex and Terramaster EC can be applied via irrigation or as drenches for suppression of root rots caused by either *Pythium* or *Phytophthora.* See the table on page 18 for a list of greenhouse fungicides.

INSECT CONTROL: *Tomatoes*[1,2]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
SOIL APPLICATION			
Aphids, Flea Beetles, Colorado Potato Beetle: Do not use foliar sprays of Actara, Assail, Belay, Provado, or Venom following soil applications of Admire, Belay, Platinum, or Venom.			
Admire Pro	7 to 10.5 fl oz	10.5 fl oz	See label for application methods.
Belay 2.13 SC	9 to 12 fl oz	12 fl oz	At planting only.
Coragen 1.67 SC	3.5 to 5 fl oz	15.4 fl oz	Soil and foliar applications possible for CPB. See label for limitations.
Platinum 2 SC	5 to 8 fl oz	8 fl oz	See label for application alternatives. Also helps to control thrips.
Sivanto 1.67 SL	21 to 28 fl oz	28 fl oz	For aphids and whiteflies.
Venom 70 SG	5 to 6 oz	12 oz	

(continued on next page)

INSECT CONTROL: *Tomatoes[1,2] (continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
FOLIAR APPLICATION			
Aphids: Treat if aphids are found on 50% of leaves.			
Actara 25 WDG	2 to 3 oz	11 oz	Allow 5 days between applications. Not during bloom. Field use only.
Admire Pro	1.3 to 2.2 fl oz	6.7 fl oz	Allow 7 days between applications. Not during bloom.
Assail 30 SG	2 to 4 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 7 days between applications. Not during bloom.
Beleaf 50 WDG	2 to 2.8 oz	8.4 oz	Allow 7 days between applications.
Closer 2 SC	1.5 to 2 fl oz	17 fl oz	Allow 7 days between applciations.
Dimethoate 4 E	8 to 16 fl oz	16 fl oz	Allow 6 days between applications.
Exirel 0.83 SE	13.5 to 20 fl oz	61.5 fl oz	Allow 5 days between applications.
Fulfill 50 DF	2.75 oz	5.5 oz	Allow 7 days between applications.
Lannate 90 SP	0.5 to 1 lb	8 lb	-
Malathion 8	1.5 pt	4 applications	Allow 5 days between applications.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications. Field use only.
Requiem 25 EC	2 to 3 qt	-	-
Sivanto 1.67 SL	7 to 12 fl oz	28 fl oz	Allow 7 days between applications.
Beet Armyworm: First detected in Kentucky in 1993, this insect can cause serious losses when present. A southern insect that occur sporadically in Kentucky. Large larvae are difficult to control effectively with insecticides.			
Avaunt 30 DG	3.5 oz	14 oz	Allow 5 days between applications.
Belt 2 SC	1.5 fl oz	4.5 fl oz	Allow 3 days between applications.
Coragen 1.67 SC	3.5 to 5 fl oz	15.4 fl oz	Soil and foliar applications possible. See label for limitations.
Exirel 0.83 SE	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	-
Proclaim 5 WDG	2.4 to 4.8 oz	28.8 oz	Allow 7 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Colorado Potato Beetle: This is a pest of tomato transplants. This pest has the ability to develop resistance to all major classes of insecticides. Do not tank-mix insecticides with the same mode of action and frequently rotate among insecticides with different modes of action to discourage resistance. Treat for Colorado potato beetle if an average of 1 adult larva or egg mass per plant is found and plants are less than 12 inches tall (staked). IRAC Codes: Insecticides followed by the same number share the same mode of action.			
