

# Vining Crops (Cucurbits)

Cucumbers, Muskmelons, Squash, Pumpkins, and 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, metribuzin, or Karmex.

For hand-harvested pickling or slicing cucumbers, train vines to run lengthwise in the row soon after vining starts. 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 quickly, 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 with which you may be contracting. Continued plantings at one- or two-week intervals can be made to extend the harvest season (see Appendix J).

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 two to three 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 pounds of seed is sufficient to direct-seed an acre; one quarter to one half of a pound per acre is sufficient for transplants. Plant the seed one-half to three-quarters of an inch deep after danger of frost is past (see Appendix J).

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 one or two 72-128 cell plug trays.

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 imidacloprid has provided good early season systemic control of cucumber beetles on melons in Kentucky, reducing 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 imidacloprid 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 the "Insect Control" table and current label for recommended rates). Imidacloprid should not be used in the setter tank water because of the potential for worker exposure during transplanting.

## 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 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 Control" and "Insect Control" tables) 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 melons need slightly wider plant spacing; see "Plant Spacing" (page 111). Some specialty melons, especially galia melons, are prone to magnesium deficiencies, and preventive measures may be required (see page 112). 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 the "Varieties" 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 has been applied per acre. To help avoid soilborne 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 Appendix J). Growers usually harvest pumpkins in mid-September to allow time for marketing.

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 practice can eliminate the need for washing pumpkins prior to marketing, may reduce fruit rots, and makes for an easier/cleaner field for schoolchildren or "pumpkin festival" customers to walk in. 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.

**VARIETIES: Cucumbers**

Variety	Days to Maturity	Comments
<b>SLICING</b>		
Intimidator	53	Early variety, CMV,scab, and angular leaf spot, Good for early and late production, smooth fruit.
Speedway	56	Early variety with CMV, powdery mildew, scab, anthracnose, and angular leaf spot tolerance.
Indy	59	Resistant or tolerant to anthracnose, angular leaf spot, powdery mildew, scab, CMV, WMV, ZYMV. All female flowering.
Cobra	60	Dark green, PRV, ZYMV, CMV, scab, anthracnose, angular leaf spot, powdery and downy mildew, good late season due to virus resistance.
Daytona	67	Dark green, ZYMV, PRV, WMV tolerant; powdery mildew, angular leaf spot, anthracnose, and scab tolerant.
Turbo	67	Small seed cavity; tolerant to CMV, downy and powdery mildew, angular leaf spot, anthracnose, and scab. All female flowering.
Marketmore 76 (open-pollinated)	67	Scab and CMV resistant, for local market or home gardens, not for commercial production.
<b>PICKLING</b>		
Calypso	52	Tolerant to scab, anthracnose, powdery and downy mildew, and CMV.

**VARIETIES: Melons**

Variety	Days to Maturity	Use	Quality <sup>3</sup>	Comments
<b>EASTERN CANTALOUPE<sup>1</sup></b>				
Lil' Loupe	76	Local	E	2.3 lb round, very small, excellent quality personal sized cantaloupe for specialty retail sales. Tolerant to powdery mildew race 1, 2 and Fusarium race 0, 2.
Minerva	77	Local, shipping	E	7 to 8 lb round to oblong with deeper sutures than Athena and heavy netting. Resistance to powdery mildew and Fusarium races 0, 1 and 2.
Athena	78	Local, shipping	E	Market standard, 5 to 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.
Aphrodite	80	Local, shipping	E	6 to 8 lb; earlier, larger Athena type, resistance to powdery mildew 1, 2 and Fusarium race 0, 1, 2.
Wrangler	80-85	Local	E	4 to 5 lb small Tuscan type cantaloupe with dark green sutures, medium net, excellent flavor, Fusarium race 0, 1, 2 and powdery mildew resistance.
Atlantis	82	Local, limited shipping	E	6 to 8 lb refined net, shallow sutures, high sugar, smooth firm deep orange flesh, powdery mildew race 1, 2 and Fusarium race 0,1,2 resistance.
Orange Sherbet	83	Local	E	6 to 8 lb; very large oval densely netted with shallow sutures, resistance to powdery mildew race 2 and Fusarium race 1, 2.
Majus	83	Local	E	6 to 8 lb netted tuscan type with deep sutures. Resistance to powdery mildew 1, 2, and 3, Fusarium wilt 1, 2, 5.
Tirreno	83	Local	E	4 to 6 lb netted tuscan type with deep sutures. Similar to Majus but smaller. Resistance to powdery mildew 1, 2, and 3, Fusarium wilt 1, 2, 5.
Eclipse	85	Local, shipping	E	5 to 8 lb oval shaped with slight sutures, medium net, good shelf life, powdery mildew and Fusarium wilt race 2 tolerant.
<b>SPECIALTY MELONS<sup>2</sup></b>				
Honey Yellow	75	Local	E	2 to 2.5 lb honeydew, bright yellow skin, orange flesh, excellent sugar content and flavor.
Honey Orange	80	Local	VG	4 to 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.
Honey Brew	90	Local	E	4 to 6 lb honeydew, green flesh, excellent flavor; Fusarium, downy mildew and powdery mildew resistance.
Summer Dew	90	Local	E	4 to 6 lb honeydew, green flesh, excellent flavor; Fusarium 0, 2 and powdery mildew 1,2 resistance.
Sugar Nut	77	Local	E	3 to 4 lb canary melon; cream to lt. green flesh, exterior bright yellow with some checking; harvest when bright yellow.
Camposol	80	Local	E	5 to 6 lb canary melon; bright yellow exterior; cream colored flesh; very sweet, excellent quality and shelf life, harvest when rind is bright yellow, powdery mildew resistance.
Dorado	85	Local, shipping	E	5 to 6 lb canary melon; bright yellow exterior; cream colored flesh; very sweet, excellent quality and shelf life, harvest when rind is golden.
Sancho	90	Local	E	6.5 to 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 to 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 to 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 to 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.
Tasty Bites	75-80	Local	E	2.8 lb charentais X ananas cross, fully netted cantaloupe exterior, orange crunchy flesh with a nice after taste, harvest at slip.

<sup>1</sup> Current market demand for Kentucky is for a 5- to 7-lb eastern type cantaloupe with a firm, deeply sutured, coarse netted rind and a thick, uniformly deep-orange flesh.

<sup>2</sup> All specialty melons in this category are highly susceptible to bacterial wilt; post-transplant drench applications of Admire insecticide(see text) together with a good preventative spray program for anthracnose control are highly recommended.

<sup>3</sup> VG: Very Good; E: Excellent; O: Outstanding.

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 J). 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).

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 72-128 cell trays two to three 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 should not be grown on the same ground year after year because of disease problems; they 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 transplanted to the field. This method must be used for seedless watermelons due to their high seed costs and poor germination percentages. If this procedure is followed, the seed should be planted 14 to 21 days before planting to the field (see Appendix J). 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

### VARIETIES: Squash, Pumpkins, Gourds

Variety	Days to Maturity	Comments
<b>SQUASH</b>		
<b>Straightneck</b>		
Fortune	39	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.
XPT 1832	42	Precocious yellow trait (py) masks virus symptoms on fruit, Genetically engineered resistant for 3 viruses (CMV, WMV, ZYMV)
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.
<b>Crookneck</b>		
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.
Gentry	43	Semi-crook; reduced spines, green stems; open bush plant.
<b>Zucchini</b>		
Dividend	47	Medium green, cylindrical, some with slight curve; tolerant to some strains of WMV, CMV, ZYMV.
Tigress	45	Cylindrical, slightly tapered; attractive medium to dark green; tolerant to WMV, ZYMV.
Wildcat	45	Intermediate resistance to powdery mildew, PRSV, ZYMV
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.
Payroll	45	Attractive medium green fruit; virus tolerant.
Spineless Beauty	50	Fruits similar to Zucchini Elite.
<b>Other Summer Squashes</b>		
Papaya Pear	45	Yellow pear shaped squash, 3.5 inches, AAS winner
Sunburst	50	Bright yellow scalloped, AAS winner.
Patty Pan	54	White scalloped; plants compact bush type.
<b>Acorn</b>		
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.
Honey Bear	85	1 to 1.25 lb fruit, excellent taste, AAS winner.
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.
<b>Ornamental Acorn</b>		
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.

(continued on next page)

**VARIETIES: Squash, Pumpkins, Gourds (continued)**

Variety	Days to Maturity	Comments
<b>Butternut</b>		
Butterboy	80	Very uniform, and early, slightly smaller than others.
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.
<b>Buttercup/Kabocha</b>		
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).
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).
<b>Spaghetti</b>		
Small Wonder	70	2 to 2.5 lb; yellow exterior; large vine
Vegetable Spaghetti	100-105	Large 4 lb fruit, vigorous vine.
<b>Miscellaneous Squash</b>		
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.
<b>PUMPKINS</b>		
<b>Extra Large</b>		
Atlantic Giant	120	Pink-orange color, world record over 1,000 lb.
Prize Winner	120	50 to 200 lb, orange, attractive; very large with good shape and color for extra large pumpkins, limit to 1 fruit per vine to get maximum size.
Full Moon	120	White color, 60 to 90 lb fruit, 36 x 24 inches.
<b>Large (15-35 lb)</b>		
Big Autumn	90	Variable sized fruit about 13 lb, high yielding; 10-inch diameter, strong handles, dark green with an orange base, deep orange, very smooth, deeply ribbed.
New Moon	90	30 to 35 lb, white fruit, full vine, heavy fruit, good med-large white pumpkin.
Gold Bullion	100	18 lb, dark orange, excellent yields, handles and color, semi bush.
Mustang	100	15 to 18 lb, 10 x 12 inches, excellent powdery mildew resistance, strong handle, light orange color.
Camaro	110	20 to 25 lb, round, excellent powdery mildew resistance, strong handles, light yellow/orange color.
Conestoga Giant	110	30 lb, dark orange, full vines, uniform, good stems.
Gold Medallion	110	Large fruited, 25 to 35 lb, large vine.
Aladdin	115	25 lb, deep orange, good yield potential, nice stems.
Magic Wand	115	15 to 25 lb, dark orange, similar to Magic Lantern with improved handles and a higher powdery mildew tolerance.
Warlock	115	20 lb, dark orange, strong handle, semi-hardshell, can be warty, excellent powdery mildew resistance, not a heavy pumpkin if selling by weight.
Gladiator	115	18 to 28 lb, deep orange, good handles and excellent powdery mildew tolerance, one of the best, good for roadside sales.
Super Herc	115	20 to 35 lb, powdery mildew tolerant, great handle.
Magic Lantern	115	15 to 22 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.
Buckskin	115	12 to 18 lb, 7x10 inches, attractive, looks like a large buff colored acorn, large vine, pretty not a jack-o-lantern.
Wolf	120	15 to 20 pound, full aggressive vines, unusually large stems, for roadside sales.
<b>Medium (5-10 lb)</b>		
Schooltime	82	8 to 10 lb, slightly flat to round, compact vines, semi-bush.
Magician	90	10 to 15 lb, dark orange, round to tall, powdery mildew tolerant.
Pick A Pie	85	5 to 6 lb, dark orange pie pumpkin with large dark green handles, uniform fruit, semi-bush.
Hybrid Pam	90	5 to 7 lb, deep orange.
Cotton Candy	105	6 to 10 lb, white pumpkin, full vine
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.
<b>Miniature (5 oz-4 lb)</b>		
Cannonball	90	3 to 5 lb, orange to dark orange, round, smooth, long shelf life, solid pumpkin, 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.
Rockafellow	95	2.5 to 3.5 lb, bottom heavy and tall with long handle, 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' Ironsides	115	2 lb, 6 inch diameter, tough, hard, dark orange shell that is not carveable, strong stem, large vine, long shelf life.
<b>ORNAMENTAL GOURDS</b>		
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.

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 that watermelon plants have deep root systems.

Good weed control is essential for high-quality melons. Melon yields and sugar

content 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.

### Special Considerations for Seedless (Triploid) 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 un-

### VARIETIES: Watermelon

Variety	Days to Maturity	Size (lb)	Comments <sup>1</sup>
<b>SEEDED</b>			
Tiger Baby	80	10-12	Excellent quality, firm flesh, small seeds; resistant to Fusarium race 1.
Sangria	83	20-25	Crimson Sweet rind; elongated; outstanding flavor; fruit blossom end may taper with drought; tolerant to Fusarium race 1 and anthracnose
Royal Star	84	21-26	Royal Sweet rind; blocky oblong fruit; good for shipping; excellent flavor; tolerant to Fusarium
Crimson Sweet	85	15-25	Dark and light green striped, blocky fruit; bright red tender sweet flesh; tolerant to Fusarium wilt and anthracnose.
Starbrite	85	21-29	Royal Sweet rind; elongated; very sweet and high yielding; resistant to Fusarium race 1 and anthracnose
Royalty	85	22-26	Royal Sweet rind; thin rind; excellent eating quality; high yields
Stars N' Stripes	85	22-31	Crimson Sweet rind; elongated; very sweet; high yielding; resistant to Fusarium race 1 and anthracnose
Star Gazer	85	24-28	Allsweet rind, elongated; excellent quality; uniform; resistance to Fusarium and anthracnose
Royal Sweet	85	20-24	Oblong; bright red flesh, small dark seeds; vigorous, resistant to Fusarium—shipper
All Sweet	90	25-30	Medium green thin stripes; elongated oval; high sugar content
<b>SEEDLESS</b>			
Fascination	83	16-20	Crimson Sweet rind; firm red flesh with good taste; good yield; resistance to Fusarium
Sweet Gem	79	13-16	Black rind; deep red firm flesh
Harvest Moon	90	8-13	Dark green rind with yellow spots. Seedless version of Moon and Stars. Excellent quality and because of the unique appearance it is well suited to farm markets and local production
Captivation	89	14-17	Crimson Sweet rind with blocky shape. Deep red flesh color of good quality with high yields.
Maxima	90	19-22	Allsweet rind pattern. Oval fruit with crisp red flesh.
Unbridled	85	18-22	Allsweet rind pattern. Round fruit with crisp red flesh.
Troubadour	87	14-17	Allsweet rind; deep red flesh color of good quality; good yield
Treasure Chest	77	9-15	Jubilee rind; bright yellow flesh color; excellent quality
Sugar Red	85	16-18	Crimson Sweet rind; vibrant red firm flesh of good quality; good yield
Indiana	76	13-15	Jubilee rind, dark background; round to oval; attractive interior; resistance to Fusarium races 0 and 1 and anthracnose races 1 and 3
Revolution	82	16	Royal Sweet rind; elongated; bright red flesh; outstanding flavor; hollow heart tolerant
Harmony	84	15-18	Crimson Sweet rind, oval; very sweet, crisp, bright red flesh
Orange Sweet	84	15-25	Jubilee rind; round; attractive orange flesh
Ruby	85	14	Medium green dark double striped rind, oval; excellent dark red firm flesh; hollow heart tolerant
Cooperstown	85	16-22	Crimson Sweet rind; round; excellent bright red interior
Crunchy Red	90	15	Crimson Sweet rind; dark pink flesh, blocky-round shape
<b>MINI-SEEDLESS</b>			
Solitaire	85	6-9	Royal Sweet rind; round, attractive; very tough rind; very firm pink flesh
Petite Perfection	77	5-7	medium green striped. Good quality and high yield.
Poquito	90	3-5	Crimson Sweet rind; round; red flesh; excellent flavor
<b>POLLINIZER<sup>2</sup></b>			
Ace			Long vine, low growing, brittle fruit; susceptible to Fusarium and anthracnose
Pollen Pro			vigorous non-competing lacy vines with non-harvestable fruit
Sidekick			Blooms very early; long vine; slightly more erect; small fruit.
SP-5			Small fruit; distinct delicate vines with deeply lobed leaves; moderate resistance to Fusarium
SP-6			Similar appearance to SP-5; hardier transplants under cool conditions; moderate resistance to Fusarium
Accomplice			Bushy upright habit; consistent male flower production; hardy under early season cool conditions; moderate resistance to Fusarium

<sup>1</sup> 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.

<sup>2</sup> Pollinizers are used with seedless melons and planted in-row allowing for seedless melons to be grown in the entire field.

til 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 pollenizer, which can be a traditional seeded variety or a special pollenizer melon 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 2 to 3 seedless plants to one seeded (used as pollenizer) is recommended. Pollenizer varieties can be planted on the edge of beds between the third and fourth seedless plant. When using a seeded melon as a pollenizer which will be harvested, outside rows and every third row in the field should be planted with the seeded variety. Never plant seedless and seeded (pollenizer) varieties in separate adjacent blocks in the field.
- Specific pollenizer varieties generally flower earlier and longer than typical seeded melons. When using a seeded melon as the pollenizer use a main-season variety. Early or late varieties may not provide pollen during the entire season, thus reducing fruit set.
- Specific pollenizer melons will be easily distinguished from your crop. Pollenizer varieties will produce small softball-size melons that are not harvested and easily crushed in the field. When using a diploid (seeded) variety as a pollenizer be sure that it is distinguished by shape or color from the seedless melons at harvest and one that is marketable, as it will make up about one third of your total production.
- Specific pollenizer varieties generally flower earlier than the seedless melons they are planted with. However, when using a traditional seeded melon as a pollenizer it should be seeded in the greenhouse one to two weeks earlier than the seedless variety. This schedule ensures good pollination when the seed-

less 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.

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.

### **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.

### **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 pounds 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 three to four 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 pounds 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 plas-

tic mulch, rows should be 5 to 6 feet apart, with plants thinned to hills 2 to 3 feet apart in the row and 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 two to three seeds every 18 to 24 inches apart in rows 4 to 6 feet apart. Seed should be planted 1 inch deep.

### **Pumpkins and Winter Squash**

Final plant stands for extra large varieties should be 3 to 4 feet apart in the row with rows 8 to 12 feet apart (24 to 48 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. Many seed companies publish charts for appropriate plant spacing for the varieties that they sell.

### **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 pounds. 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 "Fer-

tigation" 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, muskmelons 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 B 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 1/2 of the total N recommendation before laying plastic. The remaining nitrogen can be divided into equal weekly doses and fertigated as indicated in the "Fertigation" table.

**Magnesium deficiencies.** Muskmelons have high magnesium requirements. 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 pounds 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 pounds actual magnesium per acre (10 to 20 pounds per acre epsom salts or 2 to 4 pounds per acre magnesium oxide). Application rates may vary with solubility of the materials (check with the manufacturer). Foliar ap-

### FERTILIZER: *Vining Crops*

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)			
Phosphorus		Phosphate (P <sub>2</sub> O <sub>5</sub> )			
		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
Potassium		Potash (K <sub>2</sub> O)			
		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

**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 the "Fertigation" table (page 113) for slicing cucumbers grown on plastic mulch with drip irrigation.

**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 (page 113) for fertigating nitrogen.

**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.

**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 the "Fertigation" table, page 113).

**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 the "Fertigation" table, page 113).

plications 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 ounces actual molybdenum per gallon. Apply no more than 12 ounces actual molybdenum during a five-year period on the same field.

### Pumpkins and Squash

Pumpkins and squash 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 pounds of nitrogen per acre prior to planting crops to be grown on plastic with drip irrigation. See the "Fertilizer" table for 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 two 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.

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 calcium nitrate or potassium 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" table.

### 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 gynoecious hybrid varieties grown for once-over mechanical harvesting. Low bee populations result in low fruit set and poor fruit shape.

#### Muskmelons

Muskmelon have both male and perfect flowers on the same plant. However, the perfect flowers are not capable of self-pollination and must receive pollen from male flowers. 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,

### FERTIGATION: *Vining Crops*<sup>1</sup>

<b>CUCUMBERS</b>		Total amount/season: 120 lb/A
Actual N/week: 7 lb 12 oz/A		Preplant amount: 50 lb/A
Calcium 50 lb/A		Fertigated amount: 70 lb/A
Nitrate 2 lb 6 oz/1,000 plants		Growing season: 9 weeks
		Fertigation should begin about 2 weeks after seedling emergence or two weeks after transplanting.
		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.
<b>MUSKMELONS, SPECIALTY MELONS</b>		Total amount/season: 120 lb/A
Actual N/week: 8 lb 12 oz/A		Preplant amount: 50 lb/A
Calcium 56 lb 7 oz/A		Fertigated amount: 70 lb/A
Nitrate 15 lb 9 oz/1,000 plants		Growing season: 8 weeks
		Fertigation begins about two weeks after transplanting or when vines begin to "run."
		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 2 feet 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.
<b>SQUASH</b>		Total amount/season: 100 lb/A (moderate rate)
<b>Moderate Rate</b>		125 lb/A (high rate)
Actual N/week: 5 lb/A		Preplant amount: 50 lb/A
Calcium 32 lb/A		Fertigated amount: 50 lb/A (moderate rate)
Nitrate 7 lb/1,000 plants		75 lb/A (high rate)
		Growing season: 10 weeks
		Fertigation can begin 14 days after transplanting.
		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 inches apart in the rows).
		For seasons extending beyond 10 weeks a maintenance dose of 1 to 1.5 lb N/week is adequate.
<b>High Rate</b>		
Actual N/week: 7 lb 8 oz/A		
Calcium 48 lb/A		
Nitrate 10 lb/1,000 plants		
<b>WATERMELONS</b>		Total amount/season: 120 lb/A
Actual N/week: 5 lb/A		Preplant amount: 60 lb/A
Calcium 32 lb 4 oz/A		Fertigated amount: 60 lb/A
Nitrate 17 lb 12 oz/1,000 plants		Growing season: 12 weeks
		Fertigation begins about 2 weeks after transplanting or when vines begin to "run."
		Standard melons: The doses for 1,000 plants are based on plant populations of 1,815 plants/A (i.e., beds on 8 foot centers with single plants 3 feet apart in the rows).
		Icebox melons: The doses for 1,000 plants are based on plant populations of 3,630 plants/A (beds on 6 foot centers and plants 2 feet apart in rows).
		For seasons extending beyond 12 weeks, a maintenance dose of 1 to 1.5 lb N/week is adequate.
<b>Icebox Types</b>		
Actual N/week: 5 lb/A		
Calcium 32 lb 4 oz/A		
Nitrate 8 lb 14 oz/1,000 plants		

<sup>1</sup> All recommendations assume starter fertilizer was used.

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 ½ bushel waxed cartons. Fancy cucumbers should be 2 ¾ 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 “¼ slip” to “half slip” (only ¼ to ½ of the end of the vine detaches from the fruit when gently pulled). In some 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

#### PESTICIDE SAFETY: *Vining Crops*

	Signal <sup>1</sup>	Re-entry (hrs)	Harvest (days)	NOT Approved for Use on:			
				Cucumber	Melons	Squash/ Pumpkin	Watermelon
<b>INSECTICIDES</b>							
Acramite 50 WS	C	12	3				
Actara 25 W	C	12	0				
Admire Pro	C	12	21				
Assail 30 SG	C	12	0				
Avaunt 30 DG	C	12	3				
Belay 2.13 Sc	C	12	21				
Beleaf 50 SG	C	12	0				
Belt SC	C	12	1				
Closer 2 SC	C	12	1				
Coragen 1.67 SC	-	4	1				
Courier 40 SC	W	12	7				
Dicofol 4 E	C	12	2		X		X
Dimethoate 4 E	W	48	3	X		X	X
Entrust 2 SC	C	4	3				
Exirel 0.83 SE	C	12	1				
Fulfill 50 DF	C	12	0				
Intrepid 2 F	C	4	3				
Kanemite 15 SC	C	12	1			X	
Knack 0.86 EC	C	12	7				
Malathion 8	C	24	1		X		X
Oberon 2 SC	C	12	7				
Platinum 2 SC	C	12	30				
Portal 0.4 EC	W	12	3			X	
Radiant SC	C	4	1/3 <sup>4</sup>				
Requiem 25 EC	C	4	0				
Rimon 0.83 EC	W	12	1				
Scorpion 35 SL	C	12	1/21 <sup>4</sup>				
Sevin XLR	C	12	3				
Sivanto 1.67 SL	DC	12	1/21 <sup>4</sup>				
Trigard 75 WP	C	12	0				
Venom 70 SG	C	12	1/21 <sup>4</sup>				
Zeal 72 WP	C	12	7				
<b>Restricted Use</b>							
AgriMek 0.15 EC	W	12	7				
Asana XL	W	12	3				
Baythroid XL	W	12	0				
Brigade 2 EC	W	12	3				
Danitol 2.4 EC	W	24	7				
Decis 1.5 EC	DP	12	3				
Diazinon AG500	C	24	3	X		X	
Diazinon 50 W	C	24	3	X		X	
Hero 1.24 EC	C	12	3				
Lannate 90 SP	DP	48	1/3 <sup>4</sup>				
Mustang Max	W	12	1				
Permethrin 3.2 EC	C	12	0				
Renounce 20 WP	C	12	0				
Vydate 2 L	DP	48	1				
Warrior II	W	24	1				

#### PESTICIDE SAFETY: *Vining Crops*

	Signal <sup>1</sup>	Re-entry (hrs)	Harvest (days)	NOT Approved for Use on:				
				Cucumber	Melons	Winter Squash/ Pumpkins	Summer Squash	Watermelon
<b>FUNGICIDES</b>								
Actigard 50 WG	C	12	0					
Aftershock	C	12	1					
Aliette WDG <sup>2</sup>	C	12	0.5					
Ariston	C	12	3					
Cabrio EG	C	12	0					
Chlorothalonil <sup>3</sup>	D	12	0					
Fixed coppers <sup>3</sup>	D	24/48	0					
Curzate 60 DF	W	12	3					
Endura	W	12	0					
Flint	C	12	0					
Fontelis	C	12	1					
Forum SC	C	12	0					
Gavel 75 DF	C	48	5					
Inspire Super	C	12	7					
Luna Experience	C	12	7					
Mancozeb <sup>3</sup>	C	24	5					
ManKocide	D	24	5					
MetaStar 2EC AG	W	48	0					
Presidio	C	12	2					
Pristine	C	12	0					
Previcur Flex	C	12	2					
Procure 50 WS	C	12	0					
Proline 480 SC	C	12	7					
Quadris	C	4	1					
Quadris Opti	W	12	1					
Quadris Top	C	12	1					
Quintec	C	12	3	X			X	
Ranman	C	12	0					
Rally 40 WSP	W	24	0					
Reason 500 SC	C	12	14					
Revus	C	4	0					
Ridomil Gold SL	C	48	0					
Ridomil Gold Bravo SC	W	48	0					
Ridomil Gold Copper	D	48	5					
Ridomil Gold MZ	C	48	5			X		
Sulfur <sup>3</sup>	C	24	0					
Switch 62.5 WG	C	12	1					
Tanos	C	12	3					
Tebuconazole <sup>3</sup>	C	12	7					
Thiophanate-methyl <sup>3</sup>	C	12	0					
Torino	C	4	0					
Ultra Flourish	W	48	0					
Vivando	C	12	0					
Zampro	C	12	0					
Zing!	C	12	0					

<sup>1</sup> W: Warning, C: Caution, D: Danger; P: Poison

<sup>2</sup> 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.

<sup>3</sup> Several formulations are marketed. See the general introduction for more details on fungicides.

<sup>4</sup> Dependent on application or cucurbit type, see label.

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 two to five 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 half-bushel (21 pounds) waxed cardboard cartons or 1 ½ (42 to 44 pounds) 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 [ams.usda.gov/AMSV1.0/freshmarketvegetablestandards](http://ams.usda.gov/AMSV1.0/freshmarketvegetablestandards). 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-pound 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

### SAMPLE FUNGICIDE PROGRAMS: *Vining Crops*

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

Weeks <sup>1</sup>	Cucumber	Melon	Squash	Pumpkin/ Winter Squash	Watermelon
1, 2	chlorothalonil or mancozeb	chlorothalonil or mancozeb	chlorothalonil or mancozeb	chlorothalonil or mancozeb	chlorothalonil or mancozeb
3	chlorothalonil or mancozeb	(flowering) mancozeb + copper	chlorothalonil or mancozeb	chlorothalonil or mancozeb	chlorothalonil or mancozeb
4	Pristine or Fontelis	Quadris, Cabrio, Pristine, or Fontelis	Pristine or Fontelis	Quadris, Cabrio, Quadris Top, or Inspire Super	(flowering) mancozeb + copper
5	chlorothalonil or mancozeb	chlorothalonil or mancozeb + copper	chlorothalonil or mancozeb	chlorothalonil	tebuconazole
6	Pristine or Fontelis	Quadris, Cabrio, Pristine, or Fontelis	Pristine or Fontelis	Quadris, Cabrio, Quadris Top, or Inspire Super	chlorothalonil or mancozeb + copper
7	chlorothalonil or mancozeb	chlorothalonil or mancozeb + copper	chlorothalonil or mancozeb	chlorothalonil	Fontelis, Luna Experience, Inspire Super, or tebuconazole
8	chlorothalonil or mancozeb	chlorothalonil or mancozeb + copper	chlorothalonil or mancozeb	Quadris, Cabrio, Quadris Top, or Inspire Super	mancozeb + copper
9, 10	-	-	-	chlorothalonil	-

<sup>1</sup> Weeks after transplanting.

**All:** Begin applications of Quadris/Cabrio/Pristine earlier if disease becomes severe. Tank-mix Quintec, Torino, or Rally 40 WSP if powdery mildew appears. **Cucumber:** Finish season with chlorothalonil or mancozeb. Include appropriate fungicides if downy mildew or *Phytophthora* blight becomes severe. **Melon/Watermelon:** Finish season with mancozeb. **Squash:** Include appropriate fungicides if downy mildew or *Phytophthora* blight becomes severe. **Pumpkin:** Finish season with chlorothalonil or mancozeb. Include appropriate fungicides if downy mildew or *Phytophthora* blight becomes severe.

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 three to four 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 two to four weeks before they are sold. Do not store on bare ground after harvest. Tobacco barns are usually a good place for storage. Spread out a layer of dry straw or hay and set the pumpkins on it. Keep them dry. 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 pumpkins often rot or decay long before they can be marketed. Some rot, caused by injury or seasonal stresses such as drought and/or heat, is unavoidable. 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 seven to 10 days at temperatures of 80° to 85°F with relative humidity of 80 to 85 percent has been recommended in the past to heal over surface injuries and allow for further ripening; however, this practice is seldom used, 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 six to eight weeks when held at 50° to 55°F but only for a few weeks at 70°F.

Ornamental pumpkins have virtually no value after Halloween. 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 soil and air drainage and those that have not been in cucurbits, tobacco, peppers, or tomatoes during the past two to three 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 and apply materials in a timely fashion. Chlorothalonil, mancozeb (Dithane DF, Manzate, and Penncozeb), and fixed coppers tend to be inexpensive relative to other materials and should form the “backbone” of a fungicide program. Maneb (Maneb, Manex) fungicides were pulled from the marketplace in 2010, and existing stocks cannot be used legally on cucurbits. 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 two to four years. Varieties vary in susceptibility, so consider using resistant varieties. Plant anthracnose-resistant varieties whenever possible. The sample spray program on page 115 will suppress most fungal diseases, starting no later than the first appearance of disease or when vines touch within the rows (or earlier if conditions favor disease).

### Angular leaf spot, bacterial leaf spots

[C/M/SP]. Use disease-free seed (hot water, acid, or bleach treatments; see Appendix H) and crop rotations of two to three 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. Repeated use of copper may cause leaf yellowing. 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]. This disease was found in Kentucky for the first time in 2011. Suspect plant samples should be sent to the UK 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).

**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.

**Cold injury** [C/M/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 or metalaxyl pre-plant or after seeding/transplanting. 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, proper N fertilization, 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 cucurbit crops. Fungicide programs aimed at other diseases of vining crops should suppress early introduction of 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 Cucurbit Downy Mildew Forecasting System ([cdm.ipmpipe.org/](http://cdm.ipmpipe.org/)) for updates on the status of downy mildew in the Commonwealth and neighboring states. If downy mildew appears prior to the start of the regular fungicide spray program, include newer fungicides such as Ranman, Zampro, or Tanos tank mixed with a protectant fungicide such as mancozeb or chlorothalonil. Materials such as Ridomil, Forum, Revus, Presidio, and strobilurins (Quadris and Cabrio) are not recommended for control of downy

mildew, as resistance to these chemistries has been reported in the U.S. Resistant or tolerant varieties are becoming available in summer squash and other cucurbits (see "Varieties" 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 16.) Control insects and diseases (especially powdery mildew) 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 three to five years will reduce pathogen populations in soil; however, rotation alone is not an adequate control. Failure to control root-knot nematode is often tied in to Fusarium wilt outbreaks. Fumigation of soil may also provide some benefit (see "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 16 for more information).

**Gummy stem blight** [C/M/SP/W]. Use disease-free seed or transplants. Rotations of two to three 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. Resistance to strobilurins (Quadris, Cabrio) and benzimidazoles (Topsin M, T-Methyl) is common in the southeastern United States, including Kentucky and therefore these fungicides are not recommended. Resistance to carboximide fungicides (Presidio, Endura, Fontelis) is commonplace in the southern U.S., but has not been found in Kentucky to date; use caution when applying these products. 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. Quadris, Quadris Top, Inspire Super, Cabrio EG, and Flint are specifically labeled for this disease.

**Ozone injury** [C/M/SP/W]. 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 three 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 available. 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, Rally) and strobilurins (Quadris, Cabrio, Flint) in many parts of the United States. Chlorothalonil applied in a weekly spray program for other diseases will slow powdery mildew development, and rotation or tank-mixes with Quintec, Vivando, or Rally is an excellent strategy for managing this disease.

Systemic products such as Rally and Procure give the added benefit of suppressing powdery mildew on lower leaf surfaces, areas where good spray coverage can be hard to achieve. Quintec can redistribute to untreated foliage by vapor action. If one fungicide is not effective, switch immediately to a new class of chemicals, and always follow resistance management guidelines where applicable.

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 tol-

erant muskmelon, summer squash, and pumpkin varieties are available. Excellent resistance is available in some cantaloupes, cucumber, squash, and pumpkin varieties (see "Varieties" tables).

**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 three years or more in problem fields. If resistance is not used, then fungicide sprays may be necessary in cool, wet weather. 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 two or more years is a highly effective control measure. See "Nematode Control" on page 15 for more information on nematodes. Preplant 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 Captan WP at 1 teaspoon per pound 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 Mosaic, and Zucchini Yellow 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 "Varieties" 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.

**INSECT CONTROL: Vining Crops<sup>1,2</sup>—Cucumber, Melon, Pumpkin, Squash, and Watermelon**

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
<b>PREPLANT INCORPORATED</b>			
<b>Wireworms, Cutworms:</b> Wireworms are a potential problem for crops following grass or legume-grass sod.			
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.
<b>SOIL TREATMENTS</b>			
<b>Aphids, Cucumber Beetles, Whiteflies</b>			
Admire Pro	7 to 10.5 fl oz	10.5 fl oz	See label for application methods.
Belay 2.13 SC	9 to 12 fl oz	12 fl oz	At planting only. See label for application methods.
Platinum 2 SC	5 to 11 fl oz	11 fl oz	See label for application methods.
Scorpion 35 SL	9 to 10.5 fl oz	21 fl oz	See label for application methods.
Sivanto 1.67 SL	21 to 28 fl oz		For aphids, leafhoppers and whiteflies.
Venom 70 SG	5 to 6 oz	12 oz	Allow 7 days between applications. Not for cucumber beetles or aphids.
<b>FOLIAR TREATMENTS</b>			
<b>Aphids</b>			
Actara 25 WDG	1.5 to 3 oz	11 oz	Allow 5 days between applications. Not during bloom.
Assail 30 SG	2.5 to 4 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 7 days between applications. Not during bloom.
Beleaf 50 SG	2 to 2.8 oz	8.4 oz	Limit 3 applications at the 2.8 oz/A rate. Allow 7 days between applications.
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Closer 2 SC	1.5 to 2 fl oz	17 fl oz	Allow 7 days between applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Fulfill 50 DF	2.75 oz	5.5 oz	Allow 7 days between applications.
Malathion 8	1.75 pt	2 applications	Allow 7 days between applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications. Do not combine with soil applications.
Sivanto 1.67 SL	7 to 12 fl oz	28 fl oz	Allow 7 days between applications.
Requiem 25 EC	2 to 3 qt	-	-
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 14 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications. Not during bloom.
<b>Cucumber Beetles:</b> 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.			
Asana XL	5.8 to 9.6 fl oz	48 fl oz	-
Assail 30 SG	2.5 to 5.3 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Battalion 1.5 EC	1.5 to 2.4 fl oz	14.4 fl oz	-
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 7 days between applications. Not during bloom.

(continued on next page)

**INSECT CONTROL: Vining Crops<sup>1,2</sup> (continued)**

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Danitol 2.4 EC	10.67 to 16 fl oz	42.67 fl oz	Allow 7 days between applications.
Mustang Max	1.28 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	64 fl oz	-
Sevin XLR	1 qt	6 applications	Allow 7 days between applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications. Do not combine with soil applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications. Not during bloom.
Warrior II	1.28 to 1.92 fl oz	11.5 fl oz	Allow 5 days between applications.
<b>Cutworms:</b> 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	48 fl oz	-
Battalion 1.5 EC	1 to 2.4 fl oz	14.4 fl oz	-
Belt 2 SC	1.5 fl oz	4.5 fl oz	Allow 7 days between applications.
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Mustang Max	1.28 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	64 fl oz	-
Warrior II	1.28 to 1.92 fl oz	11.5 fl oz	Allow 5 days between applications.
<b>Spider Mites:</b> Regular weed control around the outside perimeter of the field is very important.			
Acramite 50 WS	0.75 to 1 lb	1 application	-
AgriMek 0.15 EC	8 to 16 fl oz	48 fl oz	Allow 7 days between applications.
Brigade 2 EC	5.12 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications. For end of season control.
Danitol 2.4 EC	10.67 fl oz	42.67 fl oz	Allow 7 days between applications. For end of season control.
Miteus 0.42 EC	2 pt	4 pt	Limit 2 applications. Allow 14 days between applications.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Allow 7 days between sprays.
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications. Allow 14 days between applications.
Zeal	2 to 3 oz	1 application	-
<b>Squash Bug:</b> 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.			
Assail 30 SG	5.3 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Belay 2.13 SC	3 to 4 oz	12 oz	Allow 7 days between applications. Not during bloom.
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Mustang Max	1.28 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	64 fl oz	-
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 14 days between applications.
Sivanto 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications. Not during bloom.
Warrior II	1.28 to 1.92 fl oz	11.5 fl oz	Allow 5 days between applications.
<b>Squash Vine Borer:</b> 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.			
Asana XL	5.8 to 9.6 fl oz	48 fl oz	-
Assail 30 SG	5.3 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Belt 2 SC	1.5 fl oz	4.5 fl oz	Allow 7 days between applications.
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Mustang Max	1.28 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	64 fl oz	-
Warrior II	1.28 to 1.92 fl oz	11.5 fl oz	Allow 5 days between applications.
<b>Whiteflies</b>			
Actara 25 W	3 to 5.5 oz	11 oz	Allow 5 days between applications. Not during bloom.
Assail 30 SG	2.5 to 5.3 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Courier 40 SC	9 to 13.6 fl oz	2 applications	Allow 7 days between applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Knack 0.86 EC	8 to 10 fl oz	20 fl oz	Limit 2 applications. Allow 14 days between applications.
Miteus 0.42 EC	2 pt	4 pt	Limit 2 applications. Allow 14 days between applications.
Oberon 2 SC	7.0 to 8.5 fl oz	25.5 fl oz	Allow 7 days between sprays.
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications.
Requiem 25 EC	2 to 3 qt	-	-
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications. Do not combine with soil applications.
Sivanto 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications. Do not use following a soil application of Venom, Platinum, or Admire.

<sup>1</sup> See an IPM Scouting Guide for Common Problems of Cucurbit Crops in Kentucky (ID-91) for photos of pests.

<sup>2</sup> Generic products available (Appendix E).

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

Product Amt/A	Lb A.I./A	Comments
<i>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.</i>		
0.5-1.6 fl oz	0.008-0.025	For contact post-emergence 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 post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
Aim 1.9 EW	carfentrazone	

(continued on next page)

**WEED CONTROL: Vining Crops (continued)**

Product Amt/A	Lb A.I./A	Comments
0.4-1 pt Command 3ME	0.15-0.37 clomazone	Not labeled for gourd. For control of annual grasses and small-seeded broadleaves; poor 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. Label specifically states not to use on Jack-o-Lantern pumpkins due to unacceptable whitening. PHI = 45 days.
3-4.5 pt Curbit 3 E	1.13-1.5 ethalfuralin	Not labeled for gourd. For pre-emergence 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.
6-14 lb Dacthal W-75	4.5-10.5 DCPA	Not labeled for pumpkin and some gourds. For pre-emergence 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.
1.0-1.33 pt Dual Magnum	0.95-1.27 s-metolachlor	Pumpkin only. For pre-emergence control of select weed species. Leave at least 6 inches of untreated area on either side of hill or row and/or any pumpkin foliage. Direct contact with foliage will result in injury. PHI = 30 days.
2-4 pt Gramoxone Inteon	0.69-1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
0.5-1.5 pt Poast 1.5 E	0.09-0.27 sethoxydim	Not labeled for gourd. For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 14 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
5-6 qt Prefar 4 E	5-6 bensulide	For control of grasses and broadleaf weeds. Apply preplant and incorporate to 1 to 2 inch depth. Apply pre-emergence only if it can be watered in within 36 hours. Max. rate of 6 qt/season.
16-22 fl oz Roundup Weather- Max 5.5L	0.69-0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 3 days between application and planting and min. 30 days before planting any non-labeled crop.
0.5-1 oz Sandea 75 DF	0.023-0.047 halosulfuron	For control of broadleaf weeds and yellow nutsedge. 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. 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. Check label for crop specific applications.
9-16 fl oz Select Max	0.07-0.12 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 16 fl oz/application. Min. 14 days between applications. PHI = 14 days.
2-4 oz Sinbar 80 WP	0.1-0.2 terbacil	Watermelon only. For pre-emergence control of broadleaves and grasses. Apply after seeding but before watermelon emerges. For transplanted watermelons, apply pre-transplant. Sinbar may be used pre-emergence 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 inch rain prior to transplanting. PHI = 70 days.
3-6 pt Strategy 2.1E	0.6-1.18 ethalfuralin + 0.18-0.39 clomazone	Not labeled for gourd. For pre-emergence 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 to 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, pumpkins, and cucumbers unless otherwise indicated.

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

Product	FRAC Code <sup>1</sup>	PHI <sup>2</sup> (days)	Amt/A	Seasonal Limits/A	Comments
<b>Angular Leaf Spot, Bacterial Leaf Spots [C/M/SP]</b>					
Actigard	21	0	0.5 to 1 oz	16 oz	Begin applications before onset of disease; apply every 7 to 14 days. Apply in a minimum of 20 gal/A of water. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Fixed coppers					
Badge SC	M	0	1 to 2.5 pt	-	-
Badge X2	M	0	0.5 to 2.5 lb	-	OMRI-listed.
Basic Copper 53	M	0	2 lb	-	OMRI-listed.
C-O-C-S WDG	M	0	2 to 4 lb	-	-
Champ DP	M	0	1.33 lb	-	-
Champ Formula 2 FL	M	0	1.33 pt	-	-
Champ WG	M	0	1.5 to 3 lb	-	OMRI-listed.
COC DF	M	0	3 to 4 lb	-	-
COC WP	M	0	3 to 4 lb	-	OMRI-listed.
Copper-Count-N	M	0	3 to 4 pt	-	-
Cueva	M	0	0.5 to 2 gal	-	OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 2 lb	-	-
Kentan DF	M	0	1 to 2.62 lb	-	-
Kocide 2000	M	0	1 to 2.25 lb	-	-
Kocide 3000	M	0	0.5 to 1.25 lb	-	-
Kocide DF	M	0	1.5 to 3 lb	-	-
Mastercop	M	0	0.5 to 1 pt	-	-
Nordox 75 WG	M	0	1 to 1.25 lb	-	OMRI-listed.
Nu-Cop 50 WP	M	0	1.5 to 3 lb	-	OMRI-listed.
Nu-Cop 3 L	M	0	0.66 to 4 pt	-	-
Nu-Cop 50 DF	M	0	1.5 to 2 lb	-	OMRI-listed.
ManKocide2	M	5	2 to 2.5 lb	see footnote	Apply when disease appears and continue every 3 to 7 days as needed.
Tanos	11/27	3	8 to 10 oz	4 apps	Suppression of bacterial fruit blotch only. Tanos must be tank-mixed with a fungicide from FRAC Group M appropriate for the target disease. Apply prior to disease onset, continue every 5 to 7 days.

(continued on next page)

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

Product	FRAC Code <sup>1</sup>	PHI <sup>2</sup> (days)	Amt/A	Seasonal Limits/A	Comments
<b>Anthraco­nose and Alternaria Leaf Blight [C/M/SP/W], Cercospora Leaf Spot [C/M/W]</b>					
Aftershock	11	1	3.0 to 5.7 oz	4 apps	Apply before disease onset, continue every 7 to 14 days. Alternate with a fungicide outside FRAC group 11.
Ariston	M/27	3	1.9 - 3.0 pt	17.5 pt	Apply before disease onset, continue every 7 days. May sunburn mature watermelon.
Azoxystrobin <sup>4</sup>					Apply before disease onset, continue every 7 to 14 days.
Azoxy 25C	11	1	11 to 15.5 fl oz <sup>3</sup>	4 apps	
AzoxyStar	11	1	11 to 15.5 fl oz <sup>3</sup>	4 apps	
Quadris	11	1	11 to 15.5 fl oz <sup>3</sup>	4 apps	
Satori	11	1	11 to 15.5 fl oz <sup>3</sup>	4 apps	
Cabrio	11	0	12 to 16 oz <sup>5</sup>	4 apps	Apply before disease onset, continue every 7 to 14 days.
Chlorothalonil <sup>4</sup>					Apply before disease onset; continue every 7 days as needed.
Bravo Ultrex	M	0	1.4 to 2.7 lb	19.1 lb	
Bravo WeatherStik	M	0	1.5 to 3 pt	21 pt	
Endura	7	0	6.5 oz <sup>5</sup>	4 apps	Apply before disease onset, continue every 7 to 14 days.
Fixed coppers					Apply every 5 to 10 days beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	M	0	1 to 2.5 pt	-	
Badge X2	M	0	0.5 to 2.5 lb	-	OMRI-listed.
Basic Copper 53	M	0	2 lb	-	OMRI-listed.
C-O-C-S WDG	M	0	2 to 4 lb	-	
Champ DP	M	0	1.33 lb	-	
Champ Formula 2 FL	M	0	1.33 pt	-	
Champ WG	M	0	1.5 to 3 lb	-	OMRI-listed.
COC DF	M	0	3 to 4 lb	-	
COC WP	M	0	3 to 4 lb	-	OMRI-listed.
Copper-Count-N	M	0	3 to 4 pt	-	
Cueva	M	0	0.5 to 2 gal	-	OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 2 lb	-	
Kentan DF	M	0	1 to 2.62 lb	-	
Kocide 2000	M	0	1 to 2.25 lb	-	
Kocide 3000	M	0	0.5 to 1.25 lb	-	
Kocide DF	M	0	1.5 to 3 lb	-	
Mastercop	M	0	0.5 to 1 pt	-	
Nordox 75 WG	M	0	1 to 1.25 lb	-	OMRI-listed.
Nu-Cop 50 WP	M	0	1.5 to 3 lb	-	OMRI-listed.
Nu-Cop 3 L	M	0	0.66 to 4 pt	-	
Nu-Cop 50 DF	M	0	1.5 to 2 lb	-	OMRI-listed.
Nu-Cop 50 HB	M	0	0.75 to 1 lb	-	
Gavel 75 DF2	22/M	5	1.5 to 2 lb	8 apps	Apply when conditions favor disease and continue every 7 to 10 days.
Fontelis	7	1	12 to 16 fl oz	67 fl oz	Alternaria. Apply before disease onset, continue every 7 to 14 days.
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	Begin prior to disease onset, continue every 7 to 10 days.
Mancozeb <sup>3</sup>					Products include Dithane, Koverall, Manzate, Penncozeb.
Dry formulations	M	5	1.5 to 3 lb	24-25.6 lb	Apply before disease appears and continue every 4 to 7 days as needed.
Liquid formulations	M		1.2 to 2.4 qt	19.2 qt	
ManKocide <sup>3</sup>	M	5	2 to 2.5 lb	see footnote	Apply before disease onset, continue every 7 to 14 days. Limit 4 apps/season. Use highest rates for anthracnose.
Pristine	7/11	0	12.5 to 18.5 oz	4 apps	Apply before disease onset, continue every 10 to 14 days. Rotate to another mode of action between applications of RG Bravo. Observe seasonal limits for chlorothalonil.
Quadris Opti	11/M	1	3.2 pt	4 apps	Apply before disease onset, continue every 7 to 14 days.
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	Apply before disease onset, continue every 7 to 14 days.
Reason 500 SC	11	14	5.5 fl oz	4 apps	Alternaria leaf blight. Apply before disease onset, continue every 5 to 10 days. Limit 22 fl oz of Reason/A per season.
Ridomil Gold Bravo SC	4/M	0	2.5 to 3.25 pt	4 apps	-
Switch 62.5 WG	9/12	1	11 to 14 oz	56 oz	Alternaria leaf blight. Apply every 7 to 10 days.
Tanos	11/27	3	8 oz	4 apps	Tanos must be tank-mixed with a fungicide from FRAC Code M appropriate for the target disease. Apply before disease onset, continue every 5 to 7 days.
Thiophanate-methyl <sup>4</sup>					Anthracnose. Apply before disease onset, continue every 7 to 14 days.
Topsin 4.5 FL	1	0	10 fl oz	60 fl oz	
Topsin M 70 WP	1	0	0.5 lb	3 lb	
Topsin M WSB	1	0			
Zing!	M/22	0	36 fl oz	8 apps	Apply before disease onset and repeat every 7 to 10 days. Alternate with another FRAC code. May cause sunburn on watermelon.
<b>Bacterial Wilt [C/M/SP]:</b> No bactericides available. Control of insect vectors is the only recommended practice—refer to the “Insect Control” table.					
<b>Belly Rot, Fruit Rot (Rhizoctonia) [C]</b>					
Aftershock	11	1	3.0 to 5.7 oz	4 apps	Apply before disease onset, continue every 7 to 14 days. Alternate with a fungicide outside FRAC group 11.
Azoxystrobin <sup>4</sup>					Make first application at 1-3 leaf stage and second at vine tip-over or 14 days after the first application, whichever comes first.
Azoxy 25C	11	1	11 to 15.5 fl oz <sup>3</sup>	4 apps	
AzoxyStar	11	1	11 to 15.5 fl oz <sup>3</sup>	4 apps	
Quadris	11	1	11 to 15.5 fl oz <sup>3</sup>	4 apps	Make first application at 1-3 leaf stage and second at vine tip-over or 14 days after the first application, whichever comes first. Observe seasonal limits for chlorothalonil.
Quadris Opti	11/M	1	3.2 pt	4 apps	
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	
Satori	11	1	11 to 15.5 fl oz <sup>3</sup>	4 apps	-



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

Product	FRAC Code <sup>1</sup>	PHI <sup>2</sup> (days)	Amt/A	Seasonal Limits/A	Comments
<b>Thiophanate-methyl<sup>4</sup></b>					
Topsin 4.5 FL	1	0	10 fl oz	60 fl oz	Apply in sufficient volume to permit runoff to soil. Begin at vine-run and make a second application at fruit-set.
Topsin M 70 WP	1	0	0.5 lb	3 lb	
Topsin M WSB	1	0			
<b>Downy Mildew [C/M/SP/W]</b>					
Actigard	21	0	0.5 to 1 oz	16 oz	Begin applications before onset of disease; apply every 7 to 14 days. Apply in a minimum of 20 gal/A of water. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Aftershock	11	1	3.0 to 5.7 oz	4 apps	Apply before disease onset, continue every 7 to 14 days. Alternate with a fungicide outside FRAC group 11.
Aliette WDG <sup>6</sup>	33	0.5	2 to 5 lb	7 apps	Apply when conditions favor disease and continue every 7 to 14 days. Do not tank-mix with copper compounds.
Ariston	M/27	3	1.9 - 3.0 pt	17.5 pt	Apply before disease onset, continue every 7 days. May sunburn mature watermelon.
Cabrio	11	0	8 to 12 oz <sup>5</sup>	4 apps	Apply before disease onset, continue every 7 to 14 days.
<b>Chlorothalonil<sup>4</sup></b>					
Bravo Ultrex	M	0	1.4 to 1.8 lb	19.1 lb	Begin before disease onset; continue every 7 days as needed.
Bravo WeatherStik	M	0	1.5 to 2 pt	21 pt	
Curzate 60 DF	27	3	3.2 oz	9 apps	Must be tank-mixed with a fungicide from FRAC Code M. Apply before disease onset, continue every 5 to 7 days.
<b>Fixed coppers</b>					
Apply every 5 to 10 days beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.					
Badge SC	M	0	1 to 2.5 pt		-
Badge X2	M	0	0.5 to 2.5 lb		OMRI-listed.
Basic Copper 53	M	0	2 lb		OMRI-listed.
C-O-C-S WDG	M	0	2 to 4 lb		-
Champ DP	M	0	1.33 lb		-
Champ Formula 2 FL	M	0	1.33 pt		-
Champ WG	M	0	1.5 to 3 lb		OMRI-listed.
COC DF	M	0	3 to 4 lb		-
COC WP	M	0	3 to 4 lb		OMRI-listed.
Copper-Count-N	M	0	3 to 4 pt		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 2 lb		-
Kentan DF	M	0	1 to 2.62 lb		-
Kocide 2000	M	0	1 to 2.25 lb		-
Kocide 3000	M	0	0.5 to 1.25 lb		-
Kocide DF	M	0	1.5 to 3 lb		-
Mastercop	M	0	0.5 to 1 pt		-
Nordox 75 WG	M	0	1 to 1.25 lb		OMRI-listed.
Nu-Cop 50 WP	M	0	1.5 to 3 lb		OMRI-listed.
Nu-Cop 3 L	M	0	0.66 to 4 pt		-
Nu-Cop 50 DF	M	0	1.5 to 2 lb		OMRI-listed.
Nu-Cop 50 HB	M	0	0.75 to 1 lb		-
Flint	11	0	4 oz	4 apps	Apply before disease onset, continue every 7 to 14 days.
Gavel 75 DF2	22/M	5	1.5 to 2	8 apps	Apply when conditions favor disease and continue every 7 to 10 days.
<b>Mancozeb<sup>4</sup></b>					
Products include Dithane, Koverall, Manzate, Penncozeb.					
Dry formulations	M	5	1.5 to 3 lb	24-25.6 lb	Apply before disease appears and continue every 4 to 7 days as needed.
Liquid formulations	M		1.2 to 2.4 qt	19.2 qt	
ManKocide <sup>3</sup>	M	5	2 to 2.5	see footnote	Apply before disease appears and continue every 3 to 7 days as needed.
Presidio	43	2	3 to 4 fl oz	12 fl oz	Apply every 7 to 14 days. Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Previcur Flex	28	2	0.6 to 1.2 pt	6 pt	Apply prior to disease onset, continue every 7 to 14 days. Use low rate when tank-mixing with other downy mildew fungicides.
Quadris Opti	11/M	1	3.2 pt	4 apps	Apply before disease onset, continue every 7 to 14 days. Observe seasonal limits for chlorothalonil.
Ranman	21	0	2.1 to 2.75 fl oz	6 apps	Apply before disease onset, continue every 7 to 10 days. 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	11/27	3	8 oz	4 apps	Tanos must be tank-mixed with a fungicide from FRAC Code M appropriate for the target disease. Apply before disease onset, continue every 5 to 7 days.
Zampro	40/45	0	14 fl oz	3 apps	Apply before disease onset and repeat every 5 to 7 days.
Zing!	M/22	0	36 fl oz	8 apps	Apply before disease onset and repeat every 7 to 10 days. Alternate with another FRAC code. May cause sunburn on watermelon.
<b>Gummy Stem Blight (Black Rot) [C/M/SP/W]</b>					
Aftershock	11	1	3.0 to 5.7 oz	4 apps	Apply before disease onset, continue every 7 to 14 days. Alternate with a fungicide outside FRAC group 11.
Ariston	M/27	3	3.0 pt	17.5 pt	Apply before disease onset, continue every 7 days. May sunburn mature watermelon.
<b>Chlorothalonil<sup>4</sup></b>					
Bravo Ultrex	M	0	1.8 to 2.7 lb	19.1 lb	Begin before disease onset; continue every 7 days as needed.
Bravo WeatherStik	M	0	2 to 3 pt	21 pt	
Endura	7	0	6.5 oz <sup>5</sup>	4 apps	Apply before disease onset, continue every 7 to 14 days.

(continued on next page)

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

Product	FRAC Code <sup>1</sup>	PHI <sup>2</sup> (days)	Amt/A	Seasonal Limits/A	Comments
Fixed coppers					Apply every 5 to 10 days beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	M	0	1 to 2.5 pt		-
Badge X2	M	0	0.5 to 2.5 lb		OMRI-listed.
Basic Copper 53	M	0	2 lb		OMRI-listed.
C-O-C-S WDG	M	0	2 to 4 lb		-
Champ DP	M	0	1.33 lb		-
Champ Formula 2 FL	M	0	1.33 pt		-
Champ WG	M	0	1.5 to 3 lb		OMRI-listed.
COC DF	M	0	3 to 4 lb		-
COC WP	M	0	3 to 4 lb		OMRI-listed.
Copper-Count-N	M	0	3 to 4 pt		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 2 lb		-
Kentan DF	M	0	1 to 2.62 lb		-
Kocide 2000	M	0	1 to 2.25 lb		-
Kocide 3000	M	0	0.5 to 1.25 lb		-
Kocide DF	M	0	1.5 to 3 lb		-
Mastercop	M	0	0.5 to 1 pt		-
Nordox 75 WG	M	0	1 to 1.25 lb		OMRI-listed.
Nu-Cop 50 WP	M	0	1.5 to 3 lb		OMRI-listed.
Nu-Cop 3 L	M	0	0.66 to 4 pt		-
Nu-Cop 50 DF	M	0	1.5 to 2 lb		OMRI-listed.
Fontelis	7	1	12 to 16 fl oz	67 fl oz	Alternaria. Apply before disease onset, continue every 7 to 14 days.
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	Begin prior to disease onset, continue every 7 to 10 days.
Luna Experience	3/7	7	17 fl oz	34 fl oz	Watermelon only. Begin prior to disease onset, continue every 10 to 14 days.
Mancozeb <sup>4</sup>					Products include Dithane, Koverall, Manzate, Penncozeb.
Dry formulations	M	5	1.5 to 3 lb	24-25.6 lb	Apply before disease appears and continue every 7 to 10 days as needed.
Liquid formulations	M		1.2 to 2.4 qt	19.2 qt	
ManKocide2	M	5	2 to 2.5 lb	see footnote	Apply before disease appears and continue every 3 to 7 days as needed.
Pristine	7/11	0	12.5 to 18.5 oz <sup>5</sup>	4 apps	Apply before disease onset, continue every 7 to 14 days.
Proline 480SC	3	7	5.7 fl oz	17.1 fl oz	Maximum two foliar applications.
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	Apply before disease onset, continue every 7 to 14 days.
Ridomil Gold Bravo	4/M	0	2 to 3 lb	4 apps	Apply before disease onset, continue every 10 to 14 days. Rotate to another mode of action between applications of RG Bravo. Avoid late-season applications. Observe seasonal limits for chlorothalonil.
Tebuconazole <sup>4</sup>	3	7			--
Thiophanate-methyl <sup>4</sup>					Apply before disease onset, continue every 7 to 14 days.
Topsin 4.5 FL	1	0	10 fl oz	60 fl oz	
Topsin M 70 WP	1	0	0.5 lb	3 lb	
Topsin M WSB	1	0			
<b>Microdochium (Plectosporium) Blight [SP]</b>					
Aftershock	11	1	3.0 to 5.7 oz	4 apps	Apply before disease onset, continue every 7 to 14 days. Alternate with a fungicide outside FRAC group 11.
Cabrio	11	0	12 to 16 oz <sup>5</sup>	4 apps	Apply before disease onset, continue every 7 to 14 days.
Dithane F-45 Rainshield	M	5	1.6 to 2.4 qt	19.2 qt	-
Dithane M-45	M	5	2 to 3 lb	24 lb	-
Flint	11	0	4 oz	8 oz	Apply before disease onset, continue every 7 to 14 days.
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	Begin prior to disease onset, continue every 7 to 10 days.
Quadris	11	1	11 to 15.5 fl oz	4 apps	Apply before disease onset, continue every 7 to 14 days.
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	--
<b>Phytophthora Blight [C/M/SP/W]</b>					
Forum SC	40	0	6 fl oz	5 apps	Must be tank-mixed with a protectant fungicide. Apply before disease onset, continue every 5 to 10 days.
Presidio	43	2	3 to 4 fl oz	12 fl oz	Apply every 7 to 14 days. Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Ranman	21	0	2.75 fl oz	6 apps	Apply before disease onset, continue every 7 to 10 days. 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.
Revus	40	0	8 fl oz	32 fl oz	Apply every 7 to 14 days. Use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Tanos	11/27	3	8 to 10 oz	4 apps	Tanos must be tank-mixed with a fixed copper plus mancozeb fungicide. Apply before disease onset; continue every 5 to 7 days.
Zampro	40/45	0	14 fl oz	3 apps	Apply before disease onset and repeat every 5 to 7 days.
<b>Powdery Mildew [C/M/SP/W]</b>					
Actigard	21	0	0.5 to 1 oz	16 oz	Begin applications before onset of disease; apply every 7 to 14 days. Apply in a minimum of 20 gal/A of water. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Aftershock	11	1	3.0 to 5.7 oz	4 apps	Apply before disease onset, continue every 7 to 14 days. Alternate with a fungicide outside FRAC group 11.
Ariston	M/27	3	3.0 pt	17.5 pt	Apply before disease onset, continue every 7 days. May sunburn mature watermelon.

(continued on next page)

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

Product	FRAC Code <sup>1</sup>	PHI <sup>2</sup> (days)	Amt/A	Seasonal Limits/A	Comments
Chlorothalonil <sup>4</sup>					Begin before disease onset; continue every 7 days as needed.
Bravo Ultrex	M	0	1.8 to 2.7 lb	19.1 lb	
Bravo WeatherStik	M	0	2 to 3 pt	21 pt	
Fixed coppers					Apply every 5 to 10 days beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	M	0	1 to 2.5 pt		
Badge X2	M	0	0.5 to 2.5 lb		OMRI-listed.
Basic Copper 53	M	0	2 lb		OMRI-listed.
C-O-C-S WDG	M	0	2 to 4 lb		-
Champ DP	M	0	1.33 lb		-
Champ Formula 2 FL	M	0	1.33 pt		-
Champ WG	M	0	1.5 to 3 lb		OMRI-listed.
COC DF	M	0	3 to 4 lb		-
COC WP	M	0	3 to 4 lb		OMRI-listed.
Copper-Count-N	M	0	3 to 4 pt		-
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Cuprofix Ultra 40 Disperss	M	0	1.25 to 2 lb		-
Kentan DF	M	0	1 to 2.62 lb		-
Kocide 2000	M	0	1 to 2.25 lb		-
Kocide 3000	M	0	0.5 to 1.25 lb		-
Kocide DF	M	0	1.5 to 3 lb		-
Mastercop	M	0	0.5 to 1 pt		-
Nordox 75 WG	M	0	1 to 1.25 lb		OMRI-listed.
Nu-Cop 50 WP	M	0	1.5 to 3 lb		OMRI-listed.
Nu-Cop 3 L	M	0	0.66 to 4 pt		-
Nu-Cop 50 DF	M	0	1.5 to 2 lb		OMRI-listed.
Fontelis	7	1	12 to 16 fl oz	67 fl oz	Alternaria. Apply before disease onset, continue every 7 to 14 days.
Pristine	7/11	0	12.5 to 18.5 oz <sup>5</sup>	4 apps	Apply before disease onset, continue every 7 to 14 days.
Procure 50 WS	3	0	4 to 8 oz	40 oz	Apply prior to vining or when symptoms are first observed and continue every 7 to 14 days.
Proline 480SC	3	7	5.7 fl oz	17.1 fl oz	Maximum two foliar applications.
Quadris Opti	11/M	1	3.2 pt	4 apps	Apply before disease onset, continue every 7 to 14 days. Observe seasonal limits for chlorothalonil.
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	Apply before disease onset, continue every 7 to 14 days.
Quintec	13	3	4 to 6 fl oz		Muskmelon, gourd, pumpkin, watermelon, and winter squash only. Apply before disease onset, continue every 7 to 14 days.
Rally 40 WSP	3	0	2.5 to 5 oz	1.5 lb	Apply every 7 to 10 days, beginning when symptoms are first observed or when conditions favor disease.
Sulfur <sup>4</sup>	M				Apply every 7 to 10 days, beginning when symptoms are first observed or when conditions favor disease. Phytotoxicity may occur when sulfur is applied when temperatures exceed 90°F.
Tebuconazole <sup>4</sup>	3	7			Apply preventively and repeat at 10 to 14 days. Use lowest listed rate of surfactant to improve coverage.
Thiophanate-methyl <sup>4</sup>					Apply before disease onset, continue every 7 to 14 days. Limit 2.1 lb ai/A per season.
Topsin 4.5 FL	1	0	10 fl oz		
Topsin M 70 WP	1	0	0.5 lb		
Topsin M WSB	1	0			
Torino	U6	0	3.4 fl oz	2 apps	Apply at disease onset, make a second application 7 days later.
Vivando	U8	0	15.4 fl oz	3 apps	Apply prior to disease onset, continue every 7 to 14 days. Do not mix with horticultural oils and alternate with a different FRAC code.
<b>Pythium Damping-off and Cottony Leak [C/M/SP/W]</b>					
Previcur Flex	28	2	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 SL	4	0	1 to 2 pt	1 app	Preplant. Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil. At planting, apply broadcast or banded, move into seed zone with 0.5 to 1 inch of irrigation if rainfall is not expected within 24 hours. Can be applied through drip and sprinkler irrigation systems.
MetaStar 2EC AG	4	0	4 to 8 pt		
Ultra Flourish	4	0	2 to 4 pt		
<b>Scab [C/M/SP/W]</b>					
Actigard	21	0	0.5 to 1 oz	16 oz	Begin applications before onset of disease; apply every 7 to 14 days. Apply in a minimum of 20 gal/A of water. May be applied through drip irrigation. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Chlorothalonil <sup>4</sup>					Begin before disease onset; continue every 7 days as needed.
Bravo Ultrex	M	0	1.8 to 2.7 lb	19.1 lb	
Bravo WeatherStik	M	0	2 to 3 pt	21 pt	
Fixed coppers					Apply every 5 to 10 days beginning before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Mancozeb <sup>4</sup>					Products include Dithane, Koverall, Manzate, Penncozeb.
Dry formulations	M	5	1.5 to 3 lb	24 lb	Apply before disease appears and continue every 7 to 10 days as needed.
Liquid formulations	M	5	1.2 to 2.4 qt	19.2 qt	

(continued on next page)

Product	FRAC Code <sup>1</sup>	PHI <sup>2</sup> (days)	Amt/A	Seasonal Limits/A	Comments
Ridomil Gold Bravo SC	4/M	0	2.5 to 3.25 pt	4 apps	Apply before disease onset, continue every 10 to 14 days. Rotate to another mode of action between applications of RG Bravo. Avoid late-season applications. Observe seasonal limits for chlorothalonil.

<sup>1</sup> Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on page 13 for more information on FRAC codes.

<sup>2</sup> Pre-harvest interval.

<sup>3</sup> Observe seasonal limits for mancozeb.

<sup>4</sup> Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.

<sup>5</sup> Use higher rate when pressure is severe.

<sup>6</sup> Restricted in some Kentucky counties. See fungicide safