

Tomatoes

Nightshade family (Solanaceae): *Lycopersicon 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 H). 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 11). 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 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 pots or containers (up to 3 inches) generally 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 (Figure 1) 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 2½-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 through 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). Subsequent strings should be put up as the plants grow to maintain a well-trained system. 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).

TOMATO SIZE CLASSES

The numbers in parentheses after each category indicate the number of rows and columns of fruit in a box: 6x7, 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 (6x7)	2-1/4	2-17/32
Large (6x6)	2-1/2	2-25/32
Extra Large (5x5)	2-3/4 and above	
Maximum Large/ Jumbo ³ (4x4 or 4x5)	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 (4x4's or 4x5's). The old USDA Extra Large class had a range of 2-7/8 minimum to 3-15/32 maximum.

At transplanting, apply ½ pint of a starter fertilizer to each plant. Prepare the starter fertilizer by mixing 3 lb 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. A machine (bed shaper/mulch layer) is used for making beds, laying plastic, and drip lines in one operation; this machine attaches to a tractor's three-point hitch. A separate piece of equipment (waterwheel setter) is commonly used to punch holes through the mulch, apply water and starter fertilizer, and enable two workers to transplant. Although quite labor intensive and only feasible for small plantings, plastic mulch can also be put down by hand without raised beds. In this case holes can be punched in the plastic using a long-handled bulb planter.

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.

VARIETIES: Tomatoes (Fresh Market)

Variety	Days to Maturity	Disease Resistance	Comments
Large Red (all are determinate hybrids)			
Sunstart/Sunshine	60-65	Fusarium Wilt races 1,2 Verticillium Wilt race 1	Sunstart and Sunshine are 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.
Mountain Spring	72	Fusarium Wilt 1,2 Verticillium Wilt race 1	Earliest of "Mountain" series; crack-resistant fruits; excellent for shipping. Spring and summer planting. Highly susceptible to early blight.
Sunbeam	72	Fusarium Wilt 1,2 Verticillium Wilt race 1	Early to midseason; spring plantings. Prune lightly to maintain adequate foliage cover.
BHN 543	72	Fusarium Wilt 1,2 Verticillium Wilt 1, Nematodes	High yielding but less crack tolerant than "Mountain" series varieties.
Mountain Crest	74	Fusarium Wilt 1,2 Verticillium Wilt 1	Smooth, crack-resistant fruits; deep red internal color and long shelf life.
Sun Leaper	75	Fusarium Wilt 1,2 Verticillium Wilt 1	Crack-resistant fruits. Early to midseason; from the "Mountain" series breeding program; sets fruit at higher temperatures: for spring or late summer/fall production.
Amelia	75	Fusarium Wilt 1, 2, 3 Verticillium Wilt, TSWV	Resistant to nematodes and intermediate resistance to tomato spotted wilt virus (TSWV).
Crista	75	Fusarium Wilt 1,2,3 Verticillium Wilt, TSWV	For trial. Tomato spotted wilt virus (TSWV) and nematode resistant; long shelf life
Solar Set	75	Fusarium Wilt 1,2 Verticillium Wilt 1	Smooth fruit. Midseason; for shipping; late summer and fall production. Sets fruit under higher temperatures. Blemishes common on blossom end in early plantings.
Mountain Fresh Plus	77	Fusarium Wilt 1,2 Verticillium Wilt 1	Crack-resistant fruits. Midseason; excellent flavor; for local sales or shipping. Early blight tolerant and nematode resistant.
Sunguard	77	Fusarium Wilt 1,2,3 Verticillium Wilt 1	Very attractive smooth, crack-resistant fruits.
Floralina	77	Fusarium Wilt 1,2,3 Verticillium Wilt 1	Very smooth, crack resistant fruits. Midseason; excellent flavor. For shipping or local sales.
Fabulous	77	Fusarium Wilt 1,2 Verticillium Wilt 1 Tobacco Mosaic Virus	High yields of jumbo and extra-large fruits. For local sales, limited shipping; softer than varieties in the "Mountain" series.
Roma/Pear/Paste			
Plum Crimson	80	Fusarium Wilt 1,2,3 Verticillium Wilt 1	Determinate hybrid; contains gene for early dark red interior color, high lycopene content, productive and early blight tolerant.
Plum Dandy	118-125	Fusarium Wilt 1 Verticillium Wilt 1	Pear/plum-shaped, high yielding variety from the "Mountain" series with good early blight tolerance.
Spectrum 882	118-125	Fusarium Wilt 1,2 Verticillium Wilt 1 Bacterial speck, gray leaf spot, root knot nematode	Productive, blocky-pear shaped; multiple disease resistance. Susceptible to "weather checking" and should be picked mature green to keep quality.
Grape			
Red Grape	60		Indeterminate, vigorous, 1/2 to 1 oz fruits.
Tami G	60		Indeterminate; 1/2 to 3/4 oz oval fruit, vigorous, yields well and picks for an extended season (for trial).
Navidad	65-70	Fusarium Wilt 2	Determinate; red oval fruit yields well, heat tolerant, picks for an extended season.
Yellow/Gold Fruit			
Carolina Gold	72	Fusarium Wilt 1,2 Verticillium Wilt 1	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.
BHN 641	76	Fusarium Wilt 1,2 Verticillium Wilt 1	Determinate, yellow to tangerine colored.
Lemon Boy	72	Verticillium Wilt 1 Fusarium Wilt, Nematodes	Yellow, indeterminate F1 hybrid for local sales; spring and summer planting.
Indeterminate and Heirloom¹			
Better Boy	72	Fusarium Wilt 1 Verticillium Wilt Root-knot nematode	Indeterminate, large fruit. On-farm and local sales only. Spring planting.
Buck's County Hybrid	72		Hybrid; for local sales. Deep red, round fruit.
Pink Girl	76	Verticillium Wilt 1, Fusarium Wilt 1	Hybrid; for local sales.
Odoriko	76	Verticillium Wilt 1, Fusarium Wilt 1, nematodes	Pink hybrid; Great taste but susceptible to cracking.
Delicious	77		Very large 1.5 to 2.5 lb fruit; solid red with small seed cavities; resists cracking.
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.
German Johnson	80-90		Large-fruited "heirloom;" for local sales. Susceptible to cracking and roughness.
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 dk. pink flesh; very sweet; less cracking than other heirlooms; heavy producer.
Big Rainbow	90-100		Large 1 to 2 lb fruit, meaty, golden orange-yellow with red stripes radiating from blossom end; prone to cracking.

VARIETIES: Tomatoes (Fresh Market)

Variety	Days to Maturity	Disease Resistance	Comments
Cherry			
Cherry Grande	65	Fusarium Wilt Verticillium Wilt	Strong determinate—1¼ inch diameter, very sweet fruit. Shipping and local sales.
Mountain Belle	65	Fusarium Wilt 1,2 Verticillium Wilt	Determinate, large meaty cherry type, 1 to 1¼ inch diameter. Local and shipping sales.
Sweet Chelsea	65	Fusarium Wilt 1,2 Verticillium Wilt 1, Nematodes, Tobacco Mosaic Virus	Indeterminate—1½ inch diameter very sweet fruit. Shipping and local sales.

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 ft) 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.

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 lb per acre (see Appendix D). 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 30 to 50 lb 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 in the tables 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

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 K₂O or 60 lb/A of P₂O₅ when soil test P and K levels are high.

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		Phosphate (P₂O₅)
Low	<31	181-240
Medium	31-60	61-180
High	61-80	1-60
Very High	>80	0

Potassium		Potash (K ₂ O)
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 golf-ball 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.

season. A grower may need to modify the recommendations slightly depending on length of harvest period, soil type, previous crop, weather conditions, etc.

Ammonium nitrate, 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 ammonium nitrate injected through the drip irrigation system. Using ammonium nitrate at recommended rates does not increase the amount of blossom end rot in tomatoes when soil moisture is uniform and soil pH is within the proper range.

Figure 1a.

Cross over between plants when weaving the first row.

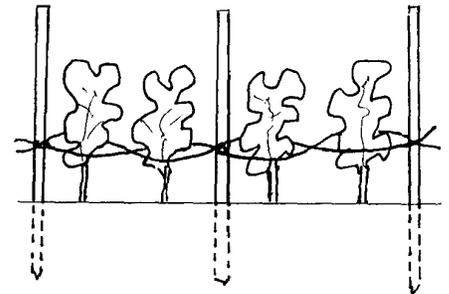


Figure 1b.

Second, third, and fourth rows of twine are pulled along sides of plants without crossing over.

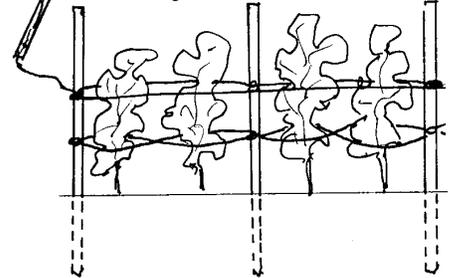
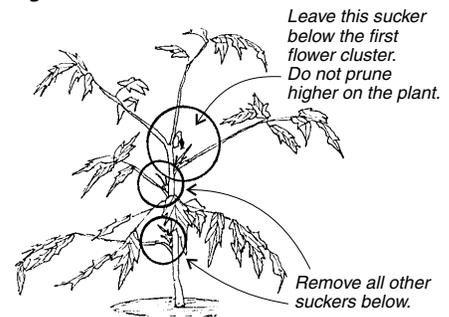


Figure 2.



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 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. Tomato varieties also differ in their susceptibility to these problems.

Magnesium deficiencies. Mild magnesium deficiencies sometimes appear at midseason on plants with very heavy fruit loads. Typical symptoms are 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 contributes 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, we would like to see at least 200 lb 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

FERTIGATION RECOMMENDATIONS (Nitrogen only): Staked Tomatoes

Based on a total season N recommendation of 150 lb actual N/A with 50 lb N/A applied preplant and the remaining N (150 - 50 = 100 lb) divided into equal amounts to be fertigated on a weekly basis (100 lb ÷ 10 weeks = 10 lb of N per week). Both moderate (75 lb) and high (100 lb) fertigated N rates are provided below. For harvest seasons extending beyond 10 weeks from transplanting, a maintenance dose of 1 to 1.5 lb N (3 to 4.5 lb ammonium nitrate) per week is adequate. The doses listed for 1,000 plants are based on a plant population of 4,200 plants/A (i.e., rows on 6 ft centers in 5-row blocks and plants 18 in apart). **IMPORTANT:** If a UK soil test indicates your site is “at risk” for ripening disorders (Hartz ratio), you should alternate fertigations using ammonium or calcium nitrate with potassium nitrate fertigations (see Potassium Fertigation table).

Total Fertigated N Requirement ¹	Actual N/wk (lb/A)	Ammonium Nitrate (lb/A/wk)	Ammonium Nitrate (lb/1,000 plants/wk)	Calcium Nitrate (lb/A/wk)	Calcium Nitrate (lb/1,000 plants/wk)
75 lb/A	7 lb 8 oz	22 lb 6 oz	5 lb 5 oz	48 lb 6 oz	11 lb 8 oz
100 lb/A	10 lb	30 lb	7 lb	64 lb 8 oz	15 lb 6 oz

¹ Fertigation can begin 10 to 14 days after transplanting and assumes 50 lb N/A was applied preplant and starter fertilizer was used.

FERTIGATION RECOMMENDATIONS (Nitrogen + Potassium): Staked Tomatoes

Potassium nitrate supplies both nitrogen and potassium and can be used as a substitute for ammonium or calcium nitrate. It is especially important to fertigate with a potassium source if a UK soil test indicates that your site is “at risk” for ripening disorders (Hartz ratio). Recommendations below are based on a total of 125 to 150 lb N/A for the season with 50 lb N/A applied preplant. The remaining (125-50)=75 or (150-50)=100 lb divided into equal amounts to be fertigated on a weekly basis for 10 weeks. This is either 7.5 or 10 lb of N/A/week. Both moderate (75 lb) and high (100 lb) fertigated N rates are given below. For harvest seasons extending beyond 10 weeks from transplanting, a maintenance dose of 1 to 1.5 lb N (11.5 lb potassium nitrate) per week is adequate. The doses listed for 1,000 plants are based on a plant population of 4,200 plants/A (i.e., rows 6 ft on center in 5-row blocks and plants 18 inches apart).

Total Fertigated N Requirement	Actual N/wk (lb/A)	Potassium Nitrate (lb/A/week)	Potassium Nitrate (lb/1,000 plants/wk)	Potassium Nitrate: K provided (lb/A/wk)	Potassium Nitrate: K provided (lb/1,000 plants/wk)
75 lb/A	7 lb 8 oz	57 lb 11 oz	13 lb 12 oz	25 lb 6 oz	6 lb 1 oz
100/lb/A	10 lb	76 lb 15 oz	18 lb 5 oz	33 lb 14 oz	8 lb 1 oz

(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 lb actual magnesium per acre (10 to 20 lb per acre epsom salts or 2 to 4 lb per acre mag 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 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, i.e., 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: <www.ams.usda.gov/standards/vegfm.htm> or can be obtained free of charge by writing: USDA, Agricultural Marketing Service, Fruit and Vegetable Division, Standardization

Section, P.O. Box 96456, Room 2049-S, Washington, DC 20090-6456.

Size classifications for both No. 1 and No. 2 grade tomatoes are shown in the table in this chapter (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 No. 1’s and No. 2’s 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 lb 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 groceries (if there are any more “local groceries!”), cooperatives, farmer’s 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 farmer’s 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 are currently underutilized in the state.

Common Diseases/Management

General. The following disease control strategies have been written with a range of commercial producers in mind. Control guidelines focus on staked tomato production, where a high level of management is critical to timely production, quality, and high yields. Control of foliar and stem diseases will require frequent 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 at the end of this section. 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 pre-

vent pathogen buildup in soil. Fungicide sprays are needed on a seven- to 10-day schedule from fruit set through harvest using any of the following: strobilurins (Quadris/Amistar, Flint, Cabrio) chlorothalonil, fixed coppers, and Ziram are labeled; see tables for rates and application information. Ziram is not cleared for cherry-type tomatoes.

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 centered on avoidance, rotation, sanitation, and slowing the buildup of epiphytic populations (those present on plant surfaces) of the canker pathogen.

PESTICIDE SAFETY: Tomatoes

	Signal ⁴	Re-entry (hrs)	Harvest (days)
Insecticides			
Acramite 50 WS	C	12	3
Actara 25 W	C	12	0
Admire Pro	C	12	21
Assail 30 SG	C	12	7
Avaunt 30 DG	C	12	3
Beleaf 50 SG	C	12	0
Bt products	C	4/12	0
Confirm 2 F	C	4	7
Courier 40 SC	W	12	7
Dicofol 4 E	C	12	2
Dimethoate 4 E	W	48	7
Endosulfan 3 EC	DP	24	2
Fulfill 50 DF	C	12	0
Intrepid 2 F	C	4	1
Knack 0.86 EC	C	12	14
Malathion 8	C	12	1
Novodor	C	4	0
Oberon 2 SC	C	12	7
Platinum 2 SC	C	12	30
Provado 1.6 F	C	12	0
Radiant SC	C	4	1
Sevin XLR	W	12	3
Spintor 2 SC	C	4	1
Trigard 75 WP	C	12	0
Venom 70 SG	C	12	1/21 ¹
RESTRICTED USE			
AgriMek 0.15 EC	W	12	7
Asana XL	W	12	1
Baythroid XL	W	12	0
Capture 2 EC	W	12	1
Danitol 2.4 EC	W	24	3
Decis 1.5 EC	DP	12	1
Diazinon AG 500	C	24	1
Diazinon 50 W	C	24	1
Hero 1.24 EC	C	12	1
Lannate 90 SP	DP	48	1
Mustang Max	W	12	1
Pounce 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
Vydate L	DP	48	3
Warrior T	W	24	5

PESTICIDE SAFETY: Tomatoes

	Signal ⁴	Re-entry (hrs)	Harvest (days)
Fungicides			
Acrobat 50 WP	C	12	4
Forum SC			
Actigard 50 WG	C	12	14
Agri-Mycin 17	C	12	0
Firewall			
Aliette WDG ⁵	C	12	14
Azoxystrobin ³	C	4	0
Botran 75 W	C	12	10
Cabrio EG	C	12	0
Chlorothalonil ³	D	12	0
Cuprofix MZ Disperss	C	24	5
Curzate 60 DF	W	12	3
Endura	W	12	0
Evito 480 SC	C	12	3
Fixed coppers ³	D	12/48 ²	0
Flint	C	12	3
Flouronil	D	48	14
Gavel 75 DF	C	48	3
Maneb/Mancozeb ³	C	24	5
ManKocide	D	24	5
Nova 40 W	W	24	0
PCNB ³	C	12	0
Quadris Opti	W	12	0
Previcur Flex	C	12	5
Ranman	C	12	0
Reason 500 SC	C	12	14
Ridomil Gold Bravo	D	48	14
Ridomil Gold Bravo SC	W		
Ridomil Gold EC/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
Tanos	C	12	3
Ziram ³	D	48	7
Ultra Flourish	W	48	28

¹ Dependent on application rates and types, see label.

² Varies by formulation; consult labels carefully.

³ Several formulations are marketed. See the general introduction for more details on fungicides.

⁴ W: Warning, C: Caution, D: Danger, P: Poison

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.

- 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. Plants with canker should be carefully rogued out and destroyed, avoided, or worked last when conducting field operations. Removal of infected plants is helpful reducing spread if disease incidence is low (≈ 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 I). In the greenhouse, use a spray program with fixed coppers 1-2 weeks after emergence. Maneb 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 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 + maneb or mancozeb immediately after transplanting and continue at seven-day intervals during wet weather (see tables for rates and products).

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 in to land that has been under a good rotational scheme. Actigard has performed well in the control of bacterial speck and spot in many tests around the country. Actigard 50WG can be applied on a 7- to 14-day schedule (8 applications maximum) beginning 1 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 gal per acre of water initially and increase volume as the rate increases (see label for specifics). The 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/maneb.* See tables for products and rates. Premixed materials such as ManKocide and Cuprofix Dispers MZ are available.

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 or 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). Mefenoxam (Ridomil Gold GR or EC, Ultra Flourish) is highly effective against sensitive strains if applied as directed; see tables for rates and use directions. Multiple applications can be made, but do not exceed 1.0 lb per acre. Ridomil Gold Bravo, Flouronil, or Ridomil Gold Copper are also effective against the aboveground infections if applied as directed.

Seed treatments and damping-off. Transplants (greenhouse or outside plant beds) should be grown in commercial soil-less mixes or in fumigated or sterilized soil. Most commercial seed is pretreated with fungicides; if not treated (dust, pellet, slurry as per label), use Thiram 50 WP at 1 teaspoon/lb of seed. Seed treatment with hot water, bleach, or trisodium phosphate (TSP) may also improve disease control. Botran 75W at 1 lb/100 gallons, sprayed to ensure good coverage of the stems, can be used in the greenhouse only for stem rots caused by *Botrytis* and *Sclerotinia*. Do not water excessively and maintain adequate ventilation. Mefenoxam can be used in the field to control seedling diseases caused by *Pythium*; see tables for rates and products.

Early blight, 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 variety table—assuming *Septoria* is not also active. Rotate away from solanaceous crops for two or more years, and control weeds during the rotation. Strobilurins (Quadris/Amistar, Cabrio) are excellent materials for control of these diseases. See tables for rates, timings, and other instructions. Rotation with protectant fungicides (chlorothalonil, mancozeb/maneb, or Ziram) 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 variety table). Avoid fields with a history of Verticillium wilt. Pre-plant soil fumigation is economical only with high-value, fresh-market tomatoes (see “Soil Fumigants for Control of Nematodes and Soilborne Diseases” on page 18). If wilt disease occurs in a resistant variety, have it correctly diagnosed by the UK Diagnostic Lab.

Late blight. This disease is frequently encountered in Kentucky. 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 + maneb/mancozeb. Acrobat 50WP, strobilurins, Gavel 75DF, Curzate 60DF, Tanos, and mefenoxam (Ridomil Gold Bravo, Ridomil Gold MZ, Ridomil Gold Copper) may be needed under severe disease pressure; see tables for rates and timings. Mefenoxam-resistant (tolerant) strains of the late blight fungus have been found in Kentucky, so products containing this active ingredient 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 are available only). Use pre-plant 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 18 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. No fungicides are labeled for *Sclerotinia*. Endura is labeled for *Botrytis* but has significantly reduced *Sclerotinia*, too, in some tests when used soon after transplanting.

Powdery Mildew. Fungicide programs typically suppress powdery mildew. Use Nova 40W where disease pressure is severe. See tables for products and rates

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. PCNB (Terraclor) can be drenched around plants at transplanting or applied in-furrow to suppress southern blight; see tables for products, rates, and instructions.

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 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. Do not use tobacco products during seedling production or transplanting to prevent spread of TMV. Washing hands with soap and water before handling tomatoes should be mandatory. 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 I). 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 other crops. The risk of TEV, PVY, and CMV is higher for fall plantings.

Greenhouse Tomato Diseases

Foliar Diseases

Bacterial diseases, leaf mold, gray mold, early blight, and late blight. A number of foliar diseases common in field-grown tomatoes also occur in the greenhouse. *These are easily controlled limiting periods of leaf wetness.* Maintain temperatures of at least 65°F in the greenhouse, along with good ventilation (air movement). Water plants to avoid long periods of leaf wetness that promote disease. Scout plants regularly for symptoms. *A spray program is necessary at the onset of the first symptoms of disease, which often appear during cool, overcast, or foggy conditions.* See fungicide tables in this section for chemical control products and rates.

Stem Diseases

Botrytis stem canker and Sclerotinia timber rot. Botran 75W at 1 lb/100 gallons 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*.

Fusarium crown and root rot. Control of Fusarium is achieved primarily through the use of sanitation and planting resistant varieties, such as Trend, Trust, Medalion, Match, Switch, and Blitz. 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.

Powdery mildew. Adequate ventilation in the greenhouse is critical in managing this disease. Potassium bicarbonate (Armicarb) can be effective if applied regularly (see table in this section). Sun Spray Oil at 1 to 2 gallons/100 gallons of water as a foliar spray is an organic control measure that is also effective; it must be started very early in the outbreak and the sprays maintained at least weekly. Exotherm Termil is no longer labeled for use on greenhouse tomatoes.

Tobacco/Tomato Mosaic Virus. See “Viruses” heading under field tomatoes for more details. Use bleach-treated seed as indicated in the “Seed Treatment and Damping-off” section on page 98. On known TMV suspects, use the TSP treatment. Dip hands in milk before handling plants. Use resistant varieties.

Sample Fungicide Program for Staked Tomatoes.

Refer to fungicide tables in this section for product rates; read product labels carefully before application.

After Transplanting	
Week 1	mancozeb + copper + Actigard 50W
Week 2	mancozeb + copper
Week 3	strobilurin or other QoI inhibitor + Actigard 50W
Week 4	mancozeb + copper
Week 5	strobilurin or other QoI inhibitor + Actigard 50W
Week 6	mancozeb + copper
Week 7	strobilurin or other QoI inhibitor + Actigard 50W
Week 8	mancozeb + copper
During Harvest	
Week 9	chlorothalonil + copper
Week 10	strobilurin or other QoI inhibitor + copper
Week 11	chlorothalonil + copper
Week 12	strobilurin or other QoI inhibitor + copper
Week 13	chlorothalonil + copper
Week 14	chlorothalonil + copper
Finish season with chlorothalonil + copper	

INSECT CONTROL: Tomatoes

Insect/Insecticide	Product Amt/A	Comments and Seasonal Limits
SOIL APPLICATION		
Aphids, Flea Beetles, Colorado Potato Beetle (Do not use foliar sprays of Actara, Assail, Provado, or Venom following soil applications of Admire, Platinum, or Venom.)		
Admire Pro	7 to 10.5 fl oz	See label for application alternatives (sidedress, in-furrow, banded, or drip or trickle irrigation). Limit 10.5 fl oz/A.
Platinum 2 SC	5 to 8 fl oz	See label for application alternatives.
Venom 70 SG	5 to 6 oz	Limit 12 oz/A for soil applications.
FOLIAR APPLICATION		
Aphids		
Actara 25 W	2 to 3 oz	Limit 11 oz per season, allow 5 days between applications.
Assail 30 SG	2 to 4 oz	Limit 16 oz/A and 4 applications/season. Allow 7 days between applications.
Beleaf 50 WDG	2 to 2.8 oz	Limit 8.4 oz per season, allow 7 days between application.
Dimethoate 4 E	0.5 to 1 pt	
Endosulfan 3 EC	0.67 to 1.33 qt	Limit 6 applications or 4 qt/A.
Fulfill 50 DF	2.75 oz	Limit 5.5 oz/A. Allow 7 days between applications.
Lannate 90 SP	0.5 to 1 lb	Limit 8 lb/A.
Malathion 8	1.5 pt	
Provado 1.6 F	3.75 fl oz	Limit 18.75 fl oz/A.
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	Limit 14 oz/A. Allow 5 days between applications.
Confirm 2 F	6 to 16 fl oz	Limit 64 fl oz/A.
Intrepid 2 F	4 to 16 fl oz	Limit 64 fl oz/A.
Proclaim 5 WDG	2.4 to 4.8 oz	Limit 28.8 oz/A, allow at least 7 days between applications.
Radiant SC	5 to 10 fl oz	Limit 34 fl oz/A. Allow 4 days between applications.
Spintor 2 SC	4 to 8 fl oz	Limit 29 fl oz/A.
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	Limit 11 oz per season and allow 5 days between applications.
Assail 30 SG (4A)	1.5 to 2.5 oz	Limit 16 oz/A, limit 4 applications/season.
AgriMek 0.15 EC (6)	8 to 16 fl oz	Limit 48 fl oz/A. Allow 7 days between applications.
Asana XL (3)	5.8 to 9.6 fl oz	Limit 96 fl oz/A.
Baythroid XL (3)	1.6 to 2.8 fl oz	Limit 16.8 fl oz/A. Allow 7 days between applications.
Decis 1.5 EC (3)	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A.
Endosulfan 3 EC (2A)	0.67 to 1.33 qt	Blister beetles. Limit 4 qt/A or 6 applications.
Hero 1.24 EC (3)	4 to 10.3 fl oz	Limit 43.2 fl oz/A. Allow 10 days between applications.
Mustang Max (3)	2.24 to 4.0 fl oz	Limit 24 fl oz/A, allow at least 7 days between applications.
Novodor FC (11C)	1 to 4 qt	For larvae only.
Pounce 3.2 EC (3)	2 to 8 fl oz	Limit 48 fl oz/A. Not for use on cherry tomatoes.
Proaxis 0.5 EC (3)	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
Provado 1.6 F (4A)	3.75 fl oz	Limit 18.75 fl oz/A.
Radiant SC (5)	5 to 10 fl oz	Limit 34 fl oz/A. Allow 4 days between applications.
SpinTor 2 SC (5)	3 to 6 fl oz	Limit 29 fl oz/A.
Venom 70 SG (4A)	1 to 4 oz	Limit 6 oz/A for foliar applications.
Warrior T (3)	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
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	Limit 96 fl oz/A.
Capture 2 E	2.1 to 5.2 fl oz	Limit 4 applications and allow 10 days between sprays.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 43.2 fl oz/A. Allow 10 days between applications.
Mustang Max	2.24 to 4.0 fl oz	Limit 24 fl oz/A, allow at least 7 days between applications.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	Limit 2.88 pt/A.
Sevin XLR	2 qt	Limit 7 applications and allow at least 7 days between sprays.
Warrior T	1.92 to 3.2 fl oz	Limit 2.88 pt/A.
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	Limit 96 fl oz/A.
Avaunt 30 DG	3.5 oz	Limit 14 oz/A. Allow 5 days between applications.
Baythroid XL	1.6 to 2.8 fl oz	Limit 16.8 fl oz/A. Allow 7 days between applications.
Capture 2 E	2.1 to 5.2 fl oz	Limit 4 applications and allow 10 days between sprays.
Danitol 2.4 EC	10.67 fl oz	Allow 7 days between applications.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A.
Endosulfan 3 EC	1.33 qt	Limit 4 qt/A or 6 applications.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 43.2 fl oz/A. Allow 10 days between applications.
Intrepid 2 F	4 to 16 fl oz	Limit 64 fl oz/A.
Lannate 90 SP	0.5 to 1 lb	Limit 8 lb/A.
Mustang Max	2.24 to 4.0 fl oz	Limit 24 fl oz/A, allow at least 7 days between applications.
Pounce 3.2 EC	2 to 8 fl oz	Limit 48 fl oz/A. Not for use on cherry tomatoes.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
Radiant SC	5 to 10 fl oz	Limit 34 fl oz/A. Allow 4 days between applications.

INSECT CONTROL: Tomatoes

Insect/Insecticide	Product Amt/A	Comments and Seasonal Limits
Sevin XLR	1 to 2 qt	Limit 7 applications and allow at least 7 days between sprays.
Spintor 2 SC	3 to 6 fl oz	Limit 29 fl oz/A
Warrior T	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
Grasshoppers		
Asana XL	5.8 to 9.6 fl oz	Limit 96 fl oz/A.
Capture 2 E	2.1 to 5.2 fl oz	Limit 4 applications and allow 10 days between sprays.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 43.2 fl oz/A. Allow 10 days between applications.
Mustang Max	3.2 to 4.0 fl oz	Limit 24 fl oz/A.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
Warrior T	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
Hornworms (Treat if an average of more than 1 hornworm per 5 plants is found.)		
Asana XL	2.9 to 5.8 fl oz	Limit 96 fl oz/A.
Avaunt 30 DG	2.5 to 3.5 oz	Limit 14 oz/A. Allow 5 days between applications.
Baythroid XL	1.6 to 2.8 fl oz	Limit 16.8 fl oz/A. Allow 7 days between applications.
Bt var kurstaki products	See labels	
Confirm 2 F	6 to 16 fl oz	Limit 64 fl oz/A.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A.
Endosulfan 3 EC	0.67 to 1.33 qt	Limit 4 qt/A or 6 applications.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 43.2 fl oz/A. Allow 10 days between applications.
Intrepid 2 F	4 to 16 fl oz	Limit 64 fl oz/A.
Mustang Max	2.24 to 4.0 fl oz	Limit 24 fl oz/A.
Pounce 3.2 EC	4 to 8 fl oz	Limit 48 fl oz/A. Not for use on cherry tomatoes.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	Limit 2.88 pt/A.
Radiant SC	5 to 10 fl oz	Limit 34 fl oz/A. Allow 4 days between applications.
Sevin XLR	1 to 2 qt	Limit 7 applications and allow at least 7 days between sprays.
Spintor 2 SC	3 to 6 fl oz	Limit 29 fl oz/A.
Warrior T	1.92 to 3.2 fl oz	Limit 2.88 pt/A.
Flea Beetles		
Asana XL	5.8 to 9.6 fl oz	Limit 96 fl oz/A.
Capture 2 E	2.1 to 5.2 fl oz	Limit 4 applications and allow 10 days between sprays.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 43.2 fl oz/A. Allow 10 days between applications.
Mustang Max	2.24 to 4.0 fl oz	Limit 24 fl oz/A.
Sevin XLR	0.5 to 1 qt	Limit 7 applications and allow at least 7 days between sprays.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
Venom 70 SG	1 to 4 oz	Limit 6 oz/A for foliar applications.
Mites		
Acramite 50 WS	0.75 to 1.0 lb	Limit 1 application.
AgriMek 0.15 EC	8 to 16 fl oz	Limit 48 fl oz/A. Allow 7 days between applications.
Capture 2 E	2.1 to 5.2 fl oz	Limit 4 applications and allow 10 days between sprays. For end of season control.
Danitol 2.4 EC	10.67 fl oz	Apply when mites first seen. Limit 42.6 oz/A. Allow 7 days between applications. For end of season control.
Dicofol 4 E	0.75 to 1.5 pt	Limit 2 applications. Do not exceed 1.6 pts per season.
Oberon 2 SC	7 to 8.5 fl oz	Limit 3 applications and allow 7 days between sprays.
Stink bugs (Treat if an average of more than 1 Stink Bug per 40 plants is found.)		
Baythroid XL	1.6 to 2.8 fl oz	Limit 16.8 fl oz/A. Allow 7 days between applications.
Capture 2 E	2.1 to 5.2 fl oz	Limit 4 applications and allow 10 days between sprays.
Danitol 2.4 EC	10.67 fl oz	Limit 42.6 fl oz/A. Allow 7 days between applications.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A.
Endosulfan 3 EC	1 to 1.33 qt	Limit 4 qt/A or 6 applications.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 43.2 fl oz/A. Allow 10 days between applications.
Mustang Max	3.2 to 4.0 fl oz	Limit 24 fl oz/A.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
Warrior T	2.56 to 3.84 fl oz	Limit 2.88 pt/A.
Whiteflies		
Assail 30 SG	2.5 to 4 oz	Limit 16 oz/A, limit 4 applications. Allow 7 days between applications.
Courier 40 SC	9 to 13.6 fl oz	Limit 2 applications. Allow at least 28 days between applications.
Knack 0.86 EC	8 to 10 fl oz	Limit 20 fl oz/A. Allow 14 days between applications.
Oberon 2 SC	7 to 8.5 fl oz	Limit 3 applications and allow 7 days between sprays.
Provado 1.6 F	3.75 fl oz	Limit 18.75 fl oz/A.
Venom 70 SG	1 to 4 oz	Limit 6 oz/A for foliar applications.

¹ To view color pictures of the pests, see: <http://www.uky.edu/Ag/IPM/picturesheets/tomatoinsects.pdf>

WEED CONTROL: Tomato (Transplanted)

Product Amt/A	Lb A.I./A	Remarks
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence 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 postemergence 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.
8 to 14 pt Dacthal 6 F	6 to 10.5 DCPA	For preemergence 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.
2 to 4 lb Devrinol 50 DF	1 to 2 napropamide	For preemergence 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 bareground 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 to 2 pt Goal 2XL	0.25 to 0.5 oxyfluorfen	For preemergence and postemergence 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.
1.3 to 2.7 pt Gramoxone Max 3 L	0.5 to 1 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, preemergence, 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. PHI = 30 days.
0.5 to 1.5 pt Poast 1.5 E	0.09 to 0.49 sethoxydim	For control of actively growing annual grasses and suppression of perennial grasses only. Use high rate on johnsongrass. PHI = 20 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
1.5 to 2 pt Prowl H2O 3.8 E	0.7 to 1 pendimethalin	For preemergence control of broadleaves and grasses. Apply broadcast preplant incorporated or broadcast pre-plant surface application prior to transplanting tomato, or as a post-directed application to transplanted and established plant. PHI = 70 days.
2 to 4 oz Matrix 25 DF	0.031 to 0.062 rimsulfuron	For preemergence control of broadleaves and grasses. Apply preemergence or postemergence to actively growing weeds. PHI = 45 days.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence 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.
0.5 to 1 oz Sandea 75 DF	0.023 to 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/season. See label for row middle applications and direct-seeded tomato.
6 to 16 fl oz Select 2E	0.09 to 0.24 clethodim	For selective postemergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. PHI = 30 days.
0.3 to 1.3 lb Sencor 75 DF	0.2 to 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. Postemergence broadcast (0.3 to 0.6 lb/A) or postemergence 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 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
1.25 to 2 pt Treflan HFP 4 E	0.62 to 1 trifluralin	For preemergence 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	Amt/A	Seasonal Limits/A	Comments
Anthracnose, Early Blight, Gray Leaf Mold, Gray Leaf Spot, Botrytis Gray Mold, Septoria Leaf Spot, Powdery Mildew			
Azoxystrobin ¹		5 apps	NOT FOR BOTRYTIS, GRAY LEAF SPOT/MOLD. Apply 21 days after transplanting or 35 days after seeding and continue on a 7- to 21-day schedule.
Amistar	1.6 to 2 oz		
Heritage	0.8 to 3.2 oz		
Quadris	5 to 6 fl oz		
Botran 75 W	1 lb	4 apps	BOTRYTIS STEM CANKER: GREENHOUSE ONLY. Apply when conditions favor disease and continue on a 7-day interval during favorable periods. Spray stem of plant from ground level to a height of 18 to 24 in.
Chlorothalonil			PRIOR TO FRUIT SET: Apply before disease onset; continue on a 7- to 10-day schedule. 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 on a 7- to 14-day schedule.
Bravo Ultrex	1.3 to 2.6 lb	18.3 lb	
Bravo WeatherStik	1.375 to 2.75 pt	20 pt	
Echo 720	1.375 to 2.75 pt	20 pt	
Echo 90 DF	1.125 to 2.5 lb	16.7 lb	
Equus 720 SST	1.375 to 2.75 pt	20 pt	
Equus DF	1.3 to 2.6 lb	18.3 lb	
Cabrio ¹	8 to 16 oz	6 apps	NOT FOR GRAY LEAF SPOT/MOLD. Use 8 to 16 oz/A for powdery mildew & Botrytis gray mold; apply 8-12 oz/A for other foliar diseases. Apply before disease onset, continue on a 7- to 14-day schedule.
Cuprofix MZ Dispers ²	1.75 to 7.25 lb	see footnote	NOT FOR BOTRYTIS, POWDERY MILDEW. Apply when disease threatens and continue on a 3- to 10-day schedule as needed.
Endura	2.5 to 12.5 oz	6 apps	EARLY BLIGHT/BOTRYTIS GRAY MOLD ONLY. Apply before disease onset, continue on a 7- to 14-day schedule. No more than 2 sequential applications of Endura can be made before rotating to another mode of action. Use higher rates for Botrytis.
Evito 480 SC ¹	3.8 to 5.7 fl oz	4 apps	EARLY BLIGHT ONLY. Apply before disease onset, continue on a 7-day interval.

DISEASE CONTROL: Tomatoes

Product	Amt/A	Seasonal Limits/A	Comments
Fixed coppers		n/a	NOT FOR BOTRYTIS, POWDERY MILDEW. Apply after transplanting or before disease appears, depending upon product and conditions. Continue on a 3- to 10-day schedule. See label for mixing instructions and tank-mix precautions. GREENHOUSE USES ARE PERMITTED, DEPENDING UPON PRODUCT—REFER TO LABEL.
Badge SC	1.8 to 3.7 pt		
Basic Copper 53	2 to 4 lb		
C-O-C-S WDG	2 to 7 lb		
Champ DP	1.33 to 2.67		
Champ Formula 2 FL	1.33 to 2.67 pt		
Champion WP	2 to 4 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	3 to 6 pt		
Cuprofix Disperss	1.25 to 6 lb		
Cuprofix Ultra 40 Disperss	1.25 to 3 lb		
Kocide 101	2 to 4 lb		
Kocide 2000	1.5 to 3 lb		
Kocide 3000	0.75 to 1.75 lb		
Kocide DF	2 to 4 lb		
Kocide 4.5 LF	1.33 to 2.66 pt		
Nu-Cop 50 WP	2 to 4 lb		
Nu-Cop 3 L	1.33 to 5.33 pt		
Nu-Cop 50 DF	2 to 4 lb		
Tenn-Cop 5 E	3 pt		
Mancozeb			NOT FOR BOTRYTIS, POWDERY MILDEW. Apply when plants emerge or after transplanting, and continue on a 7- to 10-day schedule until harvest. Some formulations are greenhouse-approved; see labels.
Dithane DF Rainshield	1.5 to 3 lb	22.4 lb	
Dithane F-45 Rainshield	1.2 to 2.4 qt	16.8 qt	
Dithane M-45	1.5 to 3 lb	21 lb	
Manzate 75 DF	1.5 to 3 lb	22.4 lb	
Manzate Flowable	1.2 to 2.4 qt	16.8 qt	
Manzate Pro-Stick	1.5 to 3 lb	22.4 lb	
Penncozeb 4 FL	1.2 to 2.4 qt	16.8 qt	
Penncozeb 75 DF	1.5 to 3 lb	22.4 lb	
Penncozeb 80 WP	1.5 to 3 lb	21 lb	
Maneb			NOT FOR BOTRYTIS, POWDERY MILDEW. Apply at first fruit cluster and continue on a 7- to 10-day schedule until harvest. Some formulations are greenhouse-approved; see labels.
Maneb 75 DF	1.5 to 3 lb	22.4 lb	
Maneb 80 WP	1.5 to 2 lb	21 lb	
Manex	1.2 to 2.4 qt	16.8 qt	
ManKocide ²	2.5 to 5 lb	see footnote	NOT FOR BOTRYTIS, POWDERY MILDEW. Apply before disease appears and continue on a 3- to 10-day schedule as needed.
Nova 40 W	2.5 to 4 oz	1.25 lb	POWDERY MILDEW. Apply when symptoms are first observed or when conditions favor disease. Do not make back-to-back applications.
Quadris Opti ¹	1.6 pt	5 apps	NOT FOR BOTRYTIS, GRAY LEAF SPOT/MOLD. Apply applications before disease onset, continue on a 7- to 21-day schedule. Observe seasonal limits for chlorothalonil.
Reason ¹	5.5 to 8.2 fl oz	24.3 fl oz	EARLY BLIGHT, SEPTORIA. Apply applications before disease onset, continue on a 5- to 10-day schedule.
Scala	7 fl oz	35 fl oz	EARLY BLIGHT/BOTRYTIS GRAY MOLD. Apply before disease onset, continue on a 7- to 14-day schedule. GREENHOUSE USE IS APPROVED.
Sulfur	5 to 10 lb	n/a	POWDERY MILDEW. Apply at disease onset, continue on a 7- to 14-day schedule as needed. Phytotoxicity may occur if applications are made when air temperatures exceed 90°F.
Tanos ¹	6 to 8 oz	5 apps	NOT FOR BOTRYTIS, EARLY BLIGHT. Tanos must be tank-mixed with a multi-site inhibitor (FRAC Group M) appropriate for the target disease. Apply before disease onset, continue on a 5- to 10-day schedule.
Ziram 76DF	3 to 4	24 lb	ANTHRACNOSE, EARLY BLIGHT, SEPTORIA. Apply at first appearance of symptoms and continue on a 7-day schedule.
Ziram Granuflo			
Bacterial Spot/Speck			
Actigard	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 on a 14-day schedule.
Agri-Mycin 17Firewall	16 oz/100 gal	n/a	PRE-TRANSPLANT TREATMENT: Apply when seedlings are in 2-leaf stage and continue on 4- to 5-day intervals until transplanting. FOR PRODUCTION OF TRANSPLANTS IN GREENHOUSES ONLY.

DISEASE CONTROL: Tomatoes

Product	Amt/A	Seasonal Limits/A	Comments
Fixed coppers		n/a	Apply after transplanting or before disease appears, depending upon product and conditions. Continue on a 3- to 10-day schedule. See label for mixing instructions and tank-mix precautions. TANK-MIX WITH MANEB OR MANCOZEB FOR MAXIMUM EFFICACY (OBSERVE SEASONAL LIMITS FOR EBDC FUNGICIDES). GREENHOUSE USES ARE PERMITTED, DEPENDING ON PRODUCT—REFER TO LABEL.
Badge SC	1.8 to 3.7 pt		
Basic Copper 53	2 to 4 lb		
C-O-C-S WDG	2 to 7 lb		
Champ DP	1.33 to 2.67 lb		
Champ Formula 2 FL	1.33 to 2.67 pt		
Champion WP	2 to 4 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	3 to 6 pt		
Cuprofix Disperss	1.25 to 6 lb		
Cuprofix Ultra 40 Disperss	1.25 to 3 lb		
Kocide 101	2 to 4 lb		
Kocide 2000	1.5 to 3 lb		
Kocide 3000	0.75 to 1.75 lb		
Kocide DF	2 to 4 lb		
Kocide 4.5 LF	1.33 to 2.66 pt		
Nu-Cop 50 WP	2 to 4 lb		
Nu-Cop 3 L	1.33 to 5.33 pt		
Nu-Cop 50 DF	2 to 4 lb		
Tenn-Cop 5 E	3 pt		
Tanos ¹	8 oz	5 apps	FOR SUPPRESSION ONLY OF BACTERIAL SPOT, SPECK, AND CANCKER. Tanos must be tank-mixed with a multi-site inhibitor (FRAC Group M). Apply before disease onset, continue on a 5- to 7-day schedule.
Late Blight			
Acrobat 50 WP	6.4 oz	32 oz	Must be tank-mixed with another Phytophthora fungicide. Apply before disease onset, continue on a 5- to 10-day schedule. Rotate to another fungicide after 2 consecutive applications.
Forum SC	6 fl oz	30 fl oz	
Azoxystrobin ¹		5 apps	Apply 21 days after transplanting or 35 days after seeding and continue on a 5- to 7-day schedule.
Amistar	2 oz		
Heritage	3.2 oz		
Quadris	6 fl oz		
Chlorothalonil			PRIOR TO FRUIT SET: Apply before disease onset; continue on a 7- to 10-day schedule. 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 on a 7- to 14-day schedule.
Bravo Ultrex	1.3 to 2.6 lb	18.3 lb	
Bravo WeatherStik	1.375 to 2.75 pt	20 pt	
Echo 720	1.375 to 2.75 pt	20 pt	
Echo 90 DF	1.125 to 2.5 lb	16.7 lb	
Equus 720 SST	1.375 to 2.75 pt	20 pt	
Equus DF	1.3 to 2.6 lb	18.3 lb	
Cabrio ¹	8 to 16 oz	6 apps	Apply before disease onset, continue on a 5- to 7-day schedule. Limit 6 apps/season.
Cuprofix MZ Disperss ²	1.75 to 7.25 lb	see footnote	Apply applications when disease threatens and continue on a 3- to 10-day schedule as needed.
Curzate 60 DF	3.2 to 5 oz	30 oz	Must be tank-mixed with a multi-site inhibitor (FRAC Group M). Apply before disease onset, continue on a 5- to 7-day schedule.
Evito 480 SC ¹	5.7 fl oz	4 apps	Apply before disease onset & continue on a 7-day interval. Limit 4 apps/A/season.
Fixed coppers		n/a	Apply after transplanting or before disease appears, depending upon product and conditions. Continue on a 3- to 10-day schedule. See label for mixing instructions and tank-mix precautions. Some formulations are greenhouse-approved; see labels.
Badge SC	1.8 to 3.7 pt		
Basic Copper 53	2 to 4 lb		
C-O-C-S WDG	2 to 7 lb		
Champ DP	1.33 to 2.67 lb		
Champ Formula 2 FL	1.33 to 2.67 pt		
Champion WP	2 to 4 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	3 to 6 pt		
Cuprofix Disperss	1.25 to 6 lb		
Cuprofix Ultra 40 Disperss	1.25 to 3 lb		
Kocide 101	2 to 4 lb		
Kocide 2000	1.5 to 3 lb		
Kocide 3000	0.75 to 1.75 lb		
Kocide DF	2 to 4 lb		
Kocide 4.5 LF	1.33 to 2.66 pt		
Nu-Cop 50 WP	2 to 4 lb		
Nu-Cop 3 L	1.33 to 5.33 pt		
Nu-Cop 50 DF	2 to 4 lb		
Flint ¹	4 oz	4 apps	Tank mix with a 75% rate of a protectant fungicide. Apply before disease onset, continue on a 7- to 10-day schedule.
Gavel 75 DF ²	1.5 to 2	8 apps	Apply after transplanting and continue on a 7- to 10-day schedule.

DISEASE CONTROL: Tomatoes

Product	Amt/A	Seasonal Limits/A	Comments
Mancozeb			
Dithane DF Rainshield	1.5 to 3 lb	22.4 lb	Apply when plants emerge or after transplanting, and continue on a 7- to 10-day schedule until harvest. Limit 16.8 lb ai/A/season. Some formulations are greenhouse-approved; see labels.
Dithane F-45 Rainshield	1.2 to 2.4 qt	16.8 qt	
Dithane M-45	1.5 to 3 lb	21 lb	
Manzate 75 DF	1.5 to 3 lb	22.4 lb	
Manzate Flowable	1.2 to 2.4 qt	16.8 qt	
Manzate Pro-Stick	1.5 to 3 lb	22.4 lb	
Penncozeb 4 FL	1.2 to 2.4 qt	16.8 qt	
Penncozeb 75 DF	1.5 to 3 lb	22.4 lb	
Penncozeb 80 WP	1.5 to 3 lb	21 lb	
Maneb			
Maneb 75 DF	1.5 to 3 lb	22.4 lb	Apply at first fruit cluster and continue on a 7- to 10-day schedule until harvest. Limit 16.8 lb ai/A/season. Some formulations are greenhouse-approved; see labels.
Maneb 80 WP	1.5 to 2 lb	21 lb	
Manex	2.4 to 4.8 pt	16.8 qt	
ManKocide ²	2.5 to 5 lb	see footnote	Apply before disease appears and continue on a 3- to 10-day schedule as needed.
Quadris Opti ¹	1.6 pt	5 apps	Apply before disease onset, continue on a 5- to 7-day schedule. Observe seasonal limits for chlorothalonil.
Previcur Flex	0.7 to 1.5 pt	7.5 pt	Apply before disease onset, continue on a 7- to 10-day schedule. Must be tank-mixed with chlorothalonil, mancozeb, or maneb.
Ranman SC	2.1 to 2.75 fl oz	6 apps	Apply before disease onset, continue on a 7- to 10-day schedule. Do not apply back to back; alternate with a fungicide having a different mode of action. Limit 6 apps/A/season.
Reason ¹	5.5 to 8.2 fl oz	24.6 fl oz	Apply before disease onset, continue on a 5- to 10-day schedule.
Ridomil Gold Bravo	2 lb	3 apps	Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG Bravo. Observe seasonal limits for chlorothalonil.
Ridomil Gold Bravo SC	2.5 pt		
Ridomil Gold Copper	2 lb	3 apps	Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG Copper.
Ridomil Gold MZ ²	2.5 lb	3 apps	Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG MZ. Observe seasonal limits for EBDC fungicides.
Tanos ¹	8 oz	5 apps	Tanos must be tank-mixed with a multi-site inhibitor (FRAC Group M) appropriate for the target disease. Apply before disease onset, continue on a 5- to 7-day schedule.
Pythium Seedling Disease			
Previcur Flex	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. Limit 7.5 pt/A/season. GREENHOUSE USE: Can be applied as a drench or by chemigation—see to label for rates.
Ridomil Gold EC	1 to 2 pt	1 app	PRE-PLANT. 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			
Ultra Flourish	2 to 4 pt	1 app	
Ridomil Gold GR	20 lb	1 app	For pre-plant application only. Adjust equipment so that granules applied uniformly over soil surface. Incorporate mechanically or with irrigation water.
Southern Blight			
Evito 480 SC ¹	3.8 to 5.7 fl oz	4 apps	Apply before disease onset & continue on a 7-day interval.
Terraclor 75 WP	3 lb/100 gal	1 app	Apply 0.5 pt of solution per plant at transplanting; maintain agitation to keep material in suspension.
Terraclor Flowable	4.5 pt/100 gal		
Verticillium/Fusarium Wilt			
Chloropicrin	22 to 36.5 gal	1 app	Inject pre-plant (minimum of 4 weeks before planting) with chisels set to 6 to 8 in depth and spaced no wider than 12 in apart. Rate listed is for broadcast application; bed applications can be made, but rate must be adjusted for smaller application area.
metam sodium 42%	37.5 to 75 gal	1 app	Products include Vapam HL, Metam CLR 42%, and Sectagon-42. Rates listed are per treated acre. Apply a minimum of 14 days before planting. May be drenched, injected, sprayed and incorporated, or applied through sprinkler irrigation systems. See label for application instructions and precautions.
Telone C-35	13 to 20.5 gal	1 app	Inject pre-plant (minimum of 4 weeks before planting) with chisels set to 8 to 10 in depth and spaced 12 to 24 in apart. Rate listed is for broadcast application. Rate listed is per treated acre.

¹ Do not make back-to-back applications or rotate with other QoI inhibitors (FRAC Group 11). Fungicides with the same Group number have the same mode of action. Do not tank-mix products with the same Group number, and rotate among fungicides with different Group numbers to discourage resistance development.

² Observe seasonal limits for Mancozeb.

Vining Crops (Cucurbits)

Cucumbers, Muskmelons, Squash, Pumpkins, & Watermelons

Gourd family (Cucurbitaceae): *Cucumis sativus* [cucumber]; *Cucumis melo*, Reticulatus Group [Muskmelon]; *Citrullus lanatus* [Watermelon]

Planting and Culture

Cucumber

Cucumbers are grown in Kentucky primarily for fresh market (slicing types) rather than for processing (pickling types). Planting and cultural requirements are similar for both. Cucumbers do best in firm, deep, well-prepared seedbeds. Fall plowing is recommended. The soil should be well drained and high in organic matter for best results. Apply 10 tons of manure per acre the previous fall if available. Land that has been in sod is very desirable. The soil should be disked two or three times in early spring to prepare for seeding. Disking helps to eliminate early germinating weed seeds and prepare a fine seedbed. A cultipacker will help prepare a good seedbed. Do not plant cucumbers on land that was treated the previous year with a triazine herbicide such as atrazine, Sencor/Lexone, or Karmex.

Train vines to run lengthwise in the row soon after vining starts for hand-harvested pickling or slicing cucumbers. Cultivating in one direction will also help to train plants to run in the row. This training will enable harvesters to pick more easily and quicker, and the plants will not be damaged as seriously. Cultivation should be shallow to prevent root damage.

Start seed about the first of May in most areas of the state or when designated by the company you may be contracting with. Continued plantings at one- or two-week intervals can be made to extend the harvest season (see Appendix H).

Slicing cucumbers are usually grown on black plastic with trickle irrigation to increase yields and earliness. Cucumbers can be direct-seeded through plastic mulch using seeders designed for that purpose, or they can be transplanted at about 2 to 3 weeks after seeding.

Muskmelon

Muskmelons (cantaloupes) and specialty melons are warm-season crops. They require a relatively long growing season of 80 to 100 days from seeding to marketable fruit. Well-drained, lighter-textured (sandy or sandy loam) soils are considered best for cantaloupes, although medium-textured soils can be just as productive with good management practices. Lighter-textured soils warm up faster than heavier soils. Because of potentially serious disease problems, melons are best grown on land that has not been in vine crops (cantaloupes, watermelons, squash, pumpkins, etc.) for at least three years.

The vining habit of the plant and its large leaves make it especially susceptible to wind damage. Planting cantaloupes between strips of annual rye or some similar, taller-growing plant will provide windbreak protection. In addition, growers can orient rows in the direction of prevailing winds (usually winds blow from the southwest in most parts of Kentucky) so that wind blows down rows rather than across them.

Cantaloupes can be direct seeded to the field or grown as transplants in the greenhouse or hotbed and transplanted to

the field. Generally, 2 lb of seed is sufficient to direct seed an acre; ¼ to ½ lb per acre is sufficient for transplants. Plant the seed ½ to ¾ inches deep after danger of frost is past (see Appendix H).

Transplants produce earlier ripening fruits that will often bring much higher early prices. With transplants, plant the seed three weeks before the plants are to be transplanted to the field. The plants should have two or three true leaves. Plant two or three seeds each in 3- or 4-inch round or square peat pots or 72-cell plug trays. Do not allow pots to dry out.

It is crucial that plants be protected from cucumber beetle feeding from the day of seedling emergence or from the day of transplanting to reduce the risk of bacterial wilt disease (vectored by the beetles). The insecticide Admire has provided good early season systemic control of cucumber beetles on melons in Kentucky. This reduces the potential for bacterial wilt while the plants are small. Although several soil application methods may be used with this product, the post-transplant drench is recommended for best control: a small amount of the Admire solution is applied at the base of each plant immediately after transplanting. With proper calibration, this can be done quickly and accurately using a backpack sprayer with the nozzle removed (see insect control table and current label for recommended rates). Admire should not be used in the setter tank water because of the potential for worker exposure during transplanting.

VARIETIES: Cucumbers

Varieties	Days to Mat.	Use	Comments
Speedway	56	Slicing	Early variety with CMV, powdery mildew, scab, anthracnose, and angular leaf spot tolerance.
Dasher II	58	Slicing	Resistant or tolerant to powdery and downy mildew, cucumber mosaic virus (CMV), scab, anthracnose, and angular leaf spot. All female flowering, very attractive.
Panther	58	Slicing	Dark green, slim with white spines; tolerant to CMV, downy and powdery mildews, angular leaf spot, anthracnose, and scab.
Indy	59	Slicing	Early, resistant or tolerant to anthracnose, angular leaf spot, powdery mildew, scab, CMV, WMV, ZYMV; all female flowering.
General Lee	60	Slicing	Heavy producer, dark green with white spines, resistant to downy and powdery mildew, scab, and CMV, very attractive.
Daytona	67	Slicing	Dark green, ZYMV, PRV, WMV tolerant; powdery mildew, angular leaf spot, anthracnose, and scab tolerant.
Turbo	67	Slicing	Small seed cavity; tolerant to CMV, downy and powdery mildew, angular leaf spot, anthracnose, and scab. All female flowering.
Marketmore 76 (open-pollinated)	67	Slicing	Scab and CMV resistant; for local market or home gardens.
Calypso	52	Pickling	Tolerant to scab, anthracnose, powdery and downy mildew, and CMV. All female flowering.

Specialty Melons

Specialty melons (honeydews, canary, galia, and others) are excellent items for direct market sales; they are full flavored and far superior to what can be obtained through local supermarkets. These melons are somewhat more difficult to grow than cantaloupes and require an extended spray program in Kentucky. Specialty melons are highly susceptible to bacterial wilt and post-transplant drench application of an imidacloprid insecticide (Admire, etc.—see the Disease and Insect Control sections) is an absolute necessity to achieve success. A season-long weekly preventative fungicide spray schedule for Anthracnose is also critical.

These melons do best when planted around May 1 and transplanted to the field around June 1. This allows harvest to coincide with dry weather late in the season which increases flavor and sugar content. Specialty melon need a slightly wider plant spacing, see “Plant Spacing” section. Some specialty melons, especially galia melons, are prone to magnesium deficiencies and preventive measures may be required (see “Magnesium and Molybdenum Deficiencies” in this chapter). In addition, growers will need to gain some experience with each type to determine exactly when to harvest as many specialty melons do not “slip” or may not change color at maturity in the same way that muskmelons do. See descriptions in variety table for specific harvesting guidelines.

Squash and Pumpkin

Squash and pumpkins produce best on well-drained, fertile soil. The plants produce large, shallow root systems very rapidly in the top 8 to 10 inches of soil, which should be prepared into a firm, well-fertilized seedbed. Squash and pumpkins do well in soils where 10 to 12 tons of well-rotted manure have been applied per acre. To help avoid soil-borne disease problems, select fields that have not had other vine crops, tobacco, tomatoes, or peppers for at least three years. Calculate the number of days to harvest to determine when to plant pumpkins for Halloween (see also Appendix H). Growers usually harvest pumpkins in mid-September to allow time for marketing.

VARIETIES: Melons

Varieties	Days to Mat.	Use	Quality3	Comments
Eastern Cantaloupe				
Athena	78	Local, shipping	E	Market standard, 5-7 lb melon; sutureless and fine heavy netting, small cavity, firm flesh, resistance to powdery mildew and Fusarium races 0, 1 and 2. Looks like a large Western melon. Grower must sign liability waiver.
Minerva	77	Local, shipping	E	7-8 lb round to oblong with deeper sutures than Athena and heavy netting. Resistance to powdery mildew and Fusarium races 0, 1 and 2.
Aphrodite	80	Local, limited shipping	E	6-8 lb; Earlier, larger Athena type, resistance to PM 1, 2 and Fusarium race 0, 1, 2.
Wrangler	80-85	Local	E	4-5 lb small Tuscan type cantaloupe with dark green sutures, medium net, excellent flavor, Fusarium race 0,1, 2 and powdery mildew resistance.
Eclipse	85	Local, shipping	E	5-8 lb oval shaped with slight sutures, medium net, good shelf life, powdery mildew and Fusarium wilt race 2 tolerant.
Starship	86	Local, limited shipping	E	4-6 lb melon, deep sutures, heavy net, good shelf life, Fusarium race 2 resistant; powdery mildew tolerant.
Jaipur	86	Local	E	5-6 lb oval melon, medium net, firm dense flesh, Fusarium races 0, 1, 2 resistant, powdery mildew tolerant; for trial.
Specialty Melons				
Honey Yellow	75	Local	E	2-2.5 lb honeydew, bright yellow skin, orange flesh, excellent sugar content and flavor.
Honey Orange	80	Local	VG	4-5 lb honeydew, cream colored exterior, orange flesh, very sweet.
Honey Pearl	80	Local	VG	4 lb honeydew, cream colored flesh, excellent flavor.
San Juan	85	Local	VG	3 lb honeydew, green flesh, excellent flavor.
Temptation #1	85	Local	E	6-7 lb oval honeydew, orange flesh, high sugar content excellent flavor.
Honey Brew	90	Local	E	4-5 lb honeydew, green flesh, excellent flavor; Fusarium, downy mildew and powdery mildew resistance.
Golden Beauty	80	Local, shipping	E	6-7 lb canary melon, bright yellow exterior, cream colored flesh, very sweet, excellent flavor and shelf life, harvest when rind is golden.
Dorado	85	Local, shipping	E	5-6 lb canary melon; bright yellow exterior; cream colored flesh; very sweet, excellent quality and shelf life, harvest when rind is golden.
Sugar Nut	77	Local	E	3-4 lb canary melon; cream to lt. green flesh, exterior bright yellow with some checking; harvest when bright yellow.
Sancho	90	Local	E	6.5-9 lb oval shaped Piel de Sapo melon, dark green rind, creamy-white flesh, outstanding quality, high consumer acceptance, develops dark yellow ground spot when ripe, powdery mildew tolerance.
Sensation	80	Local	O	5-6 lb gourmet melon, round, medium netted light yellow rind, creamy white interior, harvest when rind begins to turn yellow.
Sprite	65-75	Local, shipping	E	1.3 lb specialty melon, creamy exterior and interior, crisp flesh, reaches 16% sugar, excellent quality, high consumer demand, ripe when small checks appear around blossom end.
Napoli	72	Local	O	2.5 lb specialty melon, round, cream colored heavily netted rind, light green melting flesh, harvest when exterior is straw colored before full slip.
Sunrise	72	Local	O	2.5-3 lb specialty melon, round, cream colored heavily netted rind, orange melting flesh, harvest when exterior is straw colored before full slip.
Pixie	80	Local	E	3 lb muskmelon X galia melon cross; very firm, very sweet, orange flesh; harvest when rind develops a yellow background.
Sweetie	85	Local	E	4-5 lb muskmelon X galia melon cross; very firm, very sweet, orange flesh; harvest when rind develops a yellow background.
Arava	77	Local	VG	4 lb galia melon, netted exterior, sweet green flesh, excellent flavor, harvest when just turning yellow, relatively short shelf life.
Vicar	86	Local	E	4 lb galia melon, round, greenish-yellow netted rind, lt. green flesh; harvest when rind begins developing yellowish color.
Galileo	87	Local	VG	3.3 lb galia melon, fully netted exterior, firm light green flesh, nice balance of sweet and musky flavor, harvest when just turning yellow.

Some Kentucky growers have successfully grown pumpkins using a no-till system by seeding into stubble of a rye or rye-vetch cover crop that has been killed with herbicide. Pumpkins can be direct seeded into the mulch with a modified no-till corn planter. This can eliminate the need for washing pumpkins prior to marketing, may reduce fruit rots, and makes for an easier/cleaner field to walk in for schoolchildren or “pumpkin festival” customers. No-till has been successful on well-drained soils but may be problematic on heavier soils; problems with rodent feeding have been encountered by some growers using this system.

Having irrigation available for pumpkins will pay big yield and quality dividends in some years. A good irrigation system that can apply 1 to 2 inches of water a week and keep ground temperatures a little cooler will increase yields dramatically and pay for itself in a drought year. Using drip irrigation on pumpkins has made the difference between high profits and total crop failure for some Kentucky pumpkin growers in dry years; the easiest and most effective system employs 8 to 10 mil drip lines without the use of plastic mulch. Supplemental irrigation is critical in dry summers during flowering and fruit setting.

Summer squash (yellow straightnecks, yellow crooknecks, or zucchini types) are usually grown for an early summer market in mid- to late June or for an early fall market when prices begin to rise in September (see Appendix H). Growers producing squash for the late summer/early fall market usually encounter serious virus or fungal disease problems and should plant either a variety with the precocious yellow trait that masks virus symptoms or one of the varieties with conventional or genetically engineered virus resistance. Varieties are also available with resistance to powdery mildew (see varieties table).

VARIETIES: *Squash, Pumpkins, Gourds*

Variety	Days to Mat.	Comments
Squash		
<i>STRAIGHTNECK</i>		
Fortune	40	Precocious yellow trait (py) masks virus symptoms on fruit, downy mildew tolerant; teardrop shape.
Multipik	40	Precocious yellow trait (py) masks virus symptoms on fruit; downy mildew tolerant; teardrop shape.
Seneca Supreme	40	Precocious yellow trait (py) masks virus symptoms on fruit; teardrop shape.
Sunbar	45	Precocious yellow trait (py) masks virus symptoms on fruit; noticeable blossom end protrusions in fall trial; teardrop shape.
Cougar	50	Precocious yellow trait (py) conventional breeding resistance to ZYMV and PRSV. Similar to multipik, large bush type plants.
Conqueror III	41	Genetically engineered resistance to CMV, WMV, ZYMV and intermediate resistance to PRSV.
Lioness	50	Tolerance to ZYMV, CMV, WMV, PRSV, and powdery mildew; green stem, mature fruit have a very light greenish cast.
Sunray	50	Precocious yellow trait (py) masks virus symptoms on fruit;
<i>CROOKNECK</i>		
Prelude II	40	Genetically engineered resistance to 2 viruses (WMV, ZYMV) plus conventional powdery mildew resistance. Full crook.
Destiny III	40	Genetically engineered resistance to 3 viruses (WMV, CMV, ZYMV); similar to Dixie. Semi- to full crook.
Sundance	40	Thin necks, full crook.
Sunglo	40	Mosaic virus and powdery mildew tolerant; slender bulbs; reduced spines; green stems.
Gentry	43	Semi-crook; reduced spines, green stems; open bush plant.
Medallion	52	Semi-crook; vigorous open bush.
<i>ZUCCHINI</i>		
Dividend	47	Medium green, cylindrical, some with slight curve; tolerant to some strains of WMV, CMV, ZYMV.
Revenue	45	Medium green, cylindrical, straight; tolerant to some strains of WMV, CMV, ZYMV.
Tigress	45	Cylindrical, slightly tapered; attractive medium to dark green; tolerant to WMV, ZYMV.
Wildcat	45	
Zucchini Elite	45	Long, slightly curved and tapered fruits.
Cashflow	45	Medium green fruit with a slight taper, tolerant to some races of ZYMV, large plant.
Radiant	45	Dark green fruit; tolerant to CMV, ZYMV.
Payroll	45	Attractive medium green fruit; virus tolerant.
Spineless Beauty	50	Fruits similar to Zucchini Elite.
<i>OTHER SUMMER SQUASHES</i>		
Sunburst	50	Bright yellow scalloped, AAS winner.
Patty Pan	54	White scalloped; plants compact bush type.
<i>ACORN</i>		
Tay Belle PM	70	1 to 1.5 lb; powdery mildew tolerant; attractive, dark green exterior; bush type plant; medium orange sweet, tender flesh; excellent taste.
Mesa Queen	70	1 to 1.5 lb; dark green exterior; medium orange flesh; semi-bush; excellent taste.
Jersey Golden	82	Light yellow exterior; compact bush plant.
Cream of the Crop	85	1.5 lb; attractive creamy white exterior; cream colored flesh; bush type plant.
Table Ace	85	1.5 lb; dark green exterior; yellow orange flesh; semi-bush plants hold up well; high yielding.
Table Gold	95	1 to 1.5 lb; bright golden exterior; dark orange flesh; semi-bush plant; very attractive and excellent taste.
<i>ORNAMENTAL ACORN</i>		
Carnival	85	1 to 1.5 lb; skin flecked with shades of green, gold, and yellow; semi-bush plant.
Heart of Gold	90	1.5 lb; white with dark green mottling and golden flesh; large vine; excellent taste.
<i>BUTTERNUT</i>		
Chieftan	90	2 to 2.5 lb
Butternut Supreme	95	Productive, thick neck, very uniform shape; excellent taste.
Waltham Butternut	95	3 to 5 lb; blocky and uniform.
Cassius	110	8 lb; very large fruits; long, thick neck; very productive.

VARIETIES: Squash, Pumpkins, Gourds

Variety	Days to Mat.	Comments
BUTTERCUP/ KABOCHA		
Sun Spot	75	2 lb; very attractive, orange fruit with dark orange, fine grained, slightly moist, sweet flesh (buttercup).
Sweet Mama	85	5 lb; sweet, fine-grained, deep yellow flesh, dark green fruit; excellent taste and high yielding (kabocha).
Thunder	85	3 lb; attractive dark green exterior; dry sweet flesh, excellent eating quality (buttercup).
Delica	90	4 lb; medium-dry, slightly sweet flesh; dark green with gray-green stripes; excellent taste (kabocha)
Special Export	90-95	3 lb; excellent flavor, attractive exterior and interior, excellent eating quality (kabocha).
Burgess Buttercup	90	2 lb; smooth texture; excellent eating quality.
Sunshine	95	4 lb; bright orange skin, nutty, smooth, stringless; very sweet, excellent eating quality (buttercup).
Ambercup	100	Bright orange fruit with dry, sweet flesh, excellent eating quality (buttercup).
SPAGHETTI		
Small Wonder	70	2 to 2.5 lb; yellow exterior; large vine
Hasta-La-Pasta	80	Deep orange exterior; bright orange flesh; semi-vine.
MISCELLANEOUS SQUASH		
La Estrella	70-90	10 lb; Calabash squash; attractive green to tan blotchy exterior; fluorescent orange, moist fine grained flesh.
Hubba Hubba	95	3 lb; attractive small bright orange hubbard; orangish green flesh, bush type.
Bush Delicata	100	1 lb; exterior creamy white with green stripes; powdery mildew tolerance; excellent quality.
Grey Ghost	100	7 lb; attractive grey exterior; yellow orange, moist fine grained flesh; storage squash with ornamental value.
Cushaw Green Stripe	110	15 lb; very productive.
Pumpkins		
LARGE (15 - 35 LB)		
Appalachian	90	25 lb, dark orange; semi-bush vines, uniform, good stems ("handles").
Big Autumn	90	Variable sized fruit about 13 lb; high yielding; 10 inch diameter. Handles strong, dark green with an orange base. Deep orange, very smooth, deeply ribbed.
Gold Standard	90	13 to 15 lb; deep orange, good handles.
Pro Gold 510	95	22 to 26 lb; bright orange color; strong dark green handles; 14 to 16 inches diameter.
Howdy Doody	95	15 to 16 lb, 12x13 inch dark orange, smooth with shallow ribs, strong handle, restricted vine.
Jackpot	95-100	Compact vines; little less than 20 lb; 10 inch diameter.
Gold Bullion	100	18 lb, dark orange, excellent yields, handles and color, semi bush.
Gold Gem	105	18 to 22 lb, 15x13 inch dark orange, ribbed, strong handles; large vine.
Autumn King	105	25 lb; large vines, good color, handles, and yield.
Aladdin	105	(for trial); 25 to 35 lb; deep orange, slightly tall, powdery mildew tolerant.
Trojan	110	20 to 30 lb, 17x15 inch dark orange, deep ribs, large dark green handles, large vine.
Gladiator	115	15 to 25 lb; deep orange, 13x12 inch; good handles and powdery mildew tolerant.
Super Herc	115	20 to 35 lb; powdery mildew tolerant; "imbedded stem."
Magic Lantern	115	16 to 24 lb; dark orange; large vines; strong, dark green handle; powdery mildew tolerant.
Merlin	115	15 to 25 lb; dark orange; large vines; powdery mildew tolerant
Howden's Field	115	20 lb; older, open pollinated variety; large vines; fruit deep orange; around 14 inch diameter; problems with fruit set during hot weather; Fusarium susceptible.
Buckskin	115	12 to 18 lb, 7x10 inch, attractive, looks like a large buff colored acorn, large vine.
MEDIUM (5 - 10 LB)		
Schoolltime	82	(for trial); 8 to 10 lb, slightly flat to round; compact vines, semi-bush.
Magician	90	(for trial); 8 to 16 lb, dark orange, round to tall; powdery mildew tolerant.
Pick A Pie	85	5 to 6 lb, 6x5 inch, dark orange pie pumpkin with large dark green handles, uniform fruit, semi-bush.
Hybrid Pam	90	5 to 7 lb, 6x6 inch deep orange.
Lumina	110	7 to 8 lb white pumpkin for carving and painting with bright orange flesh; 9 inch diameter. Shape varies from globe to flat globe; not a particularly high yielder and fruit scars easily. Harvest slightly immature to obtain a better white color, otherwise these can turn gray.
MINIATURE (5 OZ - 4 LB)		
Cannonball	90	(for trial). 3 to 5 lb, orange to dark orange, round, smooth; long shelf life; powdery mildew tolerant.
Spooktacular	95	5 to 6 inch diameter; dark orange skin, smooth shallow ribbing, uniform.
Baby Boo	95	5 oz. white deeply ribbed fruit; 3.5 inch diameter, vines large; very productive.
Touch of Autumn	95	3.5 to 4 lb, 6 x 5 inches. Very attractive; semi-bush vine type; excellent handles that remain dark green; stores well; powdery mildew tolerant.
Baby Bear	105	1.5 lb, 5 inch diameter; good disease tolerance.
Oz	105	2 to 4 lb semi-bush; 5 to 6 inch diameter; precocious yellow gene—colors early; excellent for painting.
Ironman	110	3 to 4 lb, 7 to 8 inch diameter, dark orange; long shelf life; tolerant to powdery mildew, long shelf life.
Lil' Irosides	115	2 lb, 6 inch diameter, tough, hard, dark orange shell that is not carveable, strong stem, large vine, long shelf life.
EXTRA LARGE		
Atlantic Giant	120	Pink-orange color, world record over 1,000 lb
Burpee Prize Winner	120	50 to 200 lb, orange, attractive; very large with shape and color superior to Atlantic Giant.
Big Moon PVP	120	Orange color, 40 to 200 lb, a very large show pumpkin.
Ornamental Gourds		
Autumn Wings Large Swan	100	Unique gourd, multiple colors with wings, warts, shaped like a swan gourd.
Autumn Wings Medium	100	Unique gourd, many colors with wings, shape of a spoon gourd.
Autumn Wings Small	100	Unique gourd, many colors with wings, shaped like a swan pear gourd. Potential for shipping.

Squash and pumpkins are warm-season crops and do not do well until soil and air temperatures are above 60°F. Seed may decay before germinating if planted in cold, wet soil. Black plastic on raised beds with trickle irrigation will speed soil warming in spring squash plantings and can dramatically increase early and total yields. Use white plastic mulch for late squash plantings in July or August. Seed or transplants can be planted through the plastic by hand, with a waterwheel setter or with machinery designed for direct seeding through plastic.

Squash or pumpkin transplants should be started in the greenhouse in 72-cell trays 2 to 3 weeks before the anticipated transplanting date. The plants are ready when the first true leaves are fully developed; delays in transplanting can result in stunting of plants in the field.

Watermelon

Lighter-textured soils are considered best for watermelons, although medium-textured soils can be just as productive with good management practices. Watermelons grown on heavier soils tend

to be irregular in shape and may contain less sugar. Watermelons should not be grown on the same ground year after year because of disease problems; watermelons are best grown on land that has not been in tomatoes, peppers, or another vine crop (cantaloupes, squash, pumpkins, etc.) for at least three years.

Watermelon seedlings are often grown in containers in the greenhouse and later transplanted to the field. This method must be used for seedless watermelons due to their high seed costs and poor germination percentages. If one follows this procedure, the seed should be planted 14 to 21 days before planting to the field (see Appendix H). Transplants should be planted to the field around the time the first true leaf forms. Transplanted melons will mature 10 to 14 days earlier than direct seeded melons.

Black plastic on raised beds with drip irrigation is commonly used in commercial watermelon production for earlier maturity and higher yields; soils warm up faster in the spring and weeds will not grow under the mulch. Soil moisture is also retained and nutrient leaching minimized.

Direct seeding in hills was once the most common method of planting watermelons. The seedbed for planting should be thoroughly prepared to ensure good plant stands. Soil moisture should be adequate throughout the early growing season to produce good plant growth and vigorous blossoms. After fruits reach full size it is usually best to withhold or reduce irrigation during the ripening season. Sugar content will usually be higher and the melons will have better flavor if moisture levels are not high during ripening. Keep in mind the fact that watermelon plants have deep root systems.

Good weed control is essential for high-quality melons. Melon yields and sugar contents can be reduced if weeds are allowed to shade and otherwise compete with the plants. Black plastic helps to control weeds during early growth; however, it is critical to control weeds in the bare ground middles between rows of plastic. Herbicides and/or mechanical cultivation can be effectively used for early season weed control in these middles.

VARIETIES: Watermelon

Variety	Days to Mat.	Comments
Seeded		
Athens	82	23 lb; Crimson Sweet rind;* tender flesh, high yielding; tolerant to Fusarium race 1.
Tiger Baby	80	10 to 12 lb; excellent quality, firm flesh, small seeds; resistant to Fusarium race 1.
Sangria	83	20 to 25 lb; Crimson Sweet rind;* elongated; outstanding flavor; fruit blossom end may taper with drought; tolerant to Fusarium race 1 and anthracnose.
Royal Star	84	21 to 26 lb; Royal Sweet rind;* blocky oblong fruit; good for shipping; excellent flavor; tolerant to Fusarium.
Carson	85	15-18 lb; Allsweet rind;* elongated; bright red tender sweet flesh; resistance to Fusarium races 0 and 1, anthracnose races 1 and 3
Starbrite	85	21 to 29 lb; Royal Sweet rind;* elongated; very sweet and high yielding; resistant to Fusarium race 1 and anthracnose.
Royalty	85	22 to 26 lb; Royal Sweet rind;* thin rind; excellent eating quality, high yields.
Stars N' Stripes	85	22 to 31 lb; Crimson Sweet rind;* elongated; very sweet; high yielding; resistant to Fusarium race 1 and anthracnose.
Star Gazer	85	24-28 lb; Allsweet rind,* elongated; excellent quality; uniform; resistance to Fusarium and anthracnose.
Royal Sweet	85	20 to 24 lb; oblong; bright red flesh, small dark seeds; vigorous, resistant to Fusarium—shipper.
Huck Finn	85	20 to 25 lb; oblong with dark green stripes, excellent flavor.
Royal Majesty	90	21 to 30 lb; Allsweet rind;* elongated; outstanding flavor; Fusarium resistant.
Royal Jubilee	95	25 to 30 lb; Jubilee rind;* elongated; high yields; bright red flesh, small seeds. Resistant to Fusarium—shipper.
Seedless		
All sweet	90	25-30 lb; medium green thin stripes; elongated oval; high sugar content.
Ultra Cool	75	7-14 lb; Royal Sweet Rind; attractive interior.
Freedom	75	16 to 25 lb; dark Jubilee rind; long, blocky; attractive rind and interior; bright red flesh. Resistant/tolerant to Fusarium race 1.
Indiana	76	13 to 15 lb; Jubilee, dark background; round to oval; attractive interior; resistance to Fusarium races 0 and 1 and anthracnose races 1 and 3.
Millennium	78	12 to 15 lb; black*, tough rind; oval; Fusarium resistant; anthracnose tolerant; no hollow heart.
Revolution	82	16 lb; Royal Sweet rind;* elongated; bright red flesh; outstanding flavor; tolerant to hollow heart.
Harmony	84	15-18 lb; Crimson Sweet rind,* oval; very sweet, crisp, bright red flesh.
Orange Sweet	84	15 to 25 lb; Jubilee rind;* round; attractive orange flesh.
Ruby	85	14 lb; medium green dark double striped rind, oval; excellent dark red firm flesh; hollow heart tolerant.
Cooperstown	85	16 to 22 lb; Crimson Sweet rind;* round; excellent bright red interior.
Treasure Chest	88	13 to 15 lb; Jubilee rind;* bright yellow flesh; very sweet.
Mini-Seedless		
Solitaire	85	6 to 9 lb; Royal sweet rind;* round, attractive; very tough rind; very firm pink flesh.
Mohican	85	6 to 9 lb; Allsweet rind;* round, attractive; very tough rind; very firm dk. pink flesh; may be susceptible to bacterial rind necrosis.
Poquito	90	3-5 lb; Crimson Sweet rind;* round; red flesh; excellent flavor.

* Watermelon varieties are often grouped by rind color or pattern; these groups or types are often named for a popular variety with similar characteristics:

Allsweet = medium green rind w/dark green, broad mottled stripes; Jubilee = light green rind with distinct narrow, dark green stripes;

Black = solid dark green rind; Crimson Sweet = light green rind w/mottled dark green stripes; Royal Sweet = light green rind w/wide, mottled, dark green stripes.

Special Considerations for Seedless (Triplod) Watermelon Production:

Germination

- The most common reasons for poor germination are overwatering, incorrect watering, poor temperature control, and shallow seed placement.
- For growing transplants, the growing media should be moist but not wet. Check moisture level by squeezing a handful of media. Generally, if water drips from the media it is too wet.
- Water the media and allow it to dry for 12 to 24 hours. During this time, bring the temperature of the media to 85° to 90°F. Before filling trays and seeding, stir the media to ensure that it is evenly moistened.
- Seeds should be planted between ½ to ¾ inches deep in trays. This planting depth helps prevent germinating seeds from pushing out of the media and maintains better uniformity of moisture around seed.
- Plant seeds with the pointed end (root end) up; this helps prevent the seed coats from sticking to the germinating seedling.
- Place the seeded trays in a germination room or chamber for 48 to 72 hours or until germination begins. The temperature of the room should be held at 85° to 90°F and the relative humidity maintained between 90 and 100 percent.
- Once seedlings have begun to emerge, move trays to the greenhouse. Maintain a temperature of approximately 80° to 85°F until germination is complete.
- During the first week in the greenhouse, water only as needed to keep the planting media moist. Do not overwater, as this may destroy ungerminated seeds.
- Once the seedlings are established, temperature and watering can be adjusted to achieve sturdy plants.

Transplanting and Pollination of Seedless Watermelons

- A pollinizer (seeded variety) must be present for pollination and fruit set. Good pollination is extremely important for seedless watermelon production. Inadequate pollination results in triangular-shaped fruit, lower quality, and increased incidence of hollow heart.
- A ratio of two seedless plants to one seeded (used as pollinizer) is recommended. Outside rows and every third row in the field should be planted with the pollinizer (seeded) variety. Never plant seedless and seeded (pollinizer) varieties in separate adjacent blocks in the field.

- Use a main season variety as a pollinizer. Early or late varieties may not provide pollen during the entire season, thus reducing fruit set.
- Choose a pollinizer variety that can be distinguished by shape or color from the seedless melons at harvest. Choose a pollinizer that is marketable as it will make up about ⅓ of your total production.
- The pollinizer variety should be seeded in the greenhouse and transplanted to the field one to two weeks earlier than the seedless variety. This ensures good pollination when the seedless variety begins to produce female flowers.

Black Plastic and Irrigation

Black plastic mulch on raised beds with drip irrigation is often used to obtain higher yields and to encourage faster growth and earlier maturity. Drip irrigation increases fruit quality and quantity and allows fertilizer to be injected through the system (fertigation). Plastic mulch can be purchased in roll widths of 3 and 4 feet; the 4-foot-wide film is most suitable for melons. Photodegradable mulches, which break down over time from exposure to sunlight, can also be used but should be formulated to remain intact for at least 45 to 50 days; such mulches can considerably reduce the costs of plastic removal and disposal.

Bed shapers/plastic mulch layers and waterwheel setters are commercially available to make raised beds, lay plastic and drip lines, and aid in transplanting. A fine seedbed is required for plastic laying by machine; this operation is nearly impossible on cloddy ground. Clods will puncture plastic mulch, making it more vulnerable to wind damage. Machines are also available that enable direct seeding through plastic mulch.

Plastic can be applied by hand for small plantings. Prepare a fine seedbed; lay the plastic on the seedbed and anchor it by covering the edges of the film with soil. The edges must be completely covered since the plastic can be torn and blown away if wind is allowed to get under it. Holes must be punched or cut in the plastic and seed or transplants placed in the bed through these holes. A hand-operated corn planter can be used for planting seed through plastic. A bulb setter may be used effectively to cut holes for seed or transplants.

Plant Spacing

Growers should also plan for spraying, harvesting, and other field operations by leaving an 8- to 9-foot-wide middle or “skip row” after every fourth to sixth bed. The

number and placement of these skip rows will depend on the type of sprayer being used. Direct seeding in hills was once the most common method of planting vining crops. The seedbed for planting should be thoroughly prepared to ensure good plant stands.

Cucumbers

Pickling cucumbers are usually machine harvested. If a crop is to be grown for mechanical harvest (once-over harvest), seeding with precision seeders in rows 15 inches apart with seed 2 to 3 inches apart in the row is recommended. Four lb of seed per acre is required at this close spacing. For hand-harvested pickling or slicing cucumbers grown on bare ground, space rows 4 to 4½ feet apart and plant 3 to 4 seeds per foot of row. Thin plants to 8 inches between plants in the row. The seed should be planted ¾ to 1 inch deep. Uniform depth of planting is important to get uniform plant growth and maturity. Two lb of seed will be required per acre. Plasticulture cucumbers are usually grown in double rows with 12 to 18 inches between the two rows and 9 to 12 inches between plants within each row. Beds are usually spaced 5 feet between centers. Only a single plant should be grown in each planting hole.

Muskmelons or Specialty Melons

On plastic, single plants are usually spaced 18 inches apart in the rows on plastic; some growers use two plants per hill spaced 3 feet apart in the row. For direct seeding in bare ground or into plastic mulch, rows should be 5 to 6 feet apart with plants thinned to hills 2 to 3 feet apart in the row with two or three plants per hill. Plant specialty melons 3 feet apart in the row with rows 5 to 6 feet apart on black plastic with drip irrigation and fertigation.

Summer Squash

On plastic, single plants are usually transplanted 18 inches apart on beds 5 to 6 feet apart. For direct seeding in bare ground or into plastic mulch, plant 2 to 3 seeds every 18 to 24 inches apart in rows 4 to 6 feet apart. Seed should be planted 1 inch deep.

Pumpkins

Final plant stands for large varieties should be 3 to 4 feet apart in the row with rows 8 to 15 feet apart (30 to 50 square feet per plant). Smaller bush-types are spaced 2 to 3 feet apart in the row, with rows 5 to 6 feet apart. Miniature pumpkins can be

planted as densely as 1 to 2 feet apart in the row with rows 4 to 6 feet apart. Pumpkins can be transplanted or direct seeded at the above spacings. Seeds are planted at a depth of 1 to 2 inches.

Watermelon

Spacing on plastic with drip irrigation depends on the variety and the desired melon size. In general, 6 to 8 feet between-row spacings and 3 to 4 feet in-row spacings are used. Use wider spacings to produce larger, heavier melons. Smaller "icebox" watermelons can be spaced more closely with in-row spacings of 2 feet and between-row spacings of 5 to 6 feet. Mini-seedless (also called "palm" or "personal") watermelons are spaced 1½ feet apart within rows and 5 to 6 feet between rows to produce the greatest number of melons weighing less than 8 lb. On bare ground without irrigation, each plant requires about 48 square feet of space for maximum yield of larger-sized melons. In this case, thin plants to about 4 feet apart in the rows with rows spaced 12 feet apart.

Fertilizing

Cucumber

Make fertilizer and lime applications based on soil test results. A soil pH of 6.5 to 6.7 is most desirable for cucumbers. All fertilizer should be broadcast and disked in well before planting. All phosphorus and potassium and a portion of the total nitrogen requirement should be applied before laying plastic when plastic mulch and drip irrigation are used. The remaining N requirement can be fertigated (see fertigation table). When lime is needed before growing cucumbers, apply a dolomitic liming material if available in your area.

Muskmelons

Phosphorus, potassium, and lime applications should be based on soil test results. Maintain the soil pH between 6.5 and 7.0; liming will be necessary if pH falls below 6.5. Because of shallower rooting depth and preplant N applications, cantaloupes grown with drip irrigation on plastic mulch may be more susceptible to magnesium deficiency if soil pH is less than 6.5. Preplant and fertigated magnesium applications may be required on low CEC soils; added magnesium may also increase melon sugar contents. See below and Appendix D for further discussion of magnesium and molybdenum deficiencies and recommended application rates.

With plastic mulch and drip irrigation, apply all the lime, P and K, and ½ to ⅓ of the total N recommendation before lay-

FERTILIZER: Vining Crops

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)			
		Phosphate (P ₂ O ₅)			
Phosphorus		Cucumber	Melons	Squash/Pumpkin	Watermelon
Low	<31	241-300	121-180	121-180	180
Medium	31-60	121-240	61-120	61-120	120
High	61-80	1-120	1-60	1-60	60
Very High	>80	0	0	0	0
		Potash (K ₂ O)			
Potassium		Cucumber	Melons	Squash/Pumpkin	Watermelon
Low	<201	201-300	101-150	201-300	150
Medium	201-300	101-200	51-100	101-200	100
High	301-450	51-100	1-50	51-100	50
Very High	>450	50	0	0-50	0
Nitrogen					
<p>Cucumbers: Apply 40 to 50 lb of nitrogen (N) just before planting and disk into the soil. Sidedressing or topdressing an additional 30 to 50 lb of nitrogen (N) at first bloom is suggested. Rainfall, soil organic matter levels, and previous cropping history of land dictate nitrogen needs. Avoid applying N over tops of plants when foliage is wet. Applying granular fertilizer over the tops of plants when wet may burn the fruit as well as the foliage. A second sidedressing of 40 to 50 lb may be necessary with some crops. See Fertigation table for slicing cucumbers grown on plastic mulch with drip irrigation.</p> <p>Melons: Broadcast and disk into the soil 50 lb of nitrogen (N)/A before planting. High rates of nitrogen early in the season increase vine growth, delay fruiting, and make pollination more difficult. As plants begin to vine, apply an additional 70 to 100 lb N/A in two sidedressings prior to fruit formation. See the Fertigation table for fertigating nitrogen.</p> <p>Squash and Pumpkins: Bare ground plantings: apply 75 to 80 lb actual nitrogen (N)/A broadcast before planting. Apply 100 lb N/A if sod has been plowed under. Sidedress with an additional 50 lb N/A when vines begin to run. Reduce N application when manure is used; excess N may reduce fruit quality.</p> <p>Summer squash on plastic with drip irrigation: apply 30 to 50 lb N/A preplant together with P and K recommendation. Fertigate an additional 50 to 75 lb N/A (see fertigation recommendations table).</p> <p>Watermelon: Apply 50 to 70 lb of nitrogen (N)/A before planting. This should be broadcast and disked into the soil. As plants begin to vine, apply an additional 50 lb of nitrogen (N)/A as a sidedress. See fertigation recommendations for watermelons grown on plastic mulch with drip irrigation.</p>					

ing plastic. The remaining nitrogen can be divided into equal weekly doses and fertigated as indicated in the fertigation recommendations table.

Muskmelons have high magnesium requirements. Magnesium deficiencies sometimes appear a few weeks before harvest when fruits are rapidly growing in size and weight and when fruit loads are heavy. Typical symptoms are yellowing between the veins (veins remain green) on the oldest leaves (those nearest the crown of the plant). This interveinal discoloration turns brown or tan over time and eventually results in much of the leaf tissue dropping out, leaving a green and white leaf "skeleton." Entire fields are defoliated in severe cases. Magnesium deficiency problems are more likely to occur on light, sandstone-derived soils and in very dry years. Frequent fertigations with calcium or potassium nitrate can make the problem worse by competing with and displacing magnesium in soils. Preventive and/or corrective measures are required, especially on low CEC soils.

In general, we would like to have about 200 lb per acre of magnesium on soil tests prior to planting. Magnesium sources include dolomitic lime (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 lb actual magnesium per acre (10 to 20 lb per acre epsom salts or 2 to 4 lb per acre mag oxide). Application rates may vary with solubility of the materials (check with the manufacturer). Foliar applications of epsom salts are usually not as effective. A better long-term solution is to raise soil test magnesium levels with dolomitic lime prior to planting although some soils may also require magnesium fertigations throughout the season.

Molybdenum deficiency is usually associated with acid soils. Molybdenum becomes less available to the plant as the pH is lowered. Under lowered pH, manganese and aluminum toxicities may also occur and reduce yields. First symptoms are light yellow spots on the leaves followed by death of the tissue at the margins. Symptoms have also been observed in cantaloupe where black plastic has been used and the preplant nitrogen has not been disked in deep enough. This can result in lowered pH in the top 2 to 3 inches of soil where most of the plant roots are concentrated. Soils should be tested and limed to maintain pH around 6.5 to 7.0. A foliar spray of sodium molybdate usually corrects molybdenum deficiency within two weeks. Apply 1 quart of setter water molybdenum per acre as a foliar spray. This product contains 3.5 oz actual molybdenum per gallon. Apply no more than 12 ounces actual molybdenum during a five-year period on the same field.

Pumpkins and squash

These can tolerate a fairly broad range in soil pH from 5.5 to 6.8. Apply lime if needed to raise the pH to 6.5. Apply phosphate and potash as required based on soil test results. 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 nitrogen to apply; there will probably be some residual nitrogen following a crop that received heavy doses of nitrogen fertilizer during the previous season. Apply 30 to 50 lb of nitrogen per acre prior to planting crops to be grown on plastic with drip irrigation. See the fertilizer table for fertilizer rates for bare ground plantings.

The recommendations in the fertigation table have worked well for growers in Kentucky for summer squash grown on black plastic mulch with drip irrigation. Fertigation should begin about 2 weeks after transplanting and continue throughout the season. A grower may need to modify the recommendations slightly, depending on duration of harvest, soil type, previous crop, etc.

Ammonium nitrate, calcium nitrate, and potassium nitrate are commonly used water soluble sources of nitrogen for fertigation. The simplest system that has worked well on medium-textured soils in Kentucky uses ammonium nitrate injected into the drip irrigation water. We recommend that all potassium and phosphorus be applied prior to laying plastic. In areas with very sandy soils, there may be some yield advantage in fertigating some of the potassium. In these cases potassium can be fertigated with a water soluble muriate of potash (0-0-60) or potassium nitrate (14-0-45).

Watermelons

The soil pH should be maintained between 6.0 and 6.5. Liming will be necessary when the pH is below 6.0. Fertilizer and lime applications should be based on soil test results. With plastic mulch and drip irrigation, apply all the P and K and ½ of the total N recommendation before laying plastic. The remaining nitrogen can be applied in equal weekly doses according to the fertigation recommendations.

Pollination

Cucumber

Provide one hive of bees for each acre of cucumbers to ensure good pollination. This is especially important for high plant populations of gynococious hybrid varieties grown for once-over mechanical harvest-

FERTIGATION RECOMMENDATIONS: Cucumbers

Based on a total season N recommendation of 120 lb actual N/A with 50 lb N/A applied preplant and the remaining N (120 - 50 = 70 lb) divided into equal amounts to be fertigated on a weekly basis (70 lb ÷ 9 weeks = 7 lb 12 oz N per week). The doses for 1,000 plants are based on a plant population of 20,908 plants/A (i.e., beds on 5 foot centers with two rows per bed and single plants spaced 10 inches apart in the row; 12 to 18 inches between the double rows). For seasons extending beyond 9 weeks, a maintenance dose of 1 to 1.5 lb N/week is adequate.

Total Fertigated N Requirement*	Actual N/week (lb/A)	Ammonium Nitrate (lb/A/wk)	Ammonium Nitrate (lb. per 1,000 plants/wk)	Calcium Nitrate (lb/A/wk)	Calcium Nitrate (lb per 1,000 plants/wk)
70 lb/A	7 lb 12 oz	23	1 lb 2 oz	50	2 lb 6 oz

* Fertigation should begin about 2 weeks after seedling emergence or two weeks after transplanting; assumes 50 lb N/A was applied preplant and starter fertilizer was used.

FERTIGATION RECOMMENDATIONS: Muskmelons and Specialty Melons

Based on a total season N recommendation of 120 lb actual N/A with 50 lb N/A applied preplant and the remaining N (120 - 50 = 70 lb) divided into equal amounts to be fertigated on a weekly basis (70 lb ÷ 8 weeks = 8.75 lb N per week). The doses for 1,000 plants are based on a plant population of 3,630 plants/A (i.e., beds on 6 foot centers with single plants 24 in apart in the rows). For seasons extending beyond 8 weeks from "running," a maintenance dose of 1 to 1.5 lb N/week is adequate.

Total Fertigated N Requirement*	Actual N/week (lb/A)	Ammonium Nitrate (lb/A/wk)	Ammonium Nitrate (lb per 1,000 plants/wk)	Calcium Nitrate (lb/A/wk)	Calcium Nitrate (lb per 1,000 plants/wk)
70 lb/A	8 lb 12 oz	26 lb 2 oz	7 lb 5 oz	56 lb 7 oz	15 lb 9 oz

* Fertigation begins about two weeks after transplanting or when vines begin to "run" and assumes 50 lb N/A was applied preplant and starter fertilizer was used.

FERTIGATION RECOMMENDATIONS: Squash

Based on a total season N recommendations of 100 or 125 lb actual N/A with 50 lb N/A applied preplant and the remaining N (100 - 50 = 50 lb) divided into equal amounts to be fertigated on a weekly basis (50 lb ÷ 10 weeks = 5 lb N per week). The doses for 1,000 plants are based on a plant population of 4,840 plants/A (i.e., rows on 6 foot centers and plants 18 in apart). Either the moderate (50 lb) or high (75 lb) N rate can be selected below. For seasons extending beyond 10 weeks a maintenance dose of 1 to 1.5 lb N/week is adequate.

Total Fertigated N Requirement*	Actual N/week (lb/A)	Ammonium Nitrate (lb/A/wk)	Ammonium Nitrate (lb per 1,000 plants/wk)	Calcium Nitrate (lb/A/wk)	Calcium Nitrate (lb per 1,000 plants/wk)
50 lb/A	5	15	3	32	7
75 lb/A	7 lb 8 oz	22	4 lb 10 oz	48	10

* Fertigation can begin 14 days after transplanting and assumes 50 lb N/A was applied preplant and starter fertilizer was used.

FERTIGATION RECOMMENDATIONS: Watermelons

Based on a total season N recommendation of 120 lb actual N/A with 60 lb N/A applied preplant and the remaining N (120 - 60 = 60 lb) divided into equal amounts to be fertigated on a weekly basis (60 lb ÷ 12 weeks = 5 lb N per week). The doses for 1,000 plants are based on plant populations of 1,815 plants/A (i.e., beds on 8 ft centers with single plants 3 ft apart in the rows) for standard melons and 3,630 plants/A (beds on 6 ft centers and plants 2 ft apart in rows) for smaller "icebox" melons. For seasons extending beyond 12 weeks, a maintenance dose of 1 to 1.5 lb N/week is adequate.

Total Fertigated N Requirement*	Actual N/week (lb/A)	Ammonium Nitrate (lb/A/wk)	Ammonium Nitrate (lb per 1,000 plants/wk)	Calcium Nitrate (lb/A/wk)	Calcium Nitrate (lb per 1,000 plants/wk)
60 lb/A	5 lb	15 lb	8 lb 4 oz	32 lb 4 oz	17 lb 12 oz
For icebox types (3,630 plants/A):	5 lb	15 lb	4 lb 2 oz	32 lb 4 oz	8 lb 14 oz

* Fertigation begins about 2 weeks after transplanting or when vines begin to "run" and assumes 60 lb N/A was applied preplant and starter fertilizer was used.

ing. Low bee populations result in low fruit set and poor fruit shape.

Muskmelons

Since male and female flowers are separated on the same plant, growers with large acreages should provide one to two strong hives of bees for each acre of plants to ensure good pollination. Spraying for insect control should be done late in the day to avoid unnecessary bee kill.

Pumpkins and squash

The plants have separate male and female flowers on the same plant. Pollen must be transferred from the male flowers to the female flowers by bees in order to get high yields of good quality fruit. If bees are not abundant in the field at flowering time, hives should be placed next to the field, with at least one strong hive per acre. Special precautions should be taken with insecticide treatments during flower

blooming; applications should be delayed until late in the afternoon to prevent killing the bee population.

Some varieties of pumpkins grown under high temperatures (90°F days and 70°F nights) produce female flowers that wither and die before they open. The same thing may happen if pumpkin plants are heavily shaded. In both situations, male flowers develop normally and open on schedule, but few if any female flowers are seen in the field. In some cases female flowers appear but fail to bear fruit because of pollen sterility at high temperatures. The variety "Howden's Field" is particularly susceptible to these problems.

Watermelons

The plants have male and female flowers that grow separately on the same plant. Bees must carry pollen from male flower to female flower to ensure good fruit set

and development. Wild bees will help provide pollination; however, commercial growers should consider putting bee hives near their fields. One strong hive of bees is generally considered adequate for two acres of watermelons.

Harvesting and Handling Cucumbers

Picking the first cucumbers that develop when they reach the proper size is very important. If the early crown set is not harvested, production will be greatly reduced. Cucumbers picked by hand should be harvested every other day for best yields and quality. Cucumbers should be handled carefully to prevent bruising and spoilage, especially slicing types sold for fresh market. Cucumbers should never be put in plastic bags or containers where air will be excluded for any period of time.

Cucumbers for the fresh, wholesale market are waxed and marketed in 1/8 bushel waxed cartons. Fancy cukes should be 2 3/8 inches in diameter and 6 inches in length. Cucumbers can be held in storage for about two weeks at 45° to 50°F and a relative humidity of 95 percent. Do not store at temperatures below 45°F or chilling injury will result.

Muskmelons

Cantaloupes to be sold locally should be harvested at the full slip stage. The term "full slip" indicates that the vine easily detaches, or slips, from the fruit with a gentle pull. The ground color under the netting starts to turn yellowish at this time. For melons to be shipped and held for some time before marketing, it may be necessary to harvest at "1/4 slip" to "half slip" (only 1/4 to 1/2 of the end of the vine detaches from the fruit when gently pulled). In some

PESTICIDE SAFETY: *Vining Crops*

PESTICIDE SAFETY: *Vining Crops*

	Signal ³	Re-entry (hrs)	Harvest (days)	NOT Approved for Use on:				Signal ³	Re-entry (hrs)	Harvest (days)	NOT Approved for Use on:						
				Cucumber	Melons	Squash/Pumpkin	Water-melon				Cucumber	Melons	Winter Squash/Pumpkins	Summer Squash	Water-melon		
Insecticides								Fungicides									
Acramite 50 WS	C	12	3					Acrobat 50 W	C	12	0						
Actara 25 W	C	12	0					Aliette WDG ⁵	C	12	0.5						
Admire Pro	C	12	21					Azoxystrobin ²	C	4	1						
Avaunt 30 DG	C	12	3					Cabrio EG	C	12	0						
Beleaf 50 SG	C	12	0					Chlorothalonil ²	D	12	0						
Courier 40 SC	W	12	7					Cuprofix MZ Disperss	C	24	5			X			
Dibrom 8	D	24	1	X			X	Curzate 60 DF	W	12	3						
Dicofol 4 E	C	12	2		X		X	Fixed coppers ²	D	24	0						
Dimethoate 4 E	W	48	3	X		X	X	Flint	C	12	0						
Endosulfan 3 EC	DP	24	2					Forum SC	C	12	0						
Fulfill 50 DF	C	12	0					Forum SC	C	12	0						
Knack 0.86 EC	C	12	7					Gavel 75 DF	C	48	5			X			
Malathion 8	C	12	1		X		X	Maneb ²	C	24	5						
Oberon 2 SC	C	12	7					Mancozeb ²	C	24	5			X			
Platinum 2 SC	C	12	30					ManKocide	D	24	5			X			
Radiant SC	C	4	1/3 ¹					Nova 40 W	C	24	0						
Sevin XLR	C	12	3					Pristine	C	12	0						
SpinTor 2 SC	C	4	1/3 ¹					Previcur Flex	C	12	2						
Trigard 75 WP	C	12	0					Procure 50 WS	C	12	0						
Venom 70 SG	C	12	1/21 ¹					Quadris Opti	W	12	1						
RESTRICTED USE								Quintec	C	12	3	X		X	X		
AgriMek 0.15 EC	W	12	7					Ranman	C	12	0						
Asana XL	W	12	3					Reason 500 SC	C	12	14						
Baythroid XL	W	12	0					Ridomil Gold EC/SL	C	48	0						
Capture 2 EC	W	12	3					Ridomil Gold Bravo	D	48	0						
Danitol 2.4 EC	W	24	7					Ridomil Gold Bravo SC	W								
Decis 1.5 EC	DP	12	3					Ridomil Gold Copper	D	48	5						
Diazinon AG500	C	24	3	X		X		Ridomil Gold MZ	C	48	5			X			
Diazinon 50 W	C	24	3	X		X		Sovran	C	12	0						
Lannate 90 SP	DP	48	1/3 ¹					Tanos	C	12	3						
Mustang Max	W	12	1					Thiophanate-methyl ²	C	12	0						
Pounce 3.2 EC	C	12	0					Sulfur	C	24	0						
Renounce 20 WP	C	12	0														
Vydate 2 L	DP	48	1														

¹ Dependent on application or cucurbit type, see label.
² Several formulations are marketed. See the general introduction for more details on fungicides.
³ W: Warning, C: Caution, D: Danger; P: Poison
⁴ Products containing mancozeb cannot be used on pumpkins or winter squash; use maneb instead.
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.

cases it may be desirable to harvest melons based on subtle color changes in the fruit; check with buyers or co-op managers to determine exactly when to harvest. It may also be necessary to harvest every day or every other day during periods of high temperatures. Honeydew melons do not slip from the stem when ripe, but they do change colors. They usually take on a yellowish-white color and give off a slight aroma when ripe.

Harvest melons in the early morning while the fruit is cool. Care should be taken when walking through the plants to avoid injury to the plants. The plants can be trained during the early stages of development to grow in rows, enabling easier harvest. Temperature of the melon fruit at harvest may be 85° to 95°F or even higher. Cantaloupes benefit greatly from pre-cooling as soon after harvest as possible. Some chain store buyers may purchase only pre-cooled melons. Hydrocooling cantaloupes to a temperature of 55°F is possible. They should be kept at a relative humidity of 95 percent. Grower-shippers have been using forced air cooling at 40° to 42°F in recent years in order to participate in the larger chain store markets.

Summer squash

Harvest at the proper size for your market and before the skin becomes tough and hard. The skin should still have a glossy appearance and will be ready for harvest from 2 to 5 days after flowers have fully opened. It is a good idea for squash pickers to use plastic buckets and wear soft gloves to avoid bruises, scratches, and fingernail punctures. Squash should be cut from the plant leaving ½ to 1 inch of the stem attached to the fruit. Harvests may be required every other day or even daily during the peak. Always remove over-mature or oversized fruit from the plants to maintain plant vigor and production.

Summer squash is normally sold on the fresh, wholesale market in ½ bushel (21 lb) waxed cardboard cartons or 1⅓ (42 to 44 lb) bushel cartons or wire-bound crates. Produce buyers expect a uniform count of clean fruit in each carton or crate. Squash should be uniform in size to meet the buyer's count and weight requirements; talk to your buyers to become familiar with their requirements before packing the product. The USDA's Agricultural Marketing Service has established grading standards for squash and other vegetables. They are available on the Internet at <www.ams.usda.gov/standards/vegfm.htm> or can be obtained free of charge by writing: USDA, Agricultural Marketing Service, Fruit and Vegetable Division, Standardization

Section, P.O. Box 96456, Room 2049-S, Washington, D.C. 20090-6456.

Squash should be marketed quickly and not stored if possible; if storage is necessary, however, they can be kept for a week at 45° to 50°F and 90 to 95 percent relative humidity. Chilling injury can occur after several days of storage below 50°F.

Pumpkins

They are normally harvested when they reach a deep solid color and the rind is hard. Wholesale buyers may require a large percentage of 15-lb pumpkins and may also specify the number of pumpkins or "count" per bin. Pumpkins that are picked when they are green and immature will not color up. In emergencies—late maturity, fruit rots occurring, or large insect populations present—it is possible to harvest pumpkins at the mature green stage, and most of them will color up within a few weeks. At the mature green stage, the skin has toughened up and cannot be punctured with your fingernail. It is recommended, however, that pumpkins undergo at least some change in color before harvesting.

Cut pumpkins from vines carefully, leaving a 3- to 4-inch stem attached. Pumpkins do not all mature at the same time on the plant but will continue to color up over a period of 3 to 4 weeks if diseases and insects are held in check. Sunny weather is especially important in the development of mature fruit with good color.

When harvesting, use a pair of loppers, pruning shears, or a sharp knife to snip the large stem from the plant; this makes for a more attractive stem and also prevents the stem from separating from the fruit. Pumpkins are best harvested when the rind is hard and has good color characteristics typical of the variety. Do not carry a pumpkin by its stem or "handle" since these often break off, reducing the pumpkin's marketability and its storage life by encouraging decay.

It may be necessary to harvest and hold pumpkins in storage for 2 to 4 weeks before they are sold. Tobacco barns are usually a good place for storage. Spread out a layer of dry straw or hay and set the pumpkins on this. Keep them dry. Do not store on bare ground after harvest. Good air circulation will help reduce rotting. Pumpkins should be harvested and stored before temperatures drop to the 30s and 40s.

Although harvests for Halloween usually begin in late September to early October, high temperatures may cause pumpkins to mature in late August and early September; these often rot or decay long before they can be marketed. Some rot is unavoidable,

caused by injury or seasonal stresses, such as drought and/or heat. Diseases such as powdery or downy mildew, viruses, or gummy stem blight may also cause premature ripening. There are a few precautions that should be taken to minimize the decay of prematurely ripened fruit. Harvest should begin earlier! Get the pumpkins out of the field when they mature early. Pumpkins should be handled carefully to avoid cuts and bruises, which are the major entry points for rotting fungi and bacteria.

A curing period of 7 to 10 days at temperatures of 80° to 85°F with relative humidities of 80 to 85 percent has been recommended in the past to heal over surface injuries and allow for further ripening; however, this is seldom practiced and research has shown that it may not be necessary. It has not been beneficial for several types of squash, including Butternut, and may be detrimental to Acorn squash.

Store pumpkins cool and dry; storage temperatures should be 50° to 55°F with a relative humidity of 50 to 70 percent. The surface of the fruit should be dry. Keep the area as well ventilated as possible and away from any ethylene sources (tomatoes, apples). Ventilation can be provided by placing fruits on pallets or slatted benches, which allow air movement around the fruits. Avoid stacking pumpkins on top of one another. Stacking is a sure way to create bruises, and the pile will only create unwanted heat. It is possible to hold pumpkins for 6 to 8 weeks when held at 50° to 55°F but only for a few weeks at 70°F.

What can you do when pumpkins are still green in October and not yet ready for market? Prevention is the key—plant early enough for the variety you have selected and be careful not to over-fertilize with nitrogen, which can delay maturity. A dry period without irrigation can also result in pumpkins at the wrong stage of maturity at harvest. Green mature pumpkins can be harvested but are not as likely to color up uniformly.

Avoid temperatures below 50°F, which can cause chilling injury to green mature pumpkins and will result in poor color and more fruit decay. One possibility is to put green or partially colored pumpkins in a warm greenhouse, which will accelerate the maturing process.

Irrigation and proper post-harvest care are always good investments, especially because supplies may be short after growing seasons that result in orange pumpkins in August or green pumpkins in September.

Pumpkin prices and, therefore, returns per acre can vary greatly depending on supplies available and the marketing channel used. Higher and more stable prices

can be expected from direct sales or even “pumpkin festival” sales, but this market can become saturated with too many growers near a population center. In some cases, smaller growers can help supply the larger festival market grower to obtain prices that may be higher than wholesale. Larger producers and those who do not have time for direct sales will need to find wholesale buyers or, in some cases, sell directly to supermarkets. Wholesale prices are often considerably lower than direct market (retail) prices. Smaller growers should consider joint marketing efforts to attract wholesale buyers. Although consumer demand for pumpkins has expanded considerably in recent years, more growers are getting into production, and some markets may disappear at harvest time. Good production, management, and marketing can result in high profits, especially when supplies are short.

Watermelon

A grower must become familiar with the variety to determine the best stage for harvesting. A dead tendril or curl at the point where the fruit attaches to the vine is not a conclusive indication that the fruit is ready for harvest. “Thumping” the fruit is sometimes used, but only over-ripeness can be determined in this manner.

The best indicator for harvest is the color of the underside of the melon. When “Crimson Sweet” melons turn yellowish-brown on the bottom surface, for example, they are fully ripe and ready for harvest. The fruits will take on a dull appearance compared to their slick appearance prior to maturity. Determining the proper time to harvest seedless watermelons is generally more difficult than for seeded melons. The death of a tendril usually does not correlate with seedless watermelon ripeness. Melon undercolor is usually the only index of maturity on seedless watermelons, and this color will vary among varieties. Melons should not be left long in the sun or they may develop sunscald.

Melons should be handled gently to avoid bruising. When loading, melons should not be stacked so high that their weight bruises the bottom fruit. Watermelons should be stored at 50° to 60°F and 90 percent relative humidity.

Common Diseases/Management

General Practices. Field selection, crop rotation, sanitation, resistant varieties, seed treatment, insect management, residue destruction, irrigation/water management, and fungicide use are important disease control practices for all of these crops.

Select fields with good internal and surface water and air drainage and those that have not been in cucurbits, tobacco, peppers, or tomatoes during the past 2 to 3 years. Longer rotation will be required if certain diseases occurred in previous crops.

Fungicides are an important tool for management of cucurbit diseases; follow a preventive program that includes chlorothalonil, mancozeb, and strobilurins (Amistar, Quadris, Cabrio, or Flint) and apply materials in a timely fashion. These broad-spectrum materials will provide good control of many of the pathogens that affect cucurbits. Other fungicides can be used in the program to help in the control of certain diseases. Chlorothalonil, EBDC's (maneb & mancozeb), and fixed coppers tend to be inexpensive relative to other materials and should form the “backbone” of a fungicide program. When considering using an EBDC fungicide, remember that mancozeb (Dithane, Manzate) cannot be applied to pumpkins and winter squash; use maneb instead. Keep in mind that the more expensive materials (strobilurins, for example) may be more effective under severe disease pressure and should be applied when these conditions prevail.

Not all cucurbits are subject to all of the common diseases listed below. In brackets after the name of the disease, abbreviations are used to indicate the susceptible cucurbit crops (C—cucumber, M—muskmelon, SP—squash and pumpkin, W—watermelon).

Anthracnose [C,M,SP,W], **Alternaria Leaf Blight** [C,M,SP,W], and **Cercospora Leaf Spot** [C,M,W]. Use disease-free seed, promptly destroy crop residues, and practice rotation to crops other than cucurbits for 2 to 4 years. Varieties vary in susceptibility, so consider using resistant varieties. Plant anthracnose-resistant varieties whenever possible. A spray program designed to manage gummy stem blight (on the next page) will suppress the entire group of leaf spots, starting no later than the first appearance of disease or when vines touch within the rows (or earlier if conditions favor disease); see tables for recommended products and rates.

Angular Leaf Spot, Bacterial Leaf Spots [C,M,SP]. Use disease-free seed (hot water, acid, or bleach treatments; see Appendix I) and crop rotations of 2 to 3 years with non-cucurbits. Severity is enhanced with high nitrogen and low potassium levels. Work crops only when they are dry to reduce plant-to-plant spread. Using drip irrigation rather than overhead applications can aid control. Fixed coppers are helpful; see tables for rates and registered materials. Repeated use of copper may cause leaf yel-

lowing. Several angular leaf spot-tolerant cucumber varieties are available and that level of control may be adequate for most seasons. Resistant cultivars are not available for muskmelons, but they have considerable tolerance to these diseases.

Bacterial Fruit Blotch [W]. Suspect plant samples should be sent to the Plant Disease Diagnostic Lab for proper diagnosis. Since the disease is seed-borne, a key to control is to plant uncontaminated seed in clean sites. If transplants are being used, be sure they have been started from seed lots that were negative in laboratory tests for this pathogen and were produced in greenhouses operated under very sanitary conditions. Avoid plants from any greenhouse that has the disease. Plants produced from different seed lots should be segregated during transplant production and in the field to reduce cross contamination and spread. Use sites rotated to crops other than cucurbits for at least two years. Beginning at bloom (or earlier if the disease is found), apply a fixed copper product and keep copper in the spray program or alternate with fungicides (to control fungal diseases). See tables for recommended products and rates.

Bacterial Wilt [C,M,SP]. The pathogen causing this wilt overwinters in and is transmitted by cucumber beetles. Controlling these insects is essential before they feed on the plant, starting from the day of plant emergence or transplanting through fruit set. Use appropriate insecticides (see insect control table), particularly after mild winters that may promote large overwintering populations of beetles.

Belly Rot (Rhizoctonia fruit rot) [C]. Belly rot affects cucumbers, particularly those grown for pickling, but other types of cucurbits may be affected. Plant on raised beds to control soil moisture; plastic mulch will also improve disease control. Incorporate cover crops early to ensure thorough rotting before planting. Fungicides may also provide some control. See tables for labeled materials.

Cold Injury [SP]. Chilling injury causes pitting of the tender skin and can occur either in storage or in the field after several days of exposure to temperatures below 40°F, especially if humidity is high. This can occur following several days of cold, rainy weather in the fall; however, symptoms may not show in the fruit until it is well beyond the farm. Winter squash and pumpkins are sensitive to frost and temperatures of 32°F or below; some varieties may also be sensitive to cold injury at slightly higher temperatures.

Cottony Leak (Pythium fruit rot) [C,M,SP,W]. Use well-drained sites, raised beds, and plastic mulch to reduce soil contact and

wet conditions. On known problem sites, use mefenoxam (Ridomil Gold or Ultra Flourish) pre-plant or after seeding/transplanting (see tables). Incorporate cover crops and crop residues early enough to ensure that they completely decompose.

Choanephora Fruit Rots (wet rot) [C,SP]. Fungicides are not available. The disease is promoted by high moisture conditions, so the cultural practices to reduce cottony leak and belly rot may help reduce disease severity (raised beds, wider row spacings, weed control, etc).

Downy Mildew [C,M,SP,W]. Downy mildew is most problematic in the late summer and fall, and thus tends to be more severe on winter squash and pumpkins than on other cucurbits crops. Fungicide programs aimed at other diseases of vining crops should suppress downy mildew, although spray intervals may need to be shortened to achieve good control. Do not wait to see symptoms of downy mildew before applying fungicides, as it can be nearly impossible to control the disease once it starts if fungicides are not in place. Check the KY Blue Mold Warning System for updates on the status of downy mildew in the Commonwealth and neighboring states (<www.uky.edu/Agriculture/kpn/kyblue/kyblue.htm>). See tables for recommended products and rates. If downy mildew appears prior to the start of the regular fungicide spray program, include Ridomil Gold Bravo or a strobilurin fungicide. Recent reports of resistance to this class of chemistry in the southeastern US indicate that these products will likely lose their effectiveness in Kentucky in the near future. Acrobat 50WP can be tank mixed with any of the downy mildew fungicides for improved control. Resistant or tolerant varieties are becoming available in summer squash and other cucurbits (see variety table).

Fusarium Fruit Rot [C,M,SP,W]. Rotation has not proven very effective in controlling this disease. No fungicides are labeled for controlling Fusarium fruit rot; fumigation may reduce populations of Fusarium in soil. (See "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 18.) Control insects and diseases from planting through harvest, and avoid wounding to aid in suppression of Fusarium fruit rot.

Fusarium Wilt [M, W]. Resistant varieties offer the best control. For muskmelons, use those with resistance to Race 2 of *F. oxysporum* sp. *melonis* on sites with a history of the disease; if these varieties also contract Fusarium wilt, consider varieties with resistance to other races. Athena has resistance to Races 0, 1, and 2.

Watermelon varieties with resistance to Race 1 of *F. oxysporum* f.sp. *niveum* have performed well in infested fields, although other races could be present.

Rotation to crops other than cucurbits for 3 to 5 years will reduce pathogen populations in soil; however, rotation alone is not an adequate control. Failure to control root-knot nematode is often tied into Fusarium wilt outbreaks. Fumigation of soil may also provide some benefit (see "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 18 for more information).

Gummy Stem Blight [C,M,SP,W]. Use disease-free seed or transplants. Rotations of 2 to 3 years away from cucurbits will reduce the incidence of gummy stem blight. Start fungicide applications when vines begin to touch in rows or when symptoms appear. In wet years, don't wait to see the disease before spraying! Spray programs that include chlorothalonil or mancozeb are effective in managing gummy stem blight; strobilurins and Pristine should be included in the program for maximum disease control. See tables for registered fungicides and rates. Resistance to strobilurins and benzimidazoles is common in the southeastern US; however, the existence of resistance to these compounds is rare (to date) in Kentucky. Be sure to follow resistance management guidelines listed on product labels.

Microdochium Blight (Plectosporium Blight) [SP]. Microdochium blight can be suppressed by fungicide programs used to control other diseases of squash and pumpkins. Amistar/Quadris, Cabrio EG, Flint, and mancozeb are specifically labeled for this disease; refer to tables for rates.

Ozone Injury [C,M,W,SP]. Symptoms are associated mainly with older leaves and appear as a flecking of the upper leaf surface (almost never the bottom side). Mancozeb-containing materials can reduce damage but are probably not needed in Kentucky on most muskmelon crops.

Phytophthora Blight [C,M,SP,W]. Cultural practices are the most important disease-control tools for Phytophthora blight. Avoid fields that were planted (within the last 3 years) to hosts of *P. capsici*, primarily pepper, eggplant, and all cucurbits. Improving soil drainage around plants and managing irrigation very carefully to reduce the duration of wet periods and contamination of water will also reduce disease. Soil pH should be maintained at the low end of the acceptable range. Use disease-free transplants. Keep cull piles away from fields or irrigation sources; destroy infected fruit in fields by deep plowing. Avoid, if possible, irrigation with surface water (ponds and

creeks). Fungicide options are limited; see tables for materials and rates. Good coverage and timely application are important considerations for fungicides used to control Phytophthora blight.

Powdery Mildew [C,M,SP,W]. Unfortunately, powdery mildew fungi have developed resistance to benzimidazoles (Topsin M, Thiophanate 85WDG), DMI fungicides (Procure, Nova) and strobilurins (Amistar/Quadris, Cabrio, Flint) in many parts of the US. Chlorothalonil applied in a weekly spray program for other diseases will slow powdery mildew development, and rotation or tank-mixes with Nova, Pristine, Procure, or one of the strobilurins is an excellent strategy for managing this disease.

Systemic products such as Nova and Procure give the added benefit of suppressing powdery mildew on lower leaf surfaces, areas where good spray coverage can be hard to achieve. If one fungicide is not effective, switch immediately to a new class of chemicals, and always follow resistance management guidelines where applicable. See tables for labeled products and rates.

Sulfur is also labeled for powdery mildew and works well; however, sulfur can cause serious leaf burn during hot (90°F or higher), humid weather. (The amounts needed for full-season control can lower soil pH.) Powdery mildew-resistant or tolerant muskmelon, summer squash, and pumpkin varieties (see variety table) are available. Excellent resistance is available in cucumber varieties.

Rind Necrosis [W]. Bacterial rind necrosis appears sporadically but can cause serious losses in certain years. External symptoms are rare; however, cut melons exhibit a dry, brown, corky necrosis in the rind that typically doesn't extend into the fruit. Entire fields have been rejected by brokers where even a few diseased melons were found. Little is known about the epidemiology of the disease, believed to be caused by *Erwinia* spp., and no controls are available. Watermelon varieties vary in their susceptibility, and environment plays a role in the appearance of the disease.

Scab [C,M,SP,W]. Use scab-resistant varieties, depending upon the cucurbit being grown, and rotate to unrelated crops for 3 years or more in problem fields. If resistance is not used, then fungicide sprays may be necessary in cool, wet weather. See tables for a list of registered fungicides. Spray programs used for anthracnose and gummy stem blight will suppress scab but must begin early (with first leaves). Under severe disease pressure, such as on non-rotated sites, chlorothalonil is the best option (use highest labeled rate).

Root-knot Nematode [C,M,SP,W]. Rotation to small grains for 2 or more years is a highly effective control measure. See “Nematode Control” on page 16 for more information on nematodes. Pre-plant soil fumigation is also highly effective but may not be economical for cucumbers. A few contact nematicides are available.

Seed and Seedling Blights [C,M,SP,W]. Buy fungicide-treated seed whenever possible. If seed has not been treated, use Thiram 75 WP at 0.5 tsp/lb of seed. Planting into warm (when soil temperatures are 65°F or greater), well-drained soils greatly reduces the risk of seedling death. Fungicides applied to control cottony leak will also help with *Pythium* seedling diseases. Greenhouse-produced transplants should be seeded into pathogen-free media with the trays on well-drained benches rather than on the soil. Carefully manage watering to minimize prolonged periods of wetness.

Viruses [C,M,SP,W]. Viruses (Cucumber Mosaic, Watermelon Mosaic, Papaya Ringspot Virus, Squash Yellows, and Zucchini Yellows Mosaic) are common in some years in Kentucky. Plant certified, disease-free seed. Elimination of perennial weeds within 150 feet of the planting by using grasses or non-susceptible annual crops around the cucurbit planting is helpful. Control aphids to reduce secondary spread within the planting. Do not plant cucurbits adjacent to peppers, tomatoes, tobacco, or earlier cucurbit crops. The use of stilet oils and planting into reflective mulches has been shown to delay or reduce virus transmission; however, success with these methods in Kentucky has been marginal. Control aphids in nearby tobacco to reduce virus movement into cucurbits.

Plant CMV-resistant cucumber cultivars. Consider using resistant squash varieties (see variety table), but check current requirements or restrictions regarding labeling and marketing of transgenic resistant varieties. Controlling insect vectors in fall plantings is not a practical control solution for this disease complex. In pumpkins, earlier planting can reduce losses by allowing fruit to set and color before high virus loads are present.

Yellow Vine Decline [M,SP,W]. Cucurbit yellow vine decline (CYVD) is a relatively new and serious disease in Kentucky. The symptoms of yellowing and stunting are commonly observed. It is now known that the causal agent is a bacterium, *Serratia marcescens*, and it appears to survive in and be vectored into the cucurbit plants by the squash bug, *Anasa tristis*. Control measures must be focused on the squash bug. See the insect control table for specifics.

Sample Fungicide Programs for Vining Crops

Refer to fungicide tables in this section for product rates; read product labels carefully before application.

Cucumber	Melon	Squash	Pumpkin/Winter Squash	Watermelon
Week 1 (after transplanting)				
chlorothalonil or mancozeb/maneb	chlorothalonil or mancozeb	chlorothalonil or mancozeb	chlorothalonil or maneb	chlorothalonil or mancozeb
Week 2 (after transplanting)				
chlorothalonil or mancozeb/maneb	chlorothalonil or mancozeb	chlorothalonil or mancozeb	chlorothalonil or maneb	chlorothalonil or mancozeb
Week 3 (after transplanting)				
chlorothalonil or mancozeb/maneb	(flowering) chlorothalonil + copper or mancozeb + copper	chlorothalonil or mancozeb	chlorothalonil or maneb	chlorothalonil or mancozeb
Week 4 (after transplanting)				
Quadris/Amistar or Cabrio or Pristine	Quadris/Amistar or Cabrio or Pristine	Quadris/Amistar or Cabrio or Pristine	Quadris/Amistar or Cabrio or Pristine	(flowering) chlorothalonil + copper or mancozeb + copper
Week 5 (after transplanting)				
chlorothalonil or mancozeb/maneb	chlorothalonil + or mancozeb + copper	chlorothalonil or mancozeb	chlorothalonil	Quadris/Amistar or Cabrio or Pristine
Week 6 (after transplanting)				
Quadris/Amistar or Cabrio or Pristine	Quadris/Amistar or Cabrio or Pristine	Quadris/Amistar or Cabrio or Pristine	Quadris/Amistar or Cabrio or Pristine	chlorothalonil + or mancozeb + copper
Week 7 (after transplanting)				
chlorothalonil or mancozeb/maneb	chlorothalonil + or mancozeb + cop- per	chlorothalonil or mancozeb	chlorothalonil	Quadris/Amistar or Cabrio or Pristine
Week 8 (after transplanting)				
chlorothalonil or mancozeb/maneb	chlorothalonil + or mancozeb + copper	chlorothalonil or mancozeb	Quadris/Amistar or Cabrio or Pristine	mancozeb + copper
Week 9 (after transplanting)				
-	-	-	chlorothalonil	-
Week 10 (after transplanting)				
-	-	-	chlorothalonil	-

Cucumber: Finish season with chlorothalonil or mancozeb/maneb. Begin applications of Quadris/Amistar/Cabrio/Pristine earlier if disease becomes severe. Tank-mix Nova 40 W or Procure 50 WS if powdery mildew appears. Include appropriate fungicides if downy mildew or Phytophthora blight becomes severe.

Melon: Finish season with mancozeb; begin applications of Quadris/Amistar/Cabrio/Pristine earlier if disease becomes severe. Tank-mix Nova 40 W or Procure 50 WS if powdery mildew appears.

Squash: Begin applications of Quadris/Amistar/Cabrio/Pristine earlier if disease becomes severe. Tank-mix Nova 40 W or Procure 50 WS if powdery mildew appears. Include appropriate fungicides if downy mildew or Phytophthora blight becomes severe.

Pumpkin: Finish season with chlorothalonil. Begin applications of Quadris/Amistar/Cabrio/Pristine earlier if disease becomes severe. Tank-mix Nova 40 W or Procure 50 WS if powdery mildew appears. Include appropriate fungicides if downy mildew or Phytophthora blight becomes severe.

Watermelon: Finish season with mancozeb; begin applications of Quadris/Amistar/Cabrio/Pristine earlier if disease becomes severe. Tank-mix Nova 40 W or Procure 50 WS if powdery mildew appears.

INSECT CONTROL: *Vining Crops (Cucumber, Melon, Pumpkin, Squash, and Watermelon)*

Insect/Insecticide	Product Amt/A	Comments and Seasonal Limits
PREPLANT INCORPORATED		
Wireworms, Cutworms (<i>Wireworms are a potential problem for crops following grass or legume-grass sod.</i>)		
Diazinon 50 W	6 to 8 lb	Incorporate immediately. For melons and Watermelons only.
Diazinon 14 G	14 to 28 lb	Incorporate immediately. For melons and Watermelons only.
Soil Treatments		
Aphids, whiteflies		
Admire Pro	7 to 10.5 fl oz	Soil application, see label for application methods. Also controls cucumber beetles.
Platinum 2 SC	5 to 8 fl oz	Soil application, see label for application methods.
Venom 70 SG	5 to 6 oz	Soil application. Limit 2.68 lb/A. Allow 7 days between applications.
FOLIAR TREATMENTS		
Aphids		
Actara 25 W	1.5 to 3 oz	Limit 11 oz/A. Allow 5 days between applications.
Beleaf 50 SG	2 to 2.8 oz	Limit 3 applications at the 2.8 oz/A rate. Allow 7 days between applications.
Capture 2 EC	2.6 to 6.4 fl oz	Limit 19.2 fl oz/A. Limit 2 applications after bloom. Allow 7 days between applications.
Endosulfan 3 EC	1.33 to 2.33 pt	Limit 6 applications or 4 qts/A.
Fulfill 50 DF	2.75 oz	Limit 5.5 oz/A. Allow 7 days between applications.
Malathion 8	1.75 pt	
Venom 70 SG	1 to 4 oz	Foliar application. Limit 1.34 lb/A. Allow 7 days between applications. Do not use following a soil application of Venom, Platinum, or Admire.
Cucumber Beetles (<i>Key insect pest attacking cucumbers, vector of bacterial wilt. Must begin control when seedlings first emerge. Repeat applications as necessary to maintain control, particularly when plants are small. See Bacterial Wilt. Management can be relaxed when harvest begins.</i>)		
Admire Pro	7 to 10.5 fl oz	Soil application, see label for application methods.
Asana XL	5.8 to 9.6 fl oz	Limit 48 fl oz/A.
Capture 2 EC	2.6 to 6.4 fl oz	Limit 19.2 fl oz/A. Limit 2 applications after bloom. Allow 7 days between applications.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A.
Endosulfan 3 EC	1.33 to 2.67 pt	Limit 6 applications or 4 qts/A.
Mustang Max	1.28 to 4 fl oz	Limit 24 fl oz/A. Allow 7 days between applications.
Pounce 3.2 EC	4 to 8 fl oz	Limit 64 fl oz/A.
Sevin XLR	1 qt	Limit 6 applications and allow at least 7 days between applications.
Cutworms (<i>Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.</i>)		
Asana XL	5.8 to 9.6 fl oz	Limit 48 fl oz/A.
Capture 2 EC	2.6 to 6.4 fl oz	Limit 19.2 fl oz/A. Limit 2 applications after bloom. Allow 7 days between applications.
Mustang Max	1.28 to 4 fl oz	Limit 24 fl oz/A. Allow 7 days between applications.
Pounce 3.2 EC	4 to 8 fl oz	Limit 64 fl oz/A.
Spider Mites (<i>Regular weed control around the outside perimeter of the field is very important.</i>)		
Acramite 50 WS	0.75 to 1.0 lb	Limit one application.
AgriMek 0.15 EC	8 to 16 fl oz	Limit 48 fl oz. Allow 7 days between applications.
Capture 2 EC	5.12 to 6.4 fl oz	Limit 19.2 fl oz/A. Limit 2 applications after bloom. Allow 7 days between applications.
Danitol 2.4 EC	10.67 fl oz	Limit 42.6 fl oz/A. Allow 7 days between applications.
Dicofol 4 E	3/4 pt	Limit 2 applications. Allow 7 days between applications. Cucumbers and squash only.
Oberon 2 SC	7.0 to 8.5 fl oz	Allow 7 days between sprays. Limit 25.5 fl oz/A.
Squash Bug (<i>Squash bug is a common pest of squash and pumpkins through feeding and transmission of the bacteria that causes Yellow Vine Decline. It also can transmit the disease to melons and watermelons. Destroy crop residues to reduce overwintering sites for squash bugs.</i>)		
Asana XL	5.8 to 9.6 fl oz	Limit 48 oz/A.
Capture 2 EC	2.6 to 6.4 fl oz	Limit 19.2 fl oz/A. Limit 2 applications after bloom. Allow 7 days between applications.
Endosulfan 3 EC	1.33 to 2.67 pt	Limit 6 applications or 4 qt/A.
Mustang Max	1.28 to 4 fl oz	Limit 24 fl oz/A. Allow 7 days between applications.
Pounce 3.2 EC	4 to 8 fl oz	Limit 64 oz/A.
Squash Vine Borer (<i>Squash vine borer is primarily a pest of squashes and pumpkins. Treat for squash vine borer beginning 3rd week in June and repeat 3 to 5 times at weekly intervals.</i>)		
Asana XL	5.8 to 9.6 fl oz	Limit 48 oz/A.
Capture 2 EC	2.6 to 6.4 fl oz	Limit 19.2 fl oz/A. Limit 2 applications after bloom. Allow 7 days between applications.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A.
Endosulfan 3 EC	1.33 to 2.67 pt	Limit 6 applications or 4 qt/A.
Mustang Max	1.28 to 4 fl oz	Limit 24 fl oz/A. Allow 7 days between applications.
Pounce 3.2 EC	4 to 8 fl oz	Limit 64 oz/A.
Sevin XLR		Limit 6 applications and allow 7 days between sprays.
Whiteflies		
Actara 25 W	3 to 5.5 oz	Limit 11 oz/A. Allow 5 days between applications.
Courier 40 SC	9 to 13.6 fl oz	Limit 2 applications per crop cycle, allow at least 7 days between applications.
Knack 0.86 EC	8 to 10 fl oz	Limit 2 applications, allow at least 14 days between applications.
Oberon 2 SC	7.0 to 8.5 fl oz	Allow 7 days between sprays. Limit 25.5 fl oz/A.
Venom 70 SG	1 to 4 oz	Foliar application. Limit 1.34 lb/A. Allow 7 days between applications. Do not use following a soil application of Venom, Platinum, or Admire.

¹ To view color pictures of the pests, see: <http://www.uky.edu/Ag/IPM/picturesheets/cucurbitinsects.pdf>

WEED CONTROL: *Vining Crops (Cucumber, Melon, Pumpkin, Squash, and Watermelon)*

Product Amt/A	Lb A.I./A	Remarks
The stale seedbed technique for direct seeded vine crops can be very effective in eliminating initial flushes of weeds occurring when soil is disturbed. This technique involves preparing the soil, allowing a flush of weeds to emerge, and then cultivating or applying paraquat before seeding or transplanting the crop. Paraquat will have no residual activity.		
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Do not confuse and use the non-labeled Aim EC formulation. 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 postemergence 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.
0.4 to 1 pt Command 3ME (not labeled for Gourd)	0.15 to 0.37 clomazone	For control of annual grasses and small-seeded broadleaves; weak control of pigweed. Apply immediately after seeding. Max. rate for muskmelon and watermelon is 0.67 pt/A. See label for additional instructions and restrictions. PHI = 45 days.
3 to 4.5 pt Curbit 3 E (not labeled for Gourd)	1.13 to 1.5 ethalfluralin	For preemergence control of annual grasses and broadleaves. Do not use on wet or cloddy soils or before a heavy rain to avoid crop injury. Do not apply over or under hot caps, row covers, or plastic mulch. Do not apply broadcast to transplants. Do not incorporate. Clean cultivate and apply as a banded spray to soil between rows of plastic mulch.
6 to 14 pt Dacthal 6 F (not labeled for Muskmelon, Pump- kin, Gourd)	4.5 to 10.5 DCPA	For preemergence control of annual grasses and small-seeded broadleaves. Apply only to crop with 4 to 5 true leaves that is well-established and when growing conditions are favorable. Do not incorporate. Not labeled for transplanted crop.
1 to 2 pt Goal 2XL	0.25 to 0.5 oxyfluorfen	For preemergence and postemergence 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. 60 days between application and planting.
1.3 to 2.7 pt Gramoxone Max 3 L	0.5 to 1 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, preemergence, 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.
0.5 to 1.5 pt Poast 1.5 E (not labeled for Gourd)	0.09 to 0.27 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. PHI = 14 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
5 to 6 qt Prefer 4 E	5 to 6 bensulide	For control of grasses and broadleaf weeds. Apply preplant and incorporate to 1 to 2 inch depth. Apply preemergence only if it can be watered in within 36 hours. Max. rate of 6 qt/season.
16 to 22 fl oz Roundup Weather- Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence 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. 3 days between application and planting and min. 30 days before planting any non-labeled crop.
0.5 to 1 oz Sanda 75 DF	0.023 to 0.047 halosulfuron	For weed control of broadleaf weeds and yellow nutsedge. For cucumber (30 days PHI), cantaloupe, and Honeydew Melon (57 days PHI): Can be applied preplant under plastic mulch. Apply after final bed preparation and before laying plastic and transplant 7 days after application. Can also be applied post-transplanting on bare ground. Check label for instructions for direct-seeded and row middle applications. For watermelon and muskmelon (57 days PHI): Apply only in row middles in direct-seeded and transplanted watermelon. If plastic mulch is used, do not spray Sandea on plastic.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
6 to 8 fl oz Select 2E	0.09 to 0.12 clethodim	For selective postemergence control of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 8 fl oz/application. Min. 14 days interval between applications. PHI = 15 days.
2 to 4 oz Sinbar 80 WP (For Watermelon only)	0.1 to 0.2 terbacil	For preemergence control of broadleaves and grasses. Apply after seeding but before watermelon emerges. For transplanted watermelons, apply pre-transplant. Sinbar may be used preemergence under plastic mulch or to row middles. Sinbar may also be applied broadcast over the plastic mulch prior to transplanting, or prior to punching holes in the plastic mulch for transplanting. Sinbar must be washed off the plastic mulch with a minimum of 0.5" rain prior to transplanting. PHI = 70 days.
3 to 6 pt Strategy 2.1E (not labeled for Gourd)	0.6 to 1.18 ethalfluralin + 0.18 to 0.39 cloma- zone	For preemergence control of annual grasses and broadleaf weeds. Apply to seeded crop before its emergence or as a banded spray between rows after crop emergence or transplanting. Rainfall (0.5 inch) within 2 days is needed for activation. Do not incorporate. Crop injury may occur under cool temperatures that delay seedling emergence. PHI = 45 days for cucumber. Max. 1 application/year. Use lowest labeled rate for summer squash.
1.25-2 pt Treflan HFP 4 E	0.6-1 trifluralin	For control of annual grasses and broadleaf weeds. Apply after emergence to plants with 3-4 true leaves. Can be applied directed to soil between the rows to older plants but avoid foliage contact. PHI = 30 days for most cucurbits but 60 days for watermelon.

* All products in this table are labeled for use on muskmelons, watermelons and cucumbers.

DISEASE CONTROL: Vining Crops (Cucumber, Melon, Pumpkin, Squash, and Watermelon)

Product	Amt/A (lb)	Seasonal Limits/A	Comments
Angular Leaf Spot, Bacterial Leaf Spots (C, M, SP)			
Fixed coppers		n/a	Tank-mix with maneb or mancozeb (EBDC fungicides) for maximum effectiveness. Apply on a 5- to 10-day schedule, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	1.2 to 2.8 pt		
Basic Copper 53	2 lb		
C-O-C-S WDG	2 to 4 lb		
Champ DP	1.33 lb		
Champ Formula 2 FL	1.33 pt		
Champion WP	1.5 to 3 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	3 to 4 pt		
Cuprofix Disperss	2.5 lb		
Cuprofix Ultra 40 Disperss	1.25 to 2 lb		
Kocide 101	1.5 to 3 lb		
Kocide 2000	1 to 2.25 lb		
Kocide 3000	0.5 to 1.25 lb		
Kocide DF	1.5 to 3 lb		
Kocide 4.5 LF	1 to 2 pt		
Nu-Cop 50 WP	1.5 to 3 lb		
Nu-Cop 3 L	0.66 to 4 pt		
Nu-Cop 50 DF	1.5 to 2 lb		
Tenn-Cop 5 E	3 pt		
Cuprofix MZ Disperss ²	4 to 7.25 lb	see footnote	NOT FOR PUMPKINS, WINTER SQUASH. Apply when disease appears and continue on a 4 to 7 day schedule as needed.
Mancozeb			
Dithane DF Rainshield	2 to 3 lb	25.6 lb	NOT FOR PUMPKINS OR WINTER SQUASH. Will not control bacterial diseases when applied alone—must be tank-mixed with fixed copper. Apply when disease appears and continue on a 7-to 10-day schedule as needed.
Dithane F-45 Rainshield	1.6 to 2.4 qt	19.2 qt	
Dithane M-45	2 to 3 lb	24 lb	
Manzate 75 DF	2 to 3 lb	25.6 lb	
Manzate Flowable	1.6 to 2.4 qt	19.2 qt	
Manzate Pro-Stick	2 to 3 lb	25.6 lb	
Penncozeb 4 FL	1.2 to 2.4 qt	19.2 qt	
Penncozeb 75 DF	1.5 to 3 lb	25.6 lb	
Penncozeb 80 WP	1.5 to 3 lb	24 lb	
Maneb			
Maneb 75 DF	1.5 to 2 lb	17.1 lb	Will not control bacterial diseases when applied alone—must be tank-mixed with fixed copper. Apply when disease appears and continue on a 7-to 10-day schedule as needed.
Maneb 80 WP	1.5 to 2 lb	16 lb	
Manex	1.2 to 1.6 qt	12.8 qt	
ManKocide ²	2 to 2.5 lb	see footnote	NOT FOR PUMPKINS, WINTER SQUASH. Apply when disease appears and continue on a 3- to 7-day schedule as needed.
Tanos ¹	8 to 10 oz	4 apps	SUPPRESSION OF BACTERIAL FRUIT BLOTCH ONLY. Tanos must be tank-mixed with a multi-site inhibitor (FRAC Group M) appropriate for the target disease. Apply prior to disease onset, continue on a 5- to 7-day schedule.
Anthracnose and Alternaria Leaf Blight (C, M, SP, W), Cercospora Leaf Spot (C, M, W)			
Azoxystrobin¹			
Amistar	3.5 to 5 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Heritage	5.6 to 8 oz		
Quadris	11 to 15.5 fl oz		
Cabrio ¹	12 to 16 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Chlorothalonil			
Bravo Ultrex	1.4 to 2.7 lb	19.1 lb	Apply before disease onset; continue on a 7-day schedule as needed.
Bravo WeatherStik	1.5 to 3 pt	21 pt	
Echo 720	1.5 to 3 pt	21 pt	
Echo 90 DF	1.25 to 2.5 lb	17.5 lb	
Equus 720 SST	1.5 to 3 pt	21 pt	
Equus DF	1.4 to 2.7 lb	19.1 lb	
Cuprofix MZ Disperss ²	4 to 7.25	see footnote	NOT FOR PUMPKINS, WINTER SQUASH. Apply when disease appears and continue on a 4 to 7 day schedule as needed.

DISEASE CONTROL: *Vining Crops (Cucumber, Melon, Pumpkin, Squash, and Watermelon)*

Product	Amt/A (lb)	Seasonal Limits/A	Comments
Fixed coppers		n/a	Apply on a 5- to 10-day schedule beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	1.2 to 2.8 pt		
Basic Copper 53	2 lb		
C-O-C-S WDG	2 to 4 lb		
Champ DP	1.33 lb		
Champ Formula 2 FL	1.33 pt		
Champion WP	1.5 to 3 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	3 to 4 pt		
Cuprofix Disperss	2.5 lb		
Cuprofix Ultra 40 Disperss	1.25 to 2 lb		
Kocide 101	1.5 to 3 lb		
Kocide 2000	1 to 2.25 lb		
Kocide 3000	0.5 to 1.25 lb		
Kocide DF	1.5 to 3 lb		
Kocide 4.5 LF	1 to 2 pt		
Nu-Cop 3 L	0.66 to 4 pt		
Tenn-Cop 5 E	3 pt		
Gavel 75 DF ²	1.5 to 2 lb	8 apps	NOT FOR PUMPKINS, WINTER SQUASH. Apply when conditions favor disease and continue on a 7- to 10-day schedule.
Mancozeb			NOT FOR PUMPKINS OR WINTER SQUASH. Apply before disease appears and continue on a 4- to 7-day schedule as needed.
Dithane DF Rainshield	2 to 3	25.6 lb	
Dithane F-45 Rainshield	1.6 to 2.4 qt	19.2 qt	
Dithane M-45	2 to 3	24 lb	
Manzate 75 DF	2 to 3	25.6 lb	
Manzate Flowable	1.6 to 2.4 qt	19.2 qt	
Manzate Pro-Stick	2 to 3	25.6 lb	
Penncozeb 4 FL	1.2 to 2.4 qt	19.2 qt	
Penncozeb 75 DF	2 to 3	25.6 lb	
Penncozeb 80 WP	1.5 to 3	24 lb	
Maneb			Apply before disease appears and continue on a 7- to 10-day schedule as needed.
Maneb 75 DF	1.5 to 2	17.1 lb	
Maneb 80 WP	1.5 to 2	16 lb	
Manex	1.2 to 1.6 qt	12.8 qt	
ManKocide ²	2 to 2.5 lb	see footnote	NOT FOR PUMPKINS, WINTER SQUASH. Apply before disease appears and continue on a 3- to 7-day schedule as needed.
Pristine ¹	12.5 to 18.5 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Limit 4 apps/season. User highest rates for anthracnose.
Ridomil Gold Bravo	2 to 3 lb	4 apps	Apply before disease onset, continue on a 10- to 14-day schedule. Rotate to another mode of action between applications of RG Bravo. Observe seasonal limits for chlorothalonil.
Ridomil Gold Bravo SC	2.5 to 3.25 pt	4 apps	
Tanos ¹	8 oz	4 apps	Tanos must be tank-mixed with a multi-site inhibitor (FRAC Code M) appropriate for the target disease. Apply before disease onset, continue on a 5- to 7-day schedule.
Thiophanate-methyl			Apply before disease onset, continue on a 7- to 14-day schedule. Do not make back-to-back applications of thiophanate-methyl products.
T-Methyl 70W WSB	0.5 lb	3 lb	
Thiophanate-Methyl 85 WDG	0.2 to 0.4 lb	2.5 lb	
Topsin 4.5 FL	10 fl oz	60 fl oz	
Topsin M 70 WP	0.5 lb	3 lb	
Topsin M WSB	0.5 lb	3 lb	
Quadris Opti ¹	3.2 pt	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Observe seasonal limits for chlorothalonil.
Bacterial Wilt (C, M, SP)			
No bactericides available. Control of insect vectors is the only recommended practice—refer to the Insect Control table.			
Belly Rot, Fruit Rot (Rhizoctonia)			
Azoxystrobin ¹		4 apps	Make first application at 1-3 leaf stage and second at vine-tipover or 14 days after the first application, whichever comes first.
Amistar	3.5 to 5 oz		
Heritage	5.6 to 8 oz		
Quadris	11 to 15.5 fl oz		
Thiophanate-methyl			Apply in sufficient volume to permit runoff to soil. Begin at vine-run and make a second application at fruit-set. Do not make back-to-back applications of thiophanate-methyl products.
T-Methyl 70W WSB	0.5 lb	3 lb	
Thiophanate-Methyl 85 WDG	0.2 to 0.4	2.5 lb	
Topsin 4.5 FL	10 fl oz	60 fl oz	
Topsin M 70 WP	0.5 lb	3 lb	
Topsin M WSB	0.5 lb	3 lb	
Quadris Opti ¹	3.2 pt	4 apps	Make first application at 1-3 leaf stage and second at vine-tipover or 14 days after the first application, whichever comes first. Observe seasonal limits for chlorothalonil.
Downy Mildew (C, M, SP, W)			
Acrobat 50 WP	6.4 oz	5 apps	Must be tank-mixed with another downy mildew fungicide, excluding mefenoxam. Apply before disease onset, continue on a 5- to 10-day schedule.
Forum SC	6 fl oz		
Aliette WDG	2 to 5 lb	7 apps	Apply when conditions favor disease and continue on a 7- to 14-day schedule. Do not tank-mix with copper compounds.

DISEASE CONTROL: Vining Crops (Cucumber, Melon, Pumpkin, Squash, and Watermelon)

Product	Amt/A (lb)	Seasonal Limits/A	Comments
Azoxystrobin ¹		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	3.5 to 5 oz		
Heritage	5.6 to 8 oz		
Quadris	11 to 15.5 fl oz		
Cabrio ¹	8 to 12 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Chlorothalonil			Begin before disease onset; continue on a 7-day schedule as needed.
Bravo Ultrex	1.4 to 1.8 lb	19.1 lb	
Bravo WeatherStik	1.5 to 2 pt	21 pt	
Echo 720	1.5 to 2 pt	21 pt	
Echo 90 DF	1.25 to 1.625 lb	17.5 lb	
Equus 720 SST	1.5 to 2 pt	21 pt	
Equus DF	1.4 to 1.8 lb	19.1 lb	
Cuprofix MZ Disperss ²	4 to 7.25 lb	see footnote	NOT FOR PUMPKINS, WINTER SQUASH. Apply when disease appears and continue on a 4 to 7 day schedule as needed.
Curzate 60 DF	3.2 oz	9 apps	Must be tank-mixed with a multi-site inhibitor (FRAC Code M). Apply before disease onset, continue on a 5- to 7-day schedule.
Fixed coppers		n/a	Apply on a 5- to 10-day schedule beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	1.2 to 2.8 pt		
Basic Copper 53	2 lb		
C-O-C-S WDG	2 to 4 lb		
Champ DP	1.33 lb		
Champ Formula 2 FL	1.33 pt		
Champion WP	1.5 to 3 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	3 to 4 pt		
Cuprofix Disperss	2.5 lb		
Cuprofix Ultra 40 Disperss	1.25 to 2 lb		
Kocide 101	1.5 to 3 lb		
Kocide 2000	1 to 2.25 lb		
Kocide 3000	0.5 to 1.25 lb		
Kocide DF	1.5 to 3 lb		
Kocide 4.5 LF	1 to 2 pt		
Nu-Cop 3 L	0.66 to 4 pt		
Tenn-Cop 5 E	3 pt		
Flint ¹	4 oz	8 oz	Apply before disease onset, continue on a 7- to 14-day schedule.
Gavel 75 DF ²	1.5 to 2	8 apps	NOT FOR PUMPKINS, WINTER SQUASH. Apply when conditions favor disease and continue on a 7- to 10-day schedule.
Mancozeb			NOT FOR PUMPKINS, WINTER SQUASH. Apply before disease appears and continue on a 4- to 7-day schedule as needed.
Dithane DF Rainshield	2 to 3 lb	25.6 lb	
Dithane F-45 Rainshield	1.6 to 2.4 qt	19.2 qt	
Dithane M-45	2 to 3 lb	24 lb	
Manzate 75 DF	2 to 3 lb	25.6 lb	
Manzate Flowable	1.6 to 2.4 qt	19.2 qt	
Manzate Pro-Stick	2 to 3 lb	25.6 lb	
Penncozeb 4 FL	1.2 to 2.4 qt	19.2 qt	
Penncozeb 75 DF	1.5 to 3 lb	25.6 lb	
Penncozeb 80 WP	1.5 to 3 lb	24 lb	
Maneb			Apply before disease appears and continue on a 7- to 10-day schedule as needed.
Maneb 75 DF	1.5 to 2 lb	17.1 lb	
Maneb 80 WP	1.5 to 2 lb	16 lb	
Manex	1.2 to 1.6 qt	12.8 qt	
ManKocide ²	2 to 2.5	see footnote	NOT FOR PUMPKINS, WINTER SQUASH. Apply before disease appears and continue on a 3- to 7-day schedule as needed.
Previcur Flex	0.6 to 1.2 pt	6 pt	Apply prior to disease onset, continue on a 7- to 14-day schedule. Use low rate when tank-mixing with other downy mildew fungicides.
Pristine ¹	12.5 to 18.5 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Quadris Opti ¹	3.2 pt	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Observe seasonal limits for chlorothalonil.
Ranman	2.1 to 2.75 fl oz	6 apps	Apply before disease onset, continue on a 7- to 10-day schedule. Do not apply back to back; alternate with a fungicide having a different mode of action. Tank-mix with an organosilicone surfactant when disease pressure is severe; use an organosilicone or non-ionic surfactant when disease pressure is light-to-moderate.
Reason 500 SC ¹	5.5 fl oz	22 fl oz	Apply before disease onset, continue on a 5- to 10-day schedule. Limit 22 fl oz of Reason/A/season.
Ridomil Gold Bravo	2 lb/2.5 pt	4 apps	Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG Bravo. Avoid late-season applications. Observe seasonal limits for chlorothalonil.
Ridomil Gold Bravo SC			
Ridomil Gold Copper	2 lb	4 apps	Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG Copper. Avoid late-season applications.
Ridomil Gold MZ ²	2.5 lb	4 apps	NOT FOR PUMPKINS OR WINTER SQUASH. Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG MZ. Avoid late-season applications.

DISEASE CONTROL: Vining Crops (Cucumber, Melon, Pumpkin, Squash, and Watermelon)

Product	Amt/A (lb)	Seasonal Limits/A	Comments
Tanos ¹	8 oz	4 apps	Tanos must be tank-mixed with a multi-site inhibitor (FRAC Code M) appropriate for the target disease. Apply before disease onset, continue on a 5- to 7-day schedule.
Gummy Stem Blight (Black Rot) (C, M, SP, W)			
Azoxystrobin ¹		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	3.5 to 5 oz		
Heritage	5.6 to 8 oz		
Quadris	11 to 15.5 fl oz		
Cabrio ¹	12 to 16 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Chlorothalonil			Begin before disease onset; continue on a 7-day schedule as needed.
Bravo Ultrex	1.8 to 2.7 lb	19.1 lb	
Bravo WeatherStik	2 to 3 pt	21 pt	
Echo 720	2 to 3 pt	21 pt	
Echo 90 DF	1.625 to 2.5 lb	17.5 lb	
Equus 720 SST	2 to 3 pt	21 pt	
Equus DF	1.8 to 2.7 lb	19.1 lb	
Cuprofix MZ Disperss ²	4 to 7.25 lb	see footnote	NOT FOR PUMPKINS, WINTER SQUASH. Apply when disease appears and continue on a 4 to 7 day schedule as needed.
Fixed coppers		n/a	Apply on a 5- to 10-day schedule beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	1.2 to 2.8 pt		
Basic Copper 53	2 lb		
Champ DP	1.33 lb		
Champ Formula 2 FL	1.33 pt		
Champion WP	1.5 to 3 lb		
Copper-Count-N	3 to 4 pt		
Cuprofix Disperss	2.5 lb		
Cuprofix Ultra 40 Disperss	1.25 to 2 lb		
Kocide 101	1.5 to 3 lb		
Kocide 2000	1 to 2.25 lb		
Kocide 3000	0.5 to 1.25 lb		
Kocide DF	1.5 to 3 lb		
Kocide 4.5 LF	1 to 2 pt		
Nu-Cop 3 L	0.66 to 4 pt		
Mancozeb			NOT FOR PUMPKINS, WINTER SQUASH. Apply before disease appears and continue on a 7- to 10-day schedule as needed.
Dithane DF Rainshield	2 to 3 lb	25.6 lb	
Dithane F-45 Rainshield	1.6 to 2.4 qt	19.2 qt	
Dithane M-45	2 to 3 lb	24 lb	
Manzate 75 DF	2 to 3 lb	25.6 lb	
Manzate Flowable	1.6 to 2.4 qt	19.2 qt	
Manzate Pro-Stick	2 to 3 lb	25.6 lb	
Penncozeb 4 FL	1.2 to 2.4 qt	19.2 qt	
Penncozeb 75 DF	1.5 to 3 lb	25.6 lb	
Penncozeb 80 WP	1.5 to 3 lb	24 lb	
Maneb			Apply before disease appears and continue on a 7- to 10-day schedule as needed.
Maneb 75 DF	1.5 to 2	17.1 lb	
Maneb 80 WP	1.5 to 2	16 lb	
Manex	1.2 to 1.6 qt	12.8 qt	
ManKocide ²	2 to 2.5 lb	see footnote	NOT FOR PUMPKINS, WINTER SQUASH. Apply before disease appears and continue on a 3- to 7-day schedule as needed.
Pristine ¹	12.5 to 18.5 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Quadris Opti ¹	3.2 pt	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Observe seasonal limits for chlorothalonil.
Ridomil Gold Bravo	2 to 3 lb	4 apps	Apply before disease onset, continue on a 10- to 14-day schedule. Rotate to another mode of action between applications of RG Bravo. Avoid late-season applications. Observe seasonal limits for chlorothalonil.
Ridomil Gold Bravo SC	2.5 to 3.25 pt		
Sovran ¹	4.8 oz	4 apps	Apply prior to disease onset, continue on a 7- to 10-day schedule.
Thiophanate-methyl			Apply before disease onset, continue on a 7- to 14-day schedule. Do not make back-to-back applications of thiophanate-methyl products.
T-Methyl 70W WSB	0.5 lb	3 lb	
Thiophanate-Methyl 85 WDG	0.2 to 0.4 lb	2.5 lb	
Topsin 4.5 FL	10 fl oz	60 fl oz	
Topsin M 70 WP	0.5 lb	3 lb	
Topsin M WSB	0.5 lb	3 lb	
Microdochium (Plectosporium) Blight (SP)			
Azoxystrobin ¹		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	3.5 to 5 oz		
Heritage	5.6 to 8 oz		
Quadris	11 to 15.5 fl oz		
Cabrio ¹	12 to 16 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Limit 4 apps/season. User higher rates when pressure is severe.
Flint ¹	4 oz	8 oz	Apply before disease onset, continue on a 7- to 14-day schedule.
Mancozeb			FOR PUMPKINS OR WINTER SQUASH. Apply before disease appears and continue on a 7- to 10-day schedule as needed.

DISEASE CONTROL: Vining Crops (Cucumber, Melon, Pumpkin, Squash, and Watermelon)

Product	Amt/A (lb)	Seasonal Limits/A	Comments
Phytophthora Blight (C, M, SP, W)			
Acrobat 50 WP	6.4 oz	5 apps	Must be tank-mixed with a protectant fungicide. Apply before disease onset, continue on a 5- to 10-day schedule.
Forum SC	6 fl oz		
Ranman	2.75 fl oz	6 apps	Apply before disease onset, continue on a 7- to 10-day schedule. Do not apply back to back; alternate with a fungicide having a different mode of action Tank-mix with an organosilicone surfactant when disease pressure is severe; use an organosilicone or non-ionic surfactant when disease pressure is light-to-moderate.
Tanos ¹	8 to 10 oz	4 apps	Tanos must be tank-mixed with a fixed copper + and EBDC fungicide. Apply before disease onset, continue on a 5- to 7-day schedule.
Powdery Mildew (C, M, SP, W)			
Azoxystrobin ¹		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	3.5 to 5 oz		
Heritage	5.6 to 8 oz		
Quadris	11 to 15.5 fl oz		
Cabrio ¹	12 to 16 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Chlorothalonil			Begin before disease onset; continue on a 7-day schedule as needed.
Bravo Ultrex	1.8 to 2.7 lb	19.1 lb	
Bravo WeatherStik	2 to 3 pt	21 pt	
Echo 720	2 to 3 pt	21 pt	
Echo 90 DF	1.625 to 2.5 lb	17.5 lb	
Equus 720 SST	2 to 3 pt	21 pt	
Equus DF	1.8 to 2.7 lb	19.1 lb	
Fixed coppers		n/a	Apply on a 5- to 10-day schedule beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	1.2 to 2.8 pt		
Basic Copper 53	2 lb		
Champ DP	1.33 lb		
Champ Formula 2 FL	1.33 pt		
Champion WP	1.5 to 3 lb		
Copper-Count-N	3 to 4 pt		
Cuprofix Disperss	2.5 lb		
Cuprofix Ultra 40 Disperss	1.25 to 2 lb		
Kocide 101	1.5 to 3 lb		
Kocide 2000	1 to 2.25 lb		
Kocide 3000	0.5 to 1.25 lb		
Nu-Cop 3 L	0.66 to 4 pt		
Tenn-Cop 5 E	3 pt		
Flint ¹	1.5 to 2 oz	8 oz	Apply before disease onset, continue on a 7- to 14-day schedule.
Nova 40 W	2.5 to 5 oz	1.5 lb	Apply on a 7- to 10-day schedule, beginning when symptoms are first observed or when conditions favor disease. Do not make back-to-back applications.
Pristine ¹	12.5 to 18.5 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Procure 50 WS	4 to 8 oz	40 oz	Apply prior to vining or when symptoms are first observed and continue on a 7- to 14-day schedule. Do not make back-to-back applications of Procure.
Quadris Opti ¹	3.2 pt	4 apps	Apply before disease onset, continue on a 10- to 14-day schedule. Observe seasonal limits for chlorothalonil.
Quintec	4 to 6 fl oz		MUSKMELON AND WATERMELON ONLY. Apply before disease onset, continue on a 7- to 14-day schedule Do not make back-to-back applications.
Sovran ¹	3.2 to 4.8 oz	4 apps	Apply prior to disease onset, continue on a 7- to 10-day schedule.
Sulfur	2 to 35 lb	n/a	Apply on a 7- to 10-day schedule, beginning when symptoms are first observed or when conditions favor disease. Phytotoxicity may occur when sulfur is applied when air temperatures exceed 90°F.
Thiophanate-methyl			Apply before disease onset, continue on a 7- to 14-day schedule. Do not make back-to-back applications of thiophanate-methyl products. Limit 2.1 lb ai/A/season.
T-Methyl 70W WSB	0.5 lb	3 lb	
Thiophanate-Methyl 85 WDG	0.2 to 0.4 lb	2.5 lb	
Topsin 4.5 FL	10 fl oz	60 fl oz	
Topsin M 70 WP	0.5 lb	3 lb	
Topsin M WSB	0.5 lb	3 lb	
Pythium Damping-off and Cottony Leak (C, M, SP, W)			
Previcur Flex	1.2 pt	6 pt	PYTHIUM ROOT ROT, SEEDLING DISEASES ONLY. 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—refer to label for rates.
Ridomil Gold EC	1 to 2 pt	1 app	PRE-PLANT: Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil. AT PLANTING: apply broadcast or banded, move into seed zone with 0.5 to 1 in of irrigation if rainfall is not expected within 24 hours. Can be applied through drip & sprinkler irrigation systems.
Ridomil Gold SL			
Ultra Flourish	2 to 4 pt	1 app	PRE-PLANT: Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil. AT PLANTING: apply broadcast or banded, move into seed zone with 0.5 to 1 in of irrigation if rainfall is not expected within 24 hours. Can be applied through drip & sprinkler irrigation systems.

DISEASE CONTROL: Vining Crops (Cucumber, Melon, Pumpkin, Squash, and Watermelon)

Product	Amt/A (lb)	Seasonal Limits/A	Comments
Scab (C, M, SP, W)			
Chlorothalonil			Begin before disease onset; continue on a 7-day schedule as needed.
Bravo Ultrex	1.8 to 2.7 lb	19.1 lb	
Bravo WeatherStik	2 to 3 pt	21 pt	
Echo 720	2 to 3 pt	21 pt	
Echo 90 DF	1.625 to 2.5 lb	17.5 lb	
Equus 720 SST	2 to 3 pt	21 pt	
Equus DF	1.8 to 2.7 lb	19.1 lb	
Fixed coppers			Apply on a 5- to 10-day schedule beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Basic Copper 53	2 lb	n/a	
Tenn-Cop 5 E	3 pt		
Mancozeb			Apply before disease appears and continue on a 7- to 10-day schedule as needed.
Dithane DF Rainshield	2 to 3 lb	25.6 lb	
Dithane F-45 Rainshield	1.6 to 2.4 qt	19.2 qt	
Dithane M-45	2 to 3 lb	24 lb	
Manzate 75 DF	2 to 3 lb	25.6 lb	
Manzate Flowable	1.6 to 2.4 qt	19.2 qt	
Manzate Pro-Stick	2 to 3 lb	25.6 lb	
Penncozeb 4 FL	1.2 to 2.4 qt	19.2 qt	
Penncozeb 75 DF	1.5 to 3 lb	25.6 lb	
Penncozeb 80 WP	1.5 to 3 lb	24 lb	
Ridomil Gold Bravo/Ridomil Gold Bravo SC	2 to 3 lb/2.5 to 3.25 pt	4 apps	Apply before disease onset, continue on a 10- to 14-day schedule. Rotate to another mode of action between applications of RG Bravo. Avoid late-season applications. Observe seasonal limits for chlorothalonil.

¹ Do not make back-to-back applications or rotate with other QoI inhibitors (FRAC Group 11). Fungicides with the same Group number have the same mode of action. Do not tank-mix products with the same Group number, and rotate among fungicides with different Group numbers to discourage resistance development.
² Observe seasonal limits for Mancozeb.

Vegetable Production and Marketing Information Online: Selected Links for Commercial Growers

Internet Web sites contain an incredible wealth of useful information of interest to commercial vegetable growers in Kentucky and surrounding states. Below is a list of topics from over 50 Web sites considered to be of particular value to commercial growers. Links to these sites can be found at:

www.uky.edu/Agriculture/Horticulture/veglinks.htm

Warning!

Use this information with caution and at your own risk. You should be very careful about using any variety, fertilizer, or pesticide recommendation from another region or distant state. Some pesticides may be legal only for use in that particular state or production region. Varieties that perform well in another state may or may not perform well in Kentucky.

Remember that Internet addresses change frequently. *Some of the addresses listed below may have changed since the last update* (November, 2007); all addresses below (except those beginning with "http") are preceded by "www".

University of Kentucky College of Agriculture

College of Agriculture: Provides links to most UK agriculture departments and their publications.

- ca.uky.edu

Horticulture Department: Has most of UK's vegetable crop publications linked under "Commercial Horticulture" and "Vegetables".

- uky.edu/Agriculture/Horticulture

Department of Entomology: Fact sheets on Kentucky's vegetable insect and mite pests.

- uky.edu/Agriculture/Entomology/entfacts/efveg.htm

New Crop Opportunities Center: Provides research updates, seminar schedules, and profiles of promising new crops for Kentucky.

- uky.edu/Ag/NewCrops/

Ag. Weather Center: An excellent source of current and historical weather information.

- <http://www.wagwx.ca.uky.edu>

Vegetable Production Guidelines for Commercial Growers: This publication (ID-36) and most other UK extension publications available online.

- uky.edu/ag/horticulture/comveggie.html

Integrated Pest Management (IPM) guidelines: Detailed production information and pest management strategies for Kentucky sweet corn, cabbage, peppers, and pumpkins.

- uky.edu/Agriculture/IPM/manuals.htm

Fruit and Vegetable Research Reports: Results from vegetable variety trials conducted in the state, PR-436 (2000), PR-452 (2001), PR-470 (2002), PR-488 (2003), and PR-504 (2004).

- ca.uky.edu/agc/pubs/pubs.htm

Vegetable and Melon Enterprise Budgets for Kentucky: These interactive crop budgets provide average costs and returns for most vegetable crops and allows users to enter their own cost and price figures to instantly estimate returns per acre.

- uky.edu/Ag/AgEcon/pubs/software/budgets_veg_melon.html

University of Florida's Vegetable Crop Budgets: Provides a large number of vegetable crop budgets from a number of states.

- imok.ufl.edu/liv/groups/economic/budgetlinks.htm

General Vegetable Production Information from Other States

Kansas State University Horticulture Library: Good information for new vegetable growers, including these publications: Farming a Few Acres of Vegetables and Drip Irrigation.

- oznet.ksu.edu/library/hort2/

Ohio State University: Includes link to their production guide and a vast library of vegetable crops Extension bulletins and other publications from many states.

- ag.ohio-state.edu/~vegnet/
- newfarm.osu.edu/crops/vegetables.html

Purdue University: Information pertaining to our geographical area and links to additional vegetable and other horticultural crops, including aromatic and medicinal plants.

- hort.purdue.edu/fruitveg/

North Carolina State University: Horticulture Leaflet series for fruits, vegetables, and post-harvest information; information on sustainable vegetable production practices.

- ces.ncsu.edu/depts/hort/hil/veg-index.html

NCSU and UK Downy Mildew Forecasts:

Provides forecasts for downy mildew on melons, pumpkins, cucumbers, and squash. Some chemicals listed on this site may not be legal in Kentucky.

- ces.ncsu.edu/depts/pp/cucurbit

University of Florida: Extensive vegetable production information, petiole sap testing for nitrogen nutrition, alternative crops, newsletter, and Florida transplant producers.

- http://edis.ifas.ufl.edu/TOPIC_Commercial_Vegetable_Production
- imok.ufl.edu/veghort/pubs/news/news.htm
- imok.ufl.edu/veghort/tgrowers.htm

Mississippi State University Greenhouse Information: Links to Greenhouse Tomato Handbook, Starting Vegetable Transplants, and to other sources of information on greenhouse vegetable production and pest management.

- <http://www2.msstate.edu/~ricks/index.html?#35>

Virginia Tech University: Virginia Cooperative Extension's information on fruits and vegetables

- ext.vt.edu/resources

Weekly Vegetable IPM and Other Newsletters

Kentucky Pest News: Access to the current and back issues of KPN.

- uky.edu/Agriculture/kpn/kpnhome.htm

Illinois Fruit & Vegetable News: Produced at the University of Illinois.

- ipm.uiuc.edu/ifvn/index.html

Indiana's Vegetable Crops Hotline: Produced by Purdue University.

- entm.purdue.edu/entomology/ext/targets/newslett.htm

Organic Vegetable Production

Organic Extension Materials: A good synopsis of relevant books and Extension materials on organic production methods; much of the information is applicable to Kentucky.

- msstate.edu/dept/cmrec/organic/organicresources.html

USDA Publications: Information on organic food production, sustainable agriculture and community supported agriculture (CSA).

- nal.usda.gov/afsic

USDA National Organic Program (NOP): Links to new NOP standards.

- ams.usda.gov/nop/indexIE.htm

Kentucky Organic Certification: Kentucky Department of Agriculture's organic certification program (forms and information).

- kyagr.com/marketing/plantmktg/organic/index.htm

Appropriate Technology Transfer for Rural Areas (ATTRA): A number of extensive online organic vegetable production guides.

- attra.org

University of Kentucky: Information of organic crop certification.

- <http://www.uky.edu/Ag/NewCrops/othercrops.html#o>

Cornell University: Provides good basic biological control information with links to other online resources. Look at the second link for a useful publication on cultivation tools for mechanical weed control.

- nysaes.cornell.edu/ent/biocontrol
- hort.cornell.edu/extension/commercial/vegetables/index.html

University of Florida: Information on selected organic production topics.

- http://edis.ifas.ufl.edu/TOPIC_Organic_Farming

Marketing and Market Prices

UK's Marketing Options for Commercial Vegetable Growers: Publication # ID-134; this is written with tobacco growers in mind. It compares and contrasts most of the available produce marketing options.

- ca.uky.edu/agc/pubs/id/id134/id134.htm

Kentucky Horticulture and New Crops Marketing: A number of other marketing fact sheets for vegetable and fruit crops.

- uky.edu/Ag/NewCrops/newbudgets.html

Wholesale Vegetable Prices: Prices from terminal markets. Also provides fruit, flower, and herb prices.

- agribusinessonline.com

USDA Wholesale Price Information: The same wholesale prices plus specialty, auction, and farmer's market reports.

- ams.usda.gov/fv/mnocs/fvwires.htm

ProduceLinks.com: Claims to be the largest free list of produce and agricultural industry Web sites in the world. This site helps find new suppliers, customers, and services.

- producelinks.com/main.html

Today's Market Prices: One of the most comprehensive commercial sites. Includes its Market Price Service, Shipping Point Market Trends, and Green Web Links. Subscriptions cost \$25/month.

- todaymarket.com

Kentucky Farmer's Markets: Kentucky Department of Agriculture provides information on farmers' markets throughout the state.

- kyagr.com/marketing/farmmarket/index.htm

North Carolina's Regional Farmer's Markets: Wholesale prices at North Carolina regional markets and from other states; other information on their network of farmer's markets.

- agr.state.nc.us/markets/mktnews/vegetable.htm

USDA Grading Standards: Fruit and vegetable grading standards.

- ams.usda.gov/standards/stanfrfv.htm

USDA Direct Marketing Home Page: The USDA hosts this site.

- ams.usda.gov/directmarketing

Kentucky Department of Agriculture: Includes links to Horticultural Division, Organic Certification, and KY Produce Shipper's Directory. Information about Kentucky's vegetable marketing cooperatives, a Farmer's Market Directory, and guidelines for "Kentucky Proud" logo program.

- kyagr.com

KDA Country Store: The Department of Agriculture helps Kentucky producers build their own Web site and hosts those sites at no charge.

- kyagr.com/buyky/webbuild/index.htm
- kyagr.com/buyky/cstore/cstore.htm

Kentucky Farm Bureau: Provides a link to its map and directory of Kentucky Certified Roadside Farm Markets.

- kyfb.com

Commodity Growers Cooperative: Information on legislation and programs promoting agricultural diversification in Kentucky.

- commoditygrowers.com/

University of California's Small Farm News: A good source of small farm direct marketing information at UC Small Farm Center site.

- sfc.ucdavis.edu

University of Arizona's Direct Marketing Handbook: Great information on farmer's markets (probably the best available).

- ag.arizona.edu/arec/pubs/dmkt/dmkt.html

Post-harvest and Food Safety (handling, cooling, grading, packaging, etc.)

North Carolina State Postharvest Information: This includes their excellent post-harvest commodity series publications and information on precooling and packaging requirements.

- www2.ncsu.edu/bae/programs/extension/publicat/postharv/index.html

University of California Post-Harvest Guidelines: Other crop-specific post-harvest guidelines, chlorination of produce, and food safety.

- <http://postharvest.ucdavis.edu/Produce/Producefacts/index.shtml>
- <http://vric.ucdavis.edu/veginfo/veginfor.htm>

Cornell University Food Safety: Some of the best information on food safety and good agricultural practices for growers is available in the publication: Food Safety Begins on the Farm—A Grower's Guide.

- gaps.cornell.edu

Migrant Labor

US Citizenship and Immigration Services: Provides some information for agricultural employers and links to print I-9 forms.

- <http://uscis.gov/graphics/index.htm>

Farm Labor Handbook: Ohio publishes this handbook, a short summary of which is available online.

- <http://ohioline.osu.edu/hrm-fact/0005.html>

Conversion Table for Use of Pesticides on Small Areas

LIQUID MATERIALS		
Recommended Rate/A	Approximate Rate/1,000 Sq Ft	Approximate Rate/100 Sq Ft
1 pt	¾ tbs	¼ tsp
1 qt	1½ tbs	½ tsp
2 qt	3 tbs	1 tsp
1 gal	6 tbs	2 tsp
25 gal	4½ pt	1 cup
50 gal	4½ pt	1 pt
75 gal	7 qt	1½ pt
100 gal	9 qt	1 qt

DRY MATERIALS		
Recommended Rate/A	Approximate Rate/1,000 Sq Ft	Approximate Rate/100 Sq Ft
1 lb	2¼ tsp	¼ tsp
2 lb	4½ tsp	½ tsp
3 lb	2¼ tbs	¾ tsp
4 lb	3 tbs	1 tsp
5 lb	4 tbs	1¼ tsp
6 lb	4½ tbs	1½ tsp
8 lb	2/5 cup	1¾ tsp
10 lb	½ cup	2 tsp
100 lb	2¼ lb	¼ lb
200 lb	4½ lb	½ lb
400 lb	9 lb	1 lb

Pesticide Dilution Tables

These tables provide quantity of either liquid or wettable powder concentrates to use per acre to give desired dosage of active ingredient per acre.

How to Use the Tables

Example: Look at the Liquid Concentrate Table.

Suppose that this publication recommends .50 pounds of actual Guthion per acre to treat a specific problem. You have Guthion 2L (2 lb active ingredient per gal) liquid.

Find 2 lb in the left-hand column. Then, locate .50 in the heading across the top. These two columns intersect at 2.0. Thus you would add 2 pt of Guthion 2L in enough water to treat an acre.

The other two tables work the same way.

Table of Measures

3 teaspoonfuls (tsp) = 1 tablespoonful

2 tablespoonfuls (tbs) = 1 fluid ounce

16 tablespoonfuls (tbs) = 1 cup

8 fluid ounces (fl oz) = 1 cup

2 cups (c) = 1 pint

2 pints (pt) = 1 quart

4 quarts (qt) = 1 gallon

All recommendations that are given for the various crop pests in this bulletin are on the basis of pounds or pints of formulation per acre of crop unless stated otherwise.

Liquid Concentrate—Amount to use, in PINTS/acre.								
Pounds A.I./Gallon	Pounds/Acre of Active Ingredient Recommended							
	.125	.25	.50	.75	1	2	3	4
1 lb	1.0	2.0	4.0	6.0	8.0	16.0	24.0	32.0
1 ½ lb	6.7	1.3	2.6	4.0	5.3	10.6	16.0	21.3
2 lb	.50	1.0	2.0	3.0	4.0	8.0	12.0	16.0
3 lb	.34	.67	1.3	2.0	2.7	5.3	8.0	10.7
4 lb	.25	.50	1.0	1.5	2.0	4.0	6.0	8.0
5 lb	.20	.40	.80	1.2	1.6	3.2	4.8	6.4
6 lb	.17	.34	.67	1.0	1.3	2.6	4.0	5.3
7 lb	.14	.30	.60	.90	1.1	2.3	3.4	4.6
8 lb	.125	.25	.50	.75	1.0	2.0	3.0	4.0
9 lb	.11	.22	.45	.67	.9	1.8	2.7	3.6
10 lb	.10	.20	.40	.60	.8	1.6	2.4	3.2

Remember, the numbers in the body of this table are PINTS/acre.

Wettable Powder—Amount to use, in POUNDS/acre.								
% A.I.	Pounds/Acre of Active Ingredient Recommended							
	.125	.25	.50	.75	1	2	3	4
15%	13/16	1¾	3 1/3	5	6½	13	20	26½
25%	½	1	2	3	4	8	12	16
40%	5/16	5/8	1¼	1¾	2½	5	7½	10
50%	¼	½	1	1½	2	4	6	8
75%	3/16	3/8	11/16	1	1 1/3	2 2/3	4	5 1/3

Remember, the numbers in the body of this table are POUNDS/acre.

Dust or Granules—Amount to use, in POUNDS/acre.								
% A.I.	Pounds/Acre of Active Ingredient Recommended							
	.125	.25	.50	.75	1	2	3	4
2 ½%	5	10	20	30	40	80	120	160
5%	2½	5	10	15	20	40	60	80
10%	1¼	2½	5	7½	10	20	30	40
20%	5/8	1¼	2½	3¾	5	10	15	20
25%	½	1	2	3	4	8	12	16

Remember, the numbers in the body of this table are POUNDS/acre.

Secondary Nutrients and Micronutrients

Calcium—Calcium levels in soils vary with soil pH and cation exchange capacity (CEC). To avoid developing soil conditions that may lead to low levels of available calcium and low calcium uptake by some crops, have soil tested frequently. Apply lime to obtain the recommended soil pH at least six months before growing the crop. See the publication *Lime and Fertilizer Recommendations* (AGR-1) for lime rates to achieve desired pH changes.

Magnesium—Magnesium levels in Kentucky soils range from very high (loess-derived soils) to somewhat low (some sandstone-derived and recently cleared soils). Magnesium is included as part of the routine soil test. For vegetable crops, a test level of 80 lb/acre is considered the minimum, and 200 lb/acre is recommended for staked tomatoes and muskmelons. If both lime and magnesium are needed, dolomitic lime should be applied. If dolomitic lime is not available or when lime is not needed and magnesium is recommended, other sources of magnesium such as magnesium oxide or Epsom salts (magnesium sulfate) are available for broadcast or row application. Refer to Muskmelon and Tomato chapters for magnesium application rates. Magnesium deficiencies are readily identifiable in many plants. Typically deficiencies show up as interveinal chlorosis on older leaves.

Iron, Copper, Manganese—For horticultural crops, we have not measured consistent responses to soil-applied iron, copper, or manganese. To verify a suspected deficiency of iron, copper or manganese, have an analysis of plant tissue appropriate for the crop carried out with a commercial lab through your county Extension agent. Responses to foliar applications of iron, copper, or manganese, after diagnosis of a deficiency, have been superior to soil applications. Many deficiencies of iron, copper and manganese show similar signs as magnesium deficiencies (ie. interveinal chlorosis); however, typically micronutrient deficiencies appear first in new growth, whereas magnesium deficiencies will tend to first appear in older growth.

Sulfur—We have not measured a response to sulfur application on horticultural crops in Kentucky. However, cole crops established early in the spring on soils that tend to be cool and moist may be susceptible to low amounts of available sulfur. A meaningful and suitable soil test for sulfur is not available in Kentucky because of several factors affecting available sulfur levels in soils. It is suggested that sulfur-containing fertilizer be used where cole crops are to be grown as they are high sulfur users.

Boron—Yield responses to boron have been observed only for certain crops under some conditions. A boron soil test is available in Kentucky upon request through your county Extension agent. Boron should only be applied when soil test boron is less than 1 lb/A. Boron is normally applied at the rate of 1 to 2 lb of actual boron per acre.

Zinc—Zinc deficiency in snap beans and sweet corn may be significant in Central and Southcentral Kentucky. The test for zinc is now included in the routine soil test. The results of this test, in conjunction with soil test results for pH and phosphorus, can help farmers make needed applications of zinc fertilizer. When zinc is recommended and equipment is available, banding can reduce costs by two-thirds over a broadcast application. Zinc sulfate (36% Zn) is usually applied at 30 to 90 lb per acre when broadcast. Chelated zinc (14%) can be applied at 15 to 40 lb per acre. For a foliar spray, use chelated zinc at $\frac{3}{4}$ to 1 lb in 100 gallons of water. See also the "Fertilizing" section of the Sweet Corn chapter.

Names, Formulations, Classifications, and Toxicities of Insecticides Registered for Vegetables

Insecticide		Common Name	Class	Toxicity Category
Admire	2 F	imidacloprid	CN	III
*Ambush	2 E, 25 W	permethrin	SP	III
*Ammo	2.5 EC	cypermethrin	SP	III
*Asana	XL	esfenvalerate	SP	II
*Aztec	2.1% G	cyfluthrin + tebufospyrimphos	OP + SP	II
*Baythroid	2 E	cyfluthrin	SP	I
*Counter	15% G	terbufos	OP	I
Cygon	4 E	dimethoate	OP	II
Cygon	400	dimethoate	OP	II
Cythion	57% EC	malathion	OP	III
Diazinon	AG 500, 50 WP, 14% G	diazinon	OP	II
DiSyston	15% G 8 E	disulfoton	OP	I
*Dyfonate	4 E II (20%G) 10% G	fonofos	OP	I
Dylox	80 SP	trichlorfon	OP	II
*Furadan	4 F 15% G	carbofuran	CA	I
*Guthion	2 S 35% WP	azinphos-methyl	OP	I
Imidan	50% WP	phosmet	OP	II
Kelthane	35% W, MF	dicofol	CH	II
*Lannate	L, 90 WSP	methomyl	CA	I
Lorsban	4 E, 15%G	chlorpyrifos	OP	II
Malathion	57% EC	malathion	OP	III
Marlate	50% WP	methoxychlor	CH	III
Methoxychlor	50% WP	methoxychlor	CH	III
*Metasystox-R	SC	oxdemeton-methyl	OP	II
*Mocap	15% G	ethoprop	OP	I
Orthene	75 SP	acephate	OP	III
*Pounce	3.2 EC, 25 W	permethrin	SP	II
Provado	2 F	imidacloprid	CN	III
Proxol	80 SP	trichlorfon	OP	II
Pyrenone	6 E	pyrethrins	B	III
Rotenone	6.7% WP	rotenone	B	II
Sevin	80 S 50% WP 4 F, XLR Plus	carbaryl	CA	III
*Thimet	20% G	phorate	OP	I
*Thiodan	3 EC 50 WP	endosulfan	CH	I
Warrior	1 EC	Lamba-cyhalothrin	SP	I

*Indicates that some or all formulations of these products are RESTRICTED USE INSECTICIDES

OP= organophosphate, CA = carbamate, CH = chlorinated hydrocarbon, SP = synthetic pyrethroid, B = botanical, CN = Chloronicotinyl, I = highly toxic, II = moderately toxic, III = slightly toxic.

Sprayer Calibration

To apply the right amount of material per acre, it is necessary to know how much liquid the sprayer is delivering per acre at a given speed and pressure. The following is a fast, simple method of calibrating a sprayer for broadcast application.

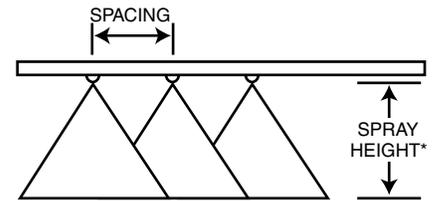
Ounce Calibration Method:

1. Using the table to the right, select the distance to catch discharge based on the row or nozzle spacing of your sprayer.
2. Measure that distance in the field to be sprayed.
3. Note the time in seconds spent to drive the measured distance at the desired throttle setting (constant speed).
4. Catch the nozzle discharge for the noted time (#3 above) in a measuring cup or other container graduated in fluid ounces.
5. The total discharge per row or nozzle spacing in fluid ounces is equal to the gallons per acre applied (at the constant speed used in #3).
6. Repeat for each nozzle or nozzle group to ensure equal distribution.

SPRAYER CALIBRATION (Distance)

Nozzle Spacing (inches)	Distance to Catch Discharge (feet)
40	102
38	107
36	113
34	120
32	127
30	136
28	146
26	157
24	170
22	185
20	204
18	227
16	255
14	291

TIP NO. (Strainer Screen Size)		Liquid Pressure in PSI	Capacity 1 Nozzle in GPM	Capacity 1 Nozzle in oz./min.	GALLONS PER ACRE 20" SPACING				GALLONS PER ACRE 30" SPACING			
80° SERIES	110° SERIES				5 MPH	6 MPH	7 MPH	8 MPH	5 MPH	6 MPH	7 MPH	8 MPH
8001VS (100 Mesh)	11001VS (100 Mesh)	30	.09	11	5.1	4.3	3.7	3.2	3.4	2.9	2.5	2.1
		35	.09	12	5.6	4.6	4.0	3.5	3.7	3.1	2.6	2.3
		40	.10	13	5.9	5.0	4.2	3.7	4.0	3.3	2.8	2.5
		45	.11	14	6.3	5.3	4.5	3.9	4.2	3.5	3.0	2.6
		60	.12	15	7.3	6.1	5.2	4.6	4.9	4.0	3.5	3.0
80015VS (100 Mesh)	110015VS (100 Mesh)	30	.13	17	7.7	6.4	5.5	4.8	5.1	4.3	3.7	3.2
		35	.14	18	8.3	6.9	6.0	5.2	5.6	4.6	4.0	3.5
		40	.15	19	8.9	7.4	6.4	5.6	5.9	5.0	4.2	3.7
		45	.16	20	9.5	7.9	6.8	5.9	6.3	5.3	4.5	3.9
		60	.18	23	10.9	9.1	7.8	6.8	7.3	6.1	5.2	4.6
8002VS (50 Mesh)	11002VS (50 Mesh)	30	.17	22	10.3	8.6	7.4	6.4	6.9	5.7	4.9	4.3
		35	.19	24	11.1	9.3	7.9	6.9	7.4	6.2	5.3	4.6
		40	.20	26	11.9	9.9	8.5	7.4	7.9	6.6	5.7	5.0
		45	.21	27	12.6	10.5	9.0	7.9	8.4	7.0	6.0	5.3
		60	.25	32	14.6	12.1	10.4	9.1	9.7	8.1	6.9	6.1
8003VS (50 Mesh)	11003VS (50 Mesh)	30	.26	33	15.4	12.9	11.0	9.7	10.3	8.6	7.4	6.4
		35	.28	36	16.7	13.9	11.9	10.4	11.1	9.3	7.9	6.9
		40	.30	38	17.8	14.9	12.7	11.1	11.9	9.9	8.5	7.4
		45	.32	41	18.9	15.8	13.5	11.8	12.6	10.5	9.0	7.9
		60	.37	47	22	18.2	15.6	13.6	14.6	12.1	10.4	9.1
8004VS (50 Mesh)	11004VS (50 Mesh)	30	.35	45	21	17.2	14.7	12.9	13.7	11.4	9.8	8.6
		35	.37	47	22	18.5	15.9	13.9	14.8	12.3	10.6	9.3
		40	.40	51	24	19.8	17.0	14.9	15.8	13.2	11.3	9.9
		45	.42	54	25	21	18.0	15.8	16.8	14.0	12.0	10.5
		60	.49	63	29	24	21	18.2	19.4	16.2	13.9	12.1
8005VS (50 Mesh)	11005VS (50 Mesh)	30	.43	55	26	21	18.4	16.1	17.2	14.3	12.3	10.7
		35	.47	60	28	23	19.8	17.4	18.5	15.4	13.2	11.6
		40	.50	64	30	25	21	18.6	19.8	16.5	14.1	12.4
		45	.53	68	32	26	23	19.7	21	17.5	15.0	13.1
		60	.61	78	36	30	26	23	24	20	17.3	15.2
8006VS (50 Mesh)	11006VS (50 Mesh)	30	.52	67	31	26	22	19.3	21	17.2	14.7	12.9
		35	.56	72	33	28	24	21	22	18.5	15.9	13.9
		40	.60	77	36	30	25	22	24	19.8	17.0	14.9
		45	.64	82	38	32	27	24	25	21	18.0	15.8
		60	.74	95	44	36	31	27	29	24	21	18.2
8008VS (50 Mesh)	11008VS (50 Mesh)	30	.69	88	41	34	29	26	27	23	19.6	17.2
		35	.75	96	44	37	32	28	30	25	21	18.5
		40	.80	102	48	40	34	30	32	26	23	19.8
		45	.85	109	50	42	36	32	34	28	24	21
		60	.98	125	58	49	42	36	39	32	28	24



*Adjust spray height in the field to overlap approximately 30% of each edge of pattern.

SUGGESTED MINIMUM SPRAY HEIGHT	
SPRAY ANGLE	SPRAY HEIGHT 20" SPACING
80°	17-19"
110°	10-12"

Flat Fan Spray Tips

- 8002VS Stainless Steel with VisiFlo color coding
- 8002-HSS Hardened Stainless Steel
- 8002-SS Stainless Steel
- 8002 Brass

Organic Manures and Fertilizers

Animal manure contributes more to the soil than just nitrogen, phosphorus, and potassium. Continued use of manure builds organic matter in soils and improves soil structure. This modification of soil structure helps improve water holding capacity, aeration, friability, and drainage. In addition, many trace nutrients needed for optimal plant growth are available from manure. Plant nutrients are also released more slowly and over a longer period of time than from most commercial fertilizers.

Disadvantages of using manure are the handling and transportation problems associated with large amounts of manure required to obtain sufficient quantities of nutrients for vegetables. The use of fresh manure may also introduce new weeds into fields since certain weed seeds remain alive even after passage through animals. Another concern is that the careless use of manure can expose fresh produce to human pathogens such as *E. coli*, which can cause serious illness. Food safety must be a primary consideration in any vegetable operation but especially where manure are being used.

General Considerations

Fresh Vegetables, Not Fresh Manure

Manure should never be used fresh (raw) if you intend to plant directly into it; composting results in a more readily usable form of manure. Composting will also destroy many weed seeds that could otherwise be introduced into new fields or gardens. Composting requires that the temperature reach 131 to 170°F for at least 15 days, and the compost must be turned 5 times. For more information on the composting process, see UK Extension publication HO-75, *Home Composting: A Guide to Managing Home Organic Waste*. This guide along with other home and commercial vegetable publications are available from the Horticulture Department's Web site at <<http://www.uky.edu/Agriculture/Horticulture/homeveggies.html>>. Links to additional information on commercial vegetable production, including organic practices, can be found at <<http://www.uky.edu/Agriculture/Horticulture/veglinks.htm>> (Appendix A).

If fresh manure is used on soil, it should be worked in as soon as possible or covered with other organic materials such as straw, hay, or grass clippings to prevent the loss of nitrogen through leaching. No fresh manure may be used during the year of harvest for certified organic production so you may want to plant a green manure or cover crop on this ground for the first year (see Web site above for information on Kentucky cover crops). See also <http://www.kyagr.com/mkt_promo/wood/programs/organic/index.htm> for detailed information on organic certification in Kentucky. This allows soil microbes to start the decomposition process that regulates nutrient availability and prevents burning of young plant roots. It also substantially reduces the chance of produce *E. coli* and *Salmonella* contamination.

Caution: Fresh manure is best applied and plowed down the fall before planting. There should be at least 120 days between manure application and planting for vegetable crops in which the edible portion touches the ground. There should be at least 90 days between manure application and planting for crops in which the edible portion does not touch the ground.

Remember that some types of animal manure have higher nitrogen contents than others (see Tables 1 and 2). These include horse, sheep, chicken, and rabbit manure. These are sometimes referred to as "hot" and are best used after composting. Cow and hog manures are considered "cold" because of their lower nitrogen levels.

Application

Composted manure can be broadcast and worked into fields or worked into rows and beds for various vegetable crops. A general recommendation for vegetable gardens is to broadcast poultry, sheep, cow, or horse manure at 25 to 100 lb per 100 square feet (approximately 5 to 20 tons per acre). This amount may need to be supplemented with 1 to 2 pounds of a complete inorganic fertilizer such as 10-10-10. Organic growers can supplement with ground rock phosphate or raw bone meal to obtain phosphorus required (see below). For crops such as melons, squash, and cucumbers, composted manure can be worked directly into planting hills and mixed thoroughly with the soil.

Nutrient Contents

It is important to remember that nutrient contents in manure vary widely according to age of the animals, feed used, moisture content, degree of decomposition, and the amount of litter or bedding material mixed in with the manure. The only really accurate way of determining the nutrient content of the manure you are using is through laboratory analysis. You may need to adjust your application rates up or down according to what you know about the age, quality, and moisture content of the manure.

When buying or getting ready to spread manure, remember that moisture content greatly affects the total pounds of nutrients in a ton of material. For example, broiler manure at 25% to 30% moisture when removed from the house will contain about 34 lb of nitrogen, 37 lb of phosphate, and 31 lb of potash per ton. But a ton of fresh manure at 75% moisture will contain only 27, 28, and 14 lb of these nutrients, respectively. At 75% moisture you will be hauling around 1,500 lb of water and only 500 lb of solid material. Not all nutrients in manure are available to crops during the season of application. In poultry manure, for example, 90% of the N, most of the potassium, *but only half of the phosphorus* becomes available in the first year.

Because phosphorus in manure must decompose before it becomes available and because it is not very mobile in soil, broadcasting manure is not considered a very efficient way of applying this element for establishment of vegetable crops. For poultry manure, phosphorus and potassium portions are considered to be about 50% to 75% as effective as they are in commercial fertilizers during the year of application; the remainder is released as the litter decomposes. Supplement manures with a complete inorganic fertilizer or with an organically approved material such as bone meal or ground rock phosphate.

How to Use and Convert Fertilizer Recommendations in this Publication

Plant nutrient requirements are provided in the Fertilizer tables under each crop in this publication. These nutrients are expressed in terms of the amounts of nitrogen (N), phosphorus or phosphate (P₂O₅), and potassium (K₂O) required by the crop. Amounts of phosphorus and potassium recommended vary according to what may already be present in the soil. For this reason, both conventional and organic growers should always have their soil tested, preferably in the fall or early spring. Soil test sample boxes and instructions are available from your county Extension office.

To calculate the amount of manure required for application on a sweet corn crop, for example, first find the suggested nutrient application rates in the Fertilizer Guidelines table in the Corn chapter. *Warning: Manure applications should never exceed the total nitrogen requirements of a crop in an attempt to satisfy phosphorus and potassium requirements—burning of the roots and leaves could occur.*

Nitrogen First

We will choose nitrogen as our “priority” nutrient, which will be used to limit the total amount of manure to be used; i.e., we will calculate the manure requirements based only on the nitrogen recommendation. Although most manure high in nitrogen is also high in potassium (Tables 1 and 2), additional phosphorus may need to be obtained from other sources. Because soil and plant nitrogen tests are not widely used in Kentucky and because much of the nitrogen in soils is used or lost from one season to the next, we make a blanket recommendation of 80 to 100 lb of N per acre for sweet corn. When commercial fertilizers are used, this amount is applied before planting and is supplemented by a sidedressing of 40 to 50 lb of N per acre when plants are about knee-high.

Consider the Source

Now consider the source, moisture content, and quality of the manure or organic material to be used. If we are using a dry or composted material containing little or no moisture, we should use Table 2 to make the necessary calculations.

Making Conversions

We have decided to use the lower N level of 80 lb per acre because we feel our soil may still have some residual N from last year’s bean crop that was grown on this plot. We have found a source of composted poultry manure and plan to use it as our nutrient source. To calculate the manure required to provide the required 80 lb of nitrogen, look at Table 2 under poultry; the N content is 3.2%. Now divide the 80 lb by 3.2 = 25 and multiply the result by 100 = 2,500 lb. This is the amount of this manure required to obtain the 80 lb/acre of nitrogen recommended. To obtain this in tons, simply divide again by 2,000 (2,500 ÷ 2,000 = 1.25 tons).

In this example we will have obtained 80 lb of nitrogen together with 130 lb of phosphorus (P₂O₅) and 45 lb of potassium (K₂O). The amount of P₂O₅ and K₂O are calculated for the 2,500 lb of manure by multiplying 2,500 by the appropriate percentages in Table 2 and then dividing by 100. The amount of P₂O₅, for example, is 2,500 lb x 5.2 = 13,000 divided by 100 = 130 lb. For the amount of K₂O, multiply 2,500 lb x 1.8 and then divide by 100 = 45 lb.

Additional Phosphorus

Now suppose that the soil is very low in phosphorus and the soil test suggests applying 180 lb of phosphorus. We have obtained 130 lb of phosphorus from the poultry manure and need an additional 50 lb, but we do not want to apply much more nitrogen.

Looking at Table 2 we decide to supply our phosphorus using raw bone meal, which is 22% P₂O₅ and 3% N. Dividing 50 lb of P₂O₅ by 22 = 2.27 and multiplying by 100 = 227 lb. Thus, 227 lb of raw bone meal/acre will supply 50 lb of P₂O₅. Performing a similar calculation for the N tells us that we will only obtain about 7 (6.8) lb of N/acre using raw bone meal. Use this same means of calculation if additional potassium is needed.

Note: Information in Tables 1 and 2 should be used only as guidelines. Nutrient contents for manures vary greatly, and the figures below are averages from a range of possible values.

Table 1. Nutrients in FRESH animal manure.

Source	Water Content	Average Nutrient Composition (percent of fresh weight)		
		N	O ₂ O ₅	K ₂ O
Beef cattle	80	0.70	0.45	0.55
Dairy cattle	84	0.60	0.25	0.60
Horses	60	0.60	0.25	0.45
Hogs	75	0.50	0.35	0.65
Sheep	65	1.05	0.35	0.95
Laying hens	75	1.00	1.25	0.50
Broilers (litter) ¹	30	2.95	2.75	1.85

¹ Some broiler producers use Roxarson and Nitarosone in their feed mixes as medications. Growers using litter containing these products cannot sell produce grown with this manure as certified organic in Kentucky.

Table 2. Nutrient contents of DRY manures and organically approved fertilizer materials.

Source	Average Nutrient Composition (percent dry weight)		
	N	P ₂ O ₅	K ₂ O
Dairy cows	1.3	0.9	3.0
Feedlot cattle	1.7	1.2	3.0
Horse	2.3	0.9	1.7
Poultry	3.2	5.2	1.8
Sheep	3.5	1.4	3.5
Hogs	3.5	0.5	0.7
Goat	1.5	1.5	3.0
Rabbit	2.4	1.4	0.6
Tobacco stems ¹	1.5	0.5	7.0
Bat guano	10.0	2.0-4.0	0-2.0
Blood meal	13.0-14.0	2.0	1.0
Bone meal, raw	3.0	22.0	--
Bone meal, steamed	1.0-2.0	11.0-15.0	--
Cottonseed meal	6.0	0.4-3.0	1.5
Fish meal	10.0	6.0	--
Fish emulsion	5.0	2.0	2.0
Feather meal	12.0	0	0
Soybean meal	7.0	1.2	1.5
Tankage ¹	7.0	10.0	1.5
Sewage sludge ¹	1.5	1.3	0.4
Sewage sludge activated ¹	6.0	3.0	0.2
“Soft” rock phosphate	0	14.0-16.0	0
Greensand	0	0	3.0
Phytamin 800	7.0	0	0

¹ Not cleared for certified organic production. Sewage sludge should not be used for vegetable crops because of possible heavy metal and E. coli contamination.

Earliest and Latest Vegetable Crop Planting Dates in Kentucky

As every vegetable grower knows, a week earlier (or later) on the market can sometimes make the difference between a highly profitable crop and a net loss. Information in the following tables is provided as an aid to planning. Table 1 lists earliest and latest safe planting dates for various vegetable crops based on experiences of growers in eastern, central, and western Kentucky; however, these are not absolute and it is always possible for killing frosts to occur later or earlier than the range of dates provided. Frosts are greatly influenced by small variations in topography and microclimate and growers can best judge for themselves how prone their fields are to early or late frosts.

Table 2 provides average dates for the latest frosts in spring and the earliest frosts in the fall. These dates are based on 30-year averages from the Kentucky weather stations listed. Find the nearest station location in the list and use the dates found in the same row. These dates represent a 90% probability (nine years out of ten) that the last frost (at or below 32°F) will occur on or before that date in the spring ("Latest Spring Frost") or a 90% probability that the first frost will occur on or after the date listed for "Earliest Fall Frost".

Use this information with caution; small differences in landscape and elevation can result in later frosts in spring and earlier frosts in the fall. Local experience will help determine the best planting dates for various crops at your location.

Table 1. Earliest and latest safe vegetable planting dates for Eastern, Central and Western Kentucky.

Crops	Earliest Date ¹			Latest Date ^{1,2}		
	Eastern Mtns.	Central	Western	Eastern Mtns.	Central	Western
Asparagus (crowns)	Mar 20	Mar 15	Mar 10			
Beans (snap)	May 1	Apr 25	Apr 10	Jul 15	Jul 25	Aug 1
Beans (lima)	May 10	May 1	Apr 15	Jul 15	Jun 20	Jul 1
Beets	Mar 20	Mar 15	Mar 10	Jul 15	Jul 20	Aug 15
Broccoli (plants)	Apr 10	Apr 5	Mar 30	Jul 15	Aug 1	Aug 15
B. Sprouts (plants)	Apr 10	Apr 5	Mar 30	Jul 1	Jul 15	Aug 1
Cabbage	Apr 1	Mar 25	Mar 15	Jul 1	Jul 15	Aug 1
Carrots	Apr 1	Mar 20	Mar 10	Jul 1	Jul 15	Aug 1
Cauliflower (plants)	Apr 10	Apr 5	Mar 30	Jul 15	Jul 20	Aug 5
Chard	Apr 1	Mar 20	Mar 15	Jun 15	Jul 15	Aug 1
Collards	Mar 15	Mar 10	Mar 1	Jul 15	Aug 1	Aug 15
Sweet Corn	May 1	Apr 20	Apr 10	Jun 15	Jul 10	Jul 20
Cucumbers	May 10	May 5	Apr 25	Jun 15	Jul 1	Jul 15
Eggplant (plants)	May 15	May 10	May 1	Jun 1	Jun 15	Jul 1
Kale	Apr 1	Mar 20	Mar 10	Jul 15	Aug 1	Aug 15
Kohlrabi	Mar 25	Mar 20	Mar 15	Jul 15	Aug 1	Aug 15
Lettuce (leaf)	Apr 1	Mar 25	Mar 15	Aug 1	Aug 15	Sep 1
Lettuce (bibb plants)	Apr 1	Mar 25	Mar 15	Jul 15	Aug 1	Aug 15
Muskmelons	May 15	May 10	Apr 25	Jun 15	Jul 1	Jul 15
Okra	May 15	May 10	Apr 20	Jul 1	Jul 15	Aug 1
Onions (sets)	Mar 15	Mar 10	Mar 1			
Onions (plants)	Apr 1	Mar 25	Mar 15	Jun 15	Jul 1	Jul 15
Onions (seed)	Apr 1	Mar 20	Mar 10	Jun 1	Jun 15	Jul 1
Parsley	Apr 1	Mar 20	Mar 10	Jul 15	Aug 1	Aug 15
Parsnips	Apr 1	Mar 20	Mar 10	Jun 1	Jun 15	Jul 1
Peas	Mar 15	Mar 1	Feb 20			
Peppers (plants)	May 20	May 10	May 1	Jun 15	Jul 1	Jul 15
Potatoes	Mar 20	Mar 15	Mar 15	Jun 15	Jul 1	Jul 15
Sweetpotatoes	May 20	May 10	May 1	Jun 1	Jun 10	Jun 15
Pumpkins	May 10	May 5	Apr 25	Jun 1	Jun 15	Jul 1
Radishes	Mar 15	Mar 10	Mar 1	Sep 1	Sep 15	Oct. 1
Rhubarb (crowns)	Mar 15	Mar 10	Mar 1			
Southernpeas	May 10	May 5	Apr 20	Jun 15	Jul 1	Jul 15
Snow Peas	Mar 15	Mar 1	Feb 20	Jul 20	Aug 1	Aug 8
Spinach	Mar 10	Mar 1	Feb 15	Aug 15	Sep 1	Sep 15
Summer Squash	May 15	May 10	Apr 20	Jul 15	Aug 1	Aug 15
Tomatoes (plants)	May 15	May 5	Apr 20	Jun 1	Jun 15	Jul 1
Turnips	Mar 15	Mar 10	Mar 1	Jul 15	Aug 1	Aug 15
Watermelons	May 15	May 5	Apr 20	Jun 15	Jul 1	Jul 15
Winter Squash	May 15	May 10	Apr 20	Jun 15	Jul 1	Jul 15

¹ Dates are for direct seeding unless otherwise indicated under "Crops" column.

² Based on the average time to harvest for early maturing varieties; mid-season and late-maturing varieties need to be planted 15 to 30 days earlier than latest date. Most fall-planted crops require irrigation.

Table 2. Average dates of last spring and first fall frost at various weather stations in Kentucky (see text).

City/weather station	Latest Spring Frost	Earliest Fall Frost	City/weather station	Latest Spring Frost	Earliest Fall Frost	City/weather station	Latest Spring Frost	Earliest Fall Frost	City/weather station	Latest Spring Frost	Earliest Fall Frost
Eastern			Bluegrass			Central			Western		
Ashland	21-May	28-Sep	Bardstown	6-May	3-Oct	Barren River Lake	29-Apr	5-Oct	Bardwell	21-Apr	3-Oct
Barbourville	8-May	9-Oct	Berea College	29-Apr	6-Oct	Bowling Green	26-Apr	8-Oct	Beaver Dam	28-Apr	3-Oct
Baxter	6-May	9-Oct	Carrollton Lock	4-May	8-Oct	Bradfordsville	10-May	30-Sep	Gilbertsville	17-Apr	16-Oct
Grayson	17-May	28-Sep	Cincinnati/Covington	6-May	5-Oct	Cambellsville*	30-Apr	5-Oct	Golden Pond	18-Apr	11-Oct
Heidelberg	12-May	4-Oct	Covington	9-May	4-Oct	Glasgow	28-Apr	6-Oct	Henderson	20-Apr	7-Oct
Hyden	12-May	4-Oct	Cynthiana	8-May	6-Oct	Greensburg	2-May	6-Oct	Hopkinsville*	22-Apr	4-Oct
London Corbin Airport	7-May	1-Oct	Danville	26-Apr	13-Oct	Hodgenville-Lincoln	2-May	6-Oct	Lovelaceville	28-Apr	3-Oct
Manchester	17-May	25-Sep	Dix Dam	25-Apr	12-Oct	Jamestown	28-Apr	9-Oct	Madisonville	24-Apr	6-Oct
Middlesboro*	11-May	4-Oct	Falmouth*	10-May	24-Sep	Leitchfield	6-May	3-Oct	Mayfield	25-Apr	7-Oct
Monticello	6-May	3-Oct	Farmers 2 S	10-May	30-Sep	Louisville Airport	21-Apr	15-Oct	Murray	17-Apr	10-Oct
Mount Vernon	10-May	3-Oct	Frankfort (Lock 4)	3-May	6-Oct	Berheim Forest	12-May	2-Oct	Owensboro*	23-Apr	5-Oct
Somerset	7-May	2-Oct	Lexington (Blue Grass Airport)	28-Apr	10-Oct	Mammoth Cave	10-May	1-Oct	Paducah (Barkley Regional Airport)	21-Apr	9-Oct
Stearns	12-May	29-Sep	Mount Sterling	5-May	9-Oct	Nolin River Lake	13-May	29-Sep	Princeton	25-Apr	6-Oct
West Liberty	22-May	25-Sep	Maysville Sewage Plant	7-May	7-Oct	Rough River Lake	11-May	26-Sep	Rochester Ferry	24-Apr	5-Oct
Williamsburg	8-May	5-Oct	Shelbyville	14-May	22-Sep	Scottsville	19-Apr	11-Oct	Russellville	26-Apr	6-Oct
			Warsaw Markland Dam	9-May	3-Oct	Summer Shade	6-May	4-Oct			
			Williamstown	26-Apr	6-Oct						

*Weather station had missing data and dates were estimated using data from surrounding stations.

Disinfection and Treatment of Vegetable Seeds

Hot Water Treatment (most vegetable seeds)

Seeds many vegetables can be soaked in hot water to reduce populations of seedborne bacteria and fungi. Germination may be reduced to some degree, so some experimentation with small seed lots should be carried out before treating large amounts of seed. *Cucurbits other than cucumber may be severely harmed by hot water treatment* and should be disinfected by other methods. In general, use fresh seed for this process, as research indicates that viability of older seed (more than 1 year old) is drastically reduced by treatment with hot water. Bacterial and fungal pathogens associated with the embryo will not be affected by hot water soaking (bacterial canker of tomato, for example, can infect the embryo of the tomato seed along with being associated with the seed coat), nor will TMV be eradicated.

Water temperature and soaking time differ by species (Table 1), and relatively tight control of temperature is critical to the success of this method. A water bath capable of holding temperature within a reasonable range is a required piece of equipment, along with a quality canning thermometer to monitor temperature. A 5-degree drop in ideal temperature may allow some pathogens to survive on seed, while a 5-degree increase in water temperature may kill some or all of the seed being treated. The same rigor should be observed for soaking time.

Guidelines published by the University of Illinois suggest that seed should be pre-warmed before beginning the actual hot water treatment. This can be done by placing seed in a weighted cheesecloth bag and soaking in 100°F water for 10 minutes. The bag may need to be squeezed to remove air bubbles—*maximum contact of water and seed is critical*.

For the next step, place the bag containing the pre-warmed seed into a water bath set to the temperature recommended for the vegetable seed being treated (Table 1). Water volume should be 5-10 times greater than the volume of seed being treated. For example, if you were treating approximately one cup of tomato seed, the capacity of the water bath should be 5-10 cups. Agitation of the water during the treatment cycle will help maintain a uniform temperature in the water bath. After the prescribed amount of time, remove seed and spread on paper towels to dry. A recommended seed treatment can then be applied to protect against soilborne pathogens.

Treatment of crops other than those listed may cause serious injury to seed.

Table 1. Recommended temperatures and soaking times for hot-water disinfection of selected vegetable seeds.

Vegetable Crop	Water Temp. (°F)	Soaking Time (min.)
Broccoli	122	20-25
Brussels sprout	122	25
Cabbage	122	25
Carrot	122	15-20
Cauliflower	122	20
Celery	122	25
Chinese cabbage	122	20
Collard	122	20
Cucumber	122	20
Eggplant	122	25
Garlic	120	20
Kale, Kohlrabi	122	20
Lettuce	118	30
Mint	112	10
Mustard, Cress, Radish	122	15
Onion (sets)	115	60
Pepper	125	30
Rape, Rutabaga	122	20
Shallot	115	60
Spinach	122	25
Sweetpotato (roots)	115	65
Sweetpotato (cuttings, sprouts)	120	10
Tomato	122	25
Turnip	122	20

Chlorine Bleach Treatment

Soaking seed in a solution of chlorine bleach has been shown to be effective in eradicating pathogens primarily borne on the surface of the seed, such as the bacteria that cause bacterial spot, speck, and canker of tomato. It is also reported that this method can also provide some control of seed-transmitted TMV. The soaking solution should be prepared by adding 1 quart of commercial bleach (sodium hypochlorite) to 3-4 quarts of water. Add a drop or two of dish detergent to decrease surface tension of the solution. Soak seed in solution for 1 minute, remove and rinse thoroughly with clean water. Spread seed on paper towels to dry. Seed can be treated with a recommended fungicide to protect against soilborne pathogens.

Trisodium Phosphate (TSP)

Tomato seed can be soaked in a 10% solution of TSP for 15 minutes to eradicate seed-transmitted TMV. Remove seeds, rinse, and spread evenly on paper towels to dry. Treat with approved fungicides if needed. Most home supply and paint stores carry TSP, which is used to clean walls and surfaces prior to painting and staining. As with the other methods, it is advisable to test this process on small batches of seed at first to make sure that there are no negative effects on germination.

Pesticide Emergency Telephone Numbers

Pesticide Spills

If you have a pesticide spill and need information on how to handle this type of emergency, call:

911

and

Kentucky Environmental Response Team

(800) 928-2380

or

(502) 564-2380

CHEMTREC Pesticide Emergency Hotline (24 hour)

(800) 424-9300

Pesticide Exposures

If someone has been exposed to a particular pesticide, provide the physician with the following emergency number, which is designed to provide pharmacological information on pesticides to health professionals.

Kentucky Regional Poison Center

(800) 222-1222

In Metro Louisville, call:

(502) 589-8222

National Pesticide Information Center

(800) 858-7378

Provides general and scientific information on pesticides. This center operates seven days a week from 6:30 am to 4:30 pm Pacific Time excluding some holidays.