Actara 25 W (4A)	2 to 3 oz	11 oz	Allow 5 days between applications. Not during bloom.
Admire Pro (4A)	1.3 to 2.2 fl oz	6.7 fl oz	Allow 5 days between applications. Not during bloom.
AgriMek 0.15 EC (6)	8 to 16 fl oz	48 fl oz	Allow 7 days between applications.
Asana XL (3)	5.8 to 9.6 fl oz	96 fl oz	-
Assail 30 SG (4A)	1.5 to 2.5 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Battalion 1.5 EC (3)	1.5 to 2.4 fl oz	14.4 fl oz	-
Baythroid XL (3)	1.6 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Belay 2.13 SC (4A)	3 to 4 fl oz	12 fl oz	Allow 7 days between applications. Not during bloom.
Coragen 1.67 SC (28)	3.5 to 5 fl oz	15.4 fl oz	Soil and foliar applications possible. See label for limitations.
Exirel 0.83 SE	13.5 to 20 fl oz	61.5 fl oz	Allow 5 days between applications.
Mustang Max (3)	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC (3)	2 to 8 fl oz	48 fl oz	Not for use on cherry tomatoes.
Proaxis 0.5 EC (3)	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Radiant SC (5)	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC (15)	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Sivanto 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Venom 70 SG (4A)	1 to 4 oz	6 oz	For foliar applications.
Warrior II (3)	1.28 to 1.92 fl oz	23 fl oz	Allow 5 days between applications.
Cutworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Battalion 1.5 EC	1.5 to 2.4 fl oz	14.4 fl oz	-
Belt 2 SC	1.5 fl oz	4.5 fl oz	Allow 3 days between applications.
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between applications.
Mustang Max	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	46 fl oz	Allow 5 days between applications.
Sevin XLR	2 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Warrior II	0.96 to 1.6 fl oz	23 fl oz	Allow 5 days between applications.
Fruitworms: Carefully monitor plants for eggs on undersides of leaves, often near flower clusters. Treat if an average of more than 1 egg or larvae per 40 plants is found.			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Avaunt 30 DG	3.5 oz	14 oz	Allow 5 days between applications.
Battalion 1.5 EC	1.5 to 2.4 fl oz	14.4 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Belt 2 SC	1.5 fl oz	4.5 fl oz	Allow 3 days between applications.
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between applications.
Coragen 1.67 SC	3.5 to 5 fl oz	15.4 fl oz	Soil and foliar applications possible. See label for limitations.
Danitol 2.4 EC	10.67 fl oz	42.6 fl oz	Allow 7 days between applications.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	-
Lannate 90 SP	0.5 to 1 lb	8 lb	-
Mustang Max	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	2 to 8 fl oz	48 fl oz	Not for use on cherry tomatoes.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.

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INSECT CONTROL: *Tomatoes[1,2] (continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Sevin XLR	1 to 2 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	23 fl oz	Allow 5 days between applications.
Grasshoppers			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between sprays.
Mustang Max	3.2 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Warrior II	1.28 to 1.92 fl oz	23 fl oz	Allow 5 days between applications.
Hornworms: Treat if an average of more than 1 hornworm per 5 plants is found.			
Asana XL	2.9 to 5.8 fl oz	96 fl oz	-
Avaunt 30 DG	2.5 to 3.5 oz	14 oz	Allow 5 days between applications.
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Belt 2 SC	1.5 fl oz	4.5 fl oz	Allow 3 days between applications.
Bt var kurstaki products	See labels	-	-
Coragen 1.67 SC	2 to 5 fl oz	15.4 fl oz	Soil and foliar applications possible. See label for limitations.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	-
Mustang Max	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	48 fl oz	Not for use on cherry tomatoes.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	46 fl oz	Allow 5 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Sevin XLR	1 to 2 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Warrior II	0.96 to 1.6 fl oz	23 fl oz	Allow 5 days between applications.
Flea Beetles: Maintain defoliation below 5 to 10%.			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Battalion 1.5 EC	1.5 to 2.4 fl oz	14.4 fl oz	-
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 7 days between applications. Not during bloom.
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between applications.
Mustang Max	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	
Sevin XLR	0.5 to 1 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	-
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Mites			
Acramite 50 WS	0.75 to 1 lb	1 application	For spider mites.
AgriMek 0.15 EC	8 to 16 fl oz	48 fl oz	Allow 7 days between applications. For broad, russett, and spider mites.
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between applications. For end of season control. For spider mites only.
Danitol 2.4 EC	10.67 fl oz	42.6 fl oz	Allow 7 days between applications. For end-of-season control. For spider mites only.
Kanemite 15 SC	31 fl oz	62 fl oz	Allow 21 days between applications. For spider mites.
Movento 2 SC	4 to 5 fl oz	10 fl oz	For broad and russett mites. Allow 7 days between applications.
Nealta 1.67 SC	13.7 fl oz	27.4 fl oz	Allow 14 days between applications. For spider mites only.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Allow 7 days between applications. For broad, russett, and spider mites.
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications. For broad, russett, and spider mites.
Stink bugs, Leaf-footed bugs: Treat if an average of more than 1 stink bug per 40 plants or 0.75% damaged fruit is found.			
Actara 25 WDG	3 to 5.5 oz	11 oz	Allow 5 days between applications. Not during bloom.
Battalion 1.5 EC	1.5 to 2.4 fl oz	14.4 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 7 days between applications. Not during bloom.
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between applications.
Danitol 2.4 EC	10.67 to 16 fl oz	42.6 fl oz	Allow 7 days between applications.
Mustang Max	3.2 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	23 fl oz	Allow 5 days between applications.
Thrips			
Assail 30 SG	4 oz	16 oz	Allow 7 days between applications.
Baythoid XL	2.1 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between applications.
Radiant SC	6 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Requiem 25 EC	2 to 4 qt	-	-
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Venom 30 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Whiteflies			
Actara 25 WDG	3.0 to 5.5 oz	11 oz	Allow 5 days between applications. Not during bloom.
Admire Pro	1.3 to 2.2 fl oz	6.7 fl oz	Allow 5 days between applications. Not during bloom.
Assail 30 SG	2.5 to 4 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Courier 40 SC	9 to 13.6 fl oz	2 applications	Allow 28 days between applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use a spray adjuvant.

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INSECT CONTROL: *Tomatoes[1,2] (continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Knack 0.86 EC	8 to 10 fl oz	20 fl oz	Allow 14 days between applications.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Allow 7 days between applications.
Portal 0.4 EC	2 pt	4 pt	-
Requiem 25 EC	2 to 3 qt	-	-
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Sivanto 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
INSECT CONTROL: GREENHOUSE/HIGH TUNNEL GROWN TOMATOES1,2			
Mites: Two spotted spider mite, broad mite, and tomato russett mite			
Acramite 50 WS	0.75 to 1 lb	1 application	For spider mites only.
AgriMek 0.15 EC	8 to 16 fl oz	48 fl oz	Allow 7 days between applications. For broad, russett, and spider mites.
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between applications. For end of season control. For spider mites only.
Danitol 2.4 EC	10.67 fl oz	42.6 fl oz	Allow 7 days between applications. For end-of-season control. For spider mites only.
Kanemite 15 SC	31 fl oz	62 fl oz	Allow 21 days between applications. For spider mites only.
Nealta 1.67 SC	13.7 fl oz	27.4 fl oz	Allow 14 days between applications. For spider mites only.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Allow 7 days between applications. For broad, russett, and spider mites.
Thrips			
Assail 30 SG	4 oz	16 oz	Allow 7 days between applications.
Baythoid XL	2.1 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Brigade 2 E	2.1 to 5.2 fl oz	4 applications	Allow 10 days between applications.
Requiem 25 EC	2 to 4 qt	-	-
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Venom 30 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Whiteflies			
Admire Pro	1.3 to 2.2 fl oz	6.7 fl oz	Allow 5 days between applications. Not during bloom.
Assail 30 SG	2.5 to 4 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Courier 40 SC	9 to 13.6 fl oz	2 applications	Allow 28 days between applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use a spray adjuvant.
Knack 0.86 EC	8 to 10 fl oz	20 fl oz	Allow 14 days between applications.
Requiem 25 EC	2 to 3 qt	-	-
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Sivanto 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.

[1] See An IPM Scouting Guide for Common Problems of Solanaceous Crops in Kentucky (ID-172) for photos of pests.
[2] Generic products available (Appendix E).

WEED CONTROL: *Tomato—Transplanted*

Product Amt/A	Lb A.I./A	Comments
0.5-1.6 fl oz Aim 1.9 EW	0.008-0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
6-14 lb Dacthal W-75	4.5-10.5 DCPA	For pre-emergence control of annual grasses and small-seeded broadleaves. Over-the-top application 4 to 6 weeks after transplanting is safe to plants. Plants should be well established. Do not apply if growing conditions are poor (ie. cool, wet weather)
2-4 lb Devrinol 50 DF	1-2 napropamide	For pre-emergence control of annual grasses and broadleaf weeds. Apply before transplanting and water-in or incorporate to a depth of 1 to 2 inches. Can be applied on bare ground middles between beds of plastic 24 hours before rain or if watered-in or incorporated. To avoid injury, do not replant with crops not specified on the label until 12 months if using the 4-lb rate.
1-2 pt Dual Magnum	0.95-1.90 s-metolachlor	For pre-emergent control of selected weed species. In transplanted tomatoes if applied preplant incorporated, transplant to a depth greater than incorporation and use the lower rate range to avoid injury. Do not plant when cool, wet or poor growing conditions exist. Reduce risk by applying seven or more days prior to transplant. PHI = 90 days.
1-2 pt Goal 2XL	0.25-0.5 oxyfluorfen	For pre-emergence and post-emergence control of certain annual grasses and most broadleaves. For fallow bed preparation only. Best if used with glyphosate for control of winter annual broadleaf weeds. Min. 30 days between application and transplanting.
2-4 pt Gramoxone Inteon	0.69-1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
4-6.4 oz League	0.19-0.3 imazosulfuron	For control of certain annual broadleaf weeds and nutsedge. Rainfall or irrigation needed for activation. No more than 6.4 oz per year. No more than one application per year.
0.5-1.5 pt Poast 1.5	0.09-0.49 sethoxydim	For control of actively growing annual grasses and suppression of perennial grasses only. Use high rate on Johnson grass. PHI = 20 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
1.5-2 pt Prowl H2O 3.8 E	0.7-1 pendimethalin	For pre-emergence control of broadleaves and grasses. Apply broadcast preplant incorporated or broadcast preplant surface application prior to transplanting tomato, or as a post-directed application to transplanted and established plant. PHI = 70 days.
2-4 oz Matrix 25 DF	0.031-0.062 rimsulfuron	For pre-emergence control of broadleaves and grasses. Apply pre-emergence or post-emergence to actively growing weeds. PHI = 45 days.
16-22 fl oz Roundup Weather-Max 5.5L	0.69-0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop. Do not make hooded or shielded sprayer applications to row middles because of the potential for crop injury.

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WEED CONTROL: *Tomato—Transplanted (continued)*

Product Amt/A	Lb A.I./A	Comments
0.5-1 oz Sandea 75 DF	0.023-0.047 halosulfuron	For control of broadleaf weeds and yellow nutsedge. For transplanted tomato: may be applied preplant under the plastic. Apply after final bed shaping but before installation of plastic. Transplant 7 days after plastic installation. As a post-transplant application, Sandea can also be applied over the top or as a directed spray or with shields, 14 days after plastic installation. Max. 2 applications/crop and 2 oz/A per season. See label for row middle applications and direct-seeded tomato.
9-32 fl oz Select Max	0.07-0.24 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. PHI = 20 days.
2.25-6 fl oz Spartan 4F	0.07-0.19 sulfentrazone	Only for transplanted tomato. May be applied as a broadcast or banded treatment prior to transplant.
0.3-1.3 lb TriCor DF	0.2-1 metribuzin	For control of annual grasses and broadleaves. Preplant: apply in min. 10 gal water/A immediately before transplanting and incorporate 2 to 4 inches. Best if used with Treflan to improve weed control. Transplant tomato with roots below herbicide zone. Post-emergence broadcast (0.3 to 0.6 lb/A) or post-emergence directed (0.6 to 1.3 lb/A): apply when plants have recovered from transplant shock and new growth is evident (about 2 weeks). Do not apply within 24 hours of other pesticides or within 3 days after cool, wet, or cloudy weather. Allow 14 days between applications. May be applied to plastic mulch row middles. PHI = 7 days.
1.25-2 pt Treflan HFP 4 E	0.62-1 trifluralin	For pre-emergence control of annual grasses and broadleaf weeds. Transplanted tomato: Apply and incorporate before transplanting or apply post-transplant as a directed spray to soil between rows and beneath plants and incorporate. See label for direct-seeded tomato.

DISEASE CONTROL: *Tomatoes*

Product	F$RAC Code	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Anthracnose, Early Blight, Leaf Mold, Gray Leaf Spot, Botrytis Gray Mold, Septoria Leaf Spot, Powdery Mildew					
Aftershock	11	3	2 to 5.7 fl oz	4 apps	Early blight. Apply before disease onset, continue every 7 to 10 days. Alternate with another FRAC code.
Ariston	M/27	3	1.9 - 3.0 pt	17.5 pt	Apply before disease onset, continue every 7 to 14 days.
Azoxystrobin[4]					Not for Botrytis, gray leaf spot/mold. Apply 21 days after transplanting or 35 days after seeding and continue every 7 to 21 days.
Azoxy 2SC	11	0	6 to 15.5 fl oz[3]	5 apps	
AzoxyStar	11	0	6 to 15.5 fl oz[3]	5 apps	
Quadris	11	0	6 to 15.5 fl oz[3]	5 apps	
Satori	11	0	6 to 15.5 fl oz[3]	5 apps	
Botran 75 W	14	10	1 lb	4 apps	Botrytis stem canker. Greenhouse only. Apply when conditions favor disease and continue every 7 days during favorable periods. Spray stem of plant from ground level to a height of 18 to 24 in.
Chlorothalonil[4]					Prior to fruit set. Apply before disease onset; continue every 7 to 10 days. Use 1.375 to 2 pt/A rate or equivalent (dry formulations). After fruit set. Increase rate to 2 to 2.75 pt/A (or equivalent for dry formulations), apply every 7 to 14 days.
Bravo Ultrex	M	0	1.3 to 2.6 lb	18.3 lb	
Bravo WeatherStik	M	0	1.375 to 2.75 pt	20 pt	
Cabrio	11	0	8 to 16 oz	6 apps	Not for gray leaf spot/mold. Use 8 to 16 oz/A for powdery mildew and Botrytis gray mold; apply 8 to 12 oz/A for other foliar diseases. Apply before disease onset, continue every 7 to 14 days.
Endura	7	0	2.5 to 12.5 oz	6 apps	Early blight/Botrytis gray mold only. Apply before disease onset, continue every 7 to 14 days. Use higher rates for Botrytis.
Evito 480 SC	11	3	3.8 to 5.7 fl oz	4 apps	Early blight. Apply before disease onset, continue every 7 days.
Fixed coppers					Not for Botrytis, powdery mildew. Apply after transplanting or before disease appears, depending upon product and conditions. Continue every 3 to 10 days. See label for mixing instructions and tank-mix precautions. Greenhouse uses are permitted, depending upon product—refer to label.
Badge SC	M	0	1.5 to 3.5 pt		-
Badge X2	M	0	0.75 to 1.75 lb		OMRI-listed.
Basic Copper 53	M	0	0.75 to 3 lb		OMRI-listed.
C-O-C-S WDG	M	0	2 to 7 lb		-
Champ DP	M	0	1.33 to 2.67 lb		-
Champ Formula 2 FL	M	0	1.33 to 2.67 pt		-
Champ WG	M	0	2 to 4 lb		OMRI-listed.
COC DF	M	0	3 to 4 lb		-
COC WP	M	0	3 to 4 lb		OMRI-listed.
Copper-Count-N	M	0	3 to 6 pt		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 3 lb		-
Kentan DF	M	0	1.32 lb		-
Kocide 2000	M	0	1.5 to 3 lb		-
Kocide 3000	M	0	0.75 to 1.75 lb		-
Kocide DF	M	0	2 to 4 lb		-
Mastercop	M	0	0.5 to 3 pt		-
Nordox 75 WG	M	0	1.25 to 2.5 lb		OMRI-listed.
Nu-Cop 50 WP	M	0	2 to 4 lb		OMRI-listed.
Nu-Cop 3 L	M	0	1.33 to 5.33 pt		-
Nu-Cop 50 DF	M	0	2 to 4 lb		OMRI-listed.
Nu-Cop 50 HB	M	0	1 to 2 lb		-
Flint	11	3	2 to 4 oz	5 apps	Begin prior to disease onset, continue every 7 to 10 days.
Fontelis	7	0	14 to 24 fl oz	72 fl oz	Anthracnose, Botrytis, early blight, Septoria leaf spot. Apply before disease onset, continue every 7 to 14 days.
Fracture		0	24.4 to 36.6 fl oz	5 apps	Botrytis, powdery mildew. Apply every 7 to 10 days.

(continued on next page)

DISEASE CONTROL: *Tomatoes (continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Inspire Super	3/9	0	16 to 20 fl oz	47 fl oz	Begin prior to disease onset, continue every 7 to 10 days.
Mancozeb[4]					Products include Dithane, Koverall, Manzate, Penncozeb.
Dry formulations	M	5	0.5 to 3 lb	21-22.4 lb	Not for Botrytis, powdery mildew. Apply when plants emerge or after transplanting, and continue every 7 to 10 days until harvest. Some formulations are greenhouse-approved; see labels.
Liquid formulations	M		0.6 to 2.4 qt	16.8 qt	
ManKocide[3]	M	5	2.5 to 5 lb	see footnote	Not for Botrytis, powdery mildew. Apply before disease appears and continue every 3 to 10 days as needed.
Priaxor	7/11	7	4 to 8 fl oz	24 fl oz	Anthracnose, Botrytis, early blight, Septoria. Apply prior to development of disease, continue every 7 to 14 days.
Quadris Opti	11/M	0	1.6 pt	5 apps	Not for Botrytis, gray leaf spot/mold. Apply applications before disease onset, continue every 7 to 21 days. Observe seasonal limits for chlorothalonil.
Quadris Top	11/3	0	8 fl oz	47 fl oz	Do not apply until 21 days after transplant.
Rally 40 WSP	3	0	2.5 to 4 oz	1.25 lb	Powdery mildew. Apply when symptoms are first observed or when conditions favor disease.
Reason	11	14	5.5 to 8.2 fl oz	24.3 fl oz	Early blight, Septoria. Apply applications before disease onset, continue every 5 to 10 days.
Revus Top	40/3	1	5.5 to 7 fl oz	28 fl oz	Apply every 7 to 10 days. Use a spreader/penetrant surfactant.
Scala	9	1	7 fl oz	35 fl oz	Early blight/Botrytis gray mold. Apply before disease onset, continue every 7 to 14 days. Greenhouse use is approved.
Sulfur[4]	M				Powdery mildew. Apply at disease onset, continue every 7 to 14 days as needed. Phytotoxicity may occur if applications are made when temperatures exceed 90°F.
Switch 62.5 WG	9/12	0	11 to 14 oz	56 oz	Early blight, Botrytis, powdery mildew. Apply every 7 to 10 days.
Tanos	11/27	3	6 to 8 oz	5 apps	Not for Botrytis. Tanos must be tank-mixed with a fungicide from FRAC Group M appropriate for the target disease. Apply before disease onset, continue every 5 to 10 days.
Vivando	U8	0	15.4 fl oz	3 apps	Powdery mildew only. Begin applications prior to disease onset and continue every 7 to 14 days. No curative activity.
Zing!	M/22	5	36 fl oz	8 apps	Early blight and Septoria. Apply before disease onset and repeat every 7 to 14 days. Alternate with another FRAC code.
Ziram 76DF	M	7	3 to 4 lb	24 lb	Anthracnose, early blight, Septoria. Apply at first appearance of symptoms and continue every 7 days.
Ziram Granuflo	M	7			
Bacterial Spot/Speck					
Actigard	21	14	0.33 to 0.75 oz	6 apps	Apply 1 week after transplanting or emergence; begin with lowest rate and increase as plants grow. Apply every 14 days. May be applied through drip irrigation.
Ag Streptomycin, Agri-Mycin 17, Harbour	25	n/a	16 oz/100 gal	n/a	Pre-transplant treatment. Apply when seedlings are in 2-leaf stage and continue every 4 to 5 days until transplanting. Alternate with fixed copper. Not for field use.
Fixed coppers					Apply after transplanting or before disease appears, depending upon product and conditions. Continue every 3 to 10 days. See label for mixing instructions and tank-mix precautions. Tank-mix with mancozeb for maximum efficacy (observe seasonal limits for EBDC fungicides). Greenhouse uses are permitted, depending on product—refer to label.
Badge SC	M	0	1.5 to 3.5 pt		-
Badge X2	M	0	0.75 to 1.75 lb		OMRI-listed.
Basic Copper 53	M	0	2 to 4 lb		OMRI-listed.
C-O-C-S WDG	M	0	2 to 7 lb		-
Champ DP	M	0	1.33 to 2.67 lb		-
Champ Formula 2 FL	M	0	1.33 to 2.67 pt		-
Champ WG	M	0	2 to 4 lb		OMRI-listed.
COC DF	M	0	3 to 4 lb		-
COC WP	M	0	3 to 4 lb		OMRI-listed.
Copper-Count-N	M	0	3 to 6 pt		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 3 lb		-
Kentan DF	M	0	1.32 lb		-
Kocide 2000	M	0	1.5 to 3 lb		-
Kocide 3000	M	0	0.75 to 1.75 lb		-
Kocide DF	M	0	2 to 4 lb		-
Mastercop	M	0	0.5 to 3 pt		-
Nordox 75 WG	M	0	1.25 to 2.5 lb		OMRI-listed.
Nu-Cop 50 WP	M	0	2 to 4 lb		OMRI-listed.
Nu-Cop 3 L	M	0	1.33 to 5.33 pt		-
Nu-Cop 50 DF	M	0	2 to 4 lb		OMRI-listed.
Nu-Cop 50 HB	M	0	1 to 2 lb		-
Late Blight					
Ariston	M/27	3	1.9 to 3.0 pt	17.5 pt	Apply before disease onset, continue every 7 to 14 days.
Chlorothalonil[4]					Prior to fruit set. Apply before disease onset; continue every 7 to 10 days. Use 1.375 to 2 pt/A rate or equivalent (dry formulations). After fruit set. Increase rate to 2 to 2.75 pt/A (or equivalent for dry formulations), apply every 7 to 14 days.
Bravo Ultrex	M	0	1.3 to 2.6 lb	18.3 lb	
Bravo WeatherStik	M	0	1.375 to 2.75 pt	20 pt	
Curzate 60 DF	27	3	3.2 to 5 oz	30 oz	Must be tank-mixed with a fungicide from FRAC Group M. Apply before disease onset, continue every 5 to 7 days.

(continued on next page)

DISEASE CONTROL: *Tomatoes (continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Fixed coppers					Apply after transplanting or before disease appears, depending upon product and conditions. Continue every 3 to 10 days. See label for mixing instructions and tank-mix precautions. Some formulations are greenhouse-approved; see labels.
Badge SC	M	0	1.5 to 3.5 pt		-
Badge X2	M	0	0.75 to 1.75 lb		OMRI-listed.
Basic Copper 53	M	0	2 to 4 lb		OMRI-listed.
C-O-C-S WDG	M	0	2 to 7 lb		-
Champ DP	M	0	1.33 to 2.67 lb		-
Champ Formula 2 FL	M	0	1.33 to 2.67 pt		-
Champ WG	M	0	2 to 4 lb		OMRI-listed.
COC DF	M	0	3 to 4 lb		-
COC WP	M	0	3 to 4 lb		OMRI-listed.
Copper-Count-N	M	0	3 to 6 pt		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 3 lb		-
Kentan DF	M	0	1.32 lb		-
Kocide 2000	M	0	1.5 to 3 lb		-
Kocide 3000	M	0	0.75 to 1.75 lb		-
Kocide DF	M	0	2 to 4 lb		-
Mastercop	M	0	0.5 to 3 pt		-
Nordox 75 WG	M	0	1.25 to 2.5 lb		OMRI-listed.
Nu-Cop 50 WP	M	0	2 to 4 lb		OMRI-listed.
Nu-Cop 3 L	M	0	1.33 to 5.33 pt		-
Nu-Cop 50 DF	M	0	2 to 4 lb		OMRI-listed.
Nu-Cop 50 HB	M	0	1 to 2 lb		-
Forum SC	40	4	6 fl oz	30 fl oz	Must be tank-mixed with another *Phytophthora* fungicide. Apply before disease onset, continue every 5 to 10 days.
Gavel 75 DF2	22/M	3	1.5 to 2 lb	8 apps	Apply after transplanting and continue every 7 to 10 days.
Mancozeb[4]					Products include Dithane, Koverall, Manzate, Penncozeb.
Dry formulations	M	5	0.5 to 3 lb	21-22.4 lb	Apply when plants emerge or after transplanting, and continue every 7 to 10 days until harvest. Limit 16.8 lb ai/A per season. Some formulations are greenhouse-approved; see labels.
Liquid formulations	M		0.6 to 2.4 qt	16.8 qt	
ManKocide[3]	M	5	2.5 to 5 lb	see footnote	Apply before disease appears and continue every 3 to 10 days as needed.
Presidio	43	2	3 to 4 fl oz	4 apps	Apply every 7 to 14 days. Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Previcur Flex	28	5	0.7 to 1.5 pt	7.5 pt	Apply before disease onset, continue every 7 to 10 days. Must be tank-mixed with chlorothalonil or mancozeb.
Ranman SC	21	0	2.1 to 2.75 fl oz	6 apps	Apply before disease onset, continue every 7 to 10 days.
Revus	40	1	5.5 to 8 fl oz	32 fl oz	Apply every 7 to 10 days. Use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Revus Top	40/3	1	5.5 to 7 fl oz	28 fl oz	Apply every 7 to 10 days. Use a spreader/penetrant surfactant.
Ridomil Gold Bravo SC	4/M	14	2.5 pt	3 apps	Apply before disease onset, continue every 14 days. Rotate to another mode of action between applications of RG Bravo. Observe seasonal limits for chlorothalonil.
Ridomil Gold Copper	4/M	14	2 lb		Apply before disease onset, continue every 14 days. Rotate to another mode of action between applications of RG Copper.
Ridomil Gold MZ2	4/M	5	2.5 lb		Apply before disease onset, continue every 14 days. Rotate to another mode of action between applications of RG MZ. Observe seasonal limits for EBDC fungicides.
Tanos	11/27	3	8 oz	5 apps	Tanos must be tank-mixed with a fungicide from FRAC Group M appropriate for the target disease. Apply before disease onset, continue every 5 to 7 days.
Zampro	40/45	4	14 fl oz	3 apps	Apply before disease onset and repeat every 5 to 7 days.
Pythium Seedling Disease					
MetaStar 2EC AG	4	28	4 to 8 pt	1 app	Preplant. Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil mechanically or with irrigation if rainfall is not expected within 24 hours of treatment.
Ridomil Gold SL	4	28	1 to 2 pt		
Ultra Flourish	4	28	2 to 4 pt		
Previcur Flex	28	5	1.5 pt	7.5 pt	Field application. Can be directed at lower stems and soil, applied in transplant water, or delivered through drip irrigation. Greenhouse use. Can be applied as a drench or by chemigation—see to label for rates.
Ridomil Gold GR	4	7	20 lb	1 app	For preplant application only. Adjust equipment so that granules applied uniformly over soil surface. Incorporate mechanically or with irrigation water.
Southern Blight					
Aftershock	11	3	2 to 5.7 fl oz	4 apps	Apply before disease onset and continue every 7 days.
Blocker Flowable, Blocker 4F	14	0	4.5 pt/100 gal	1 app	Apply as a drench at planting. Actual rate is dependent on row spacing; see label for application instructions.
Evito 480 SC	11	3	3.8 to 5.7 fl oz	4 apps	Apply before disease onset and continue every 7 days.

[1] Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on page 13 for more information on FRAC codes.
[2] Pre-harvest interval.
[3] Observe seasonal limits for mancozeb.
[4] Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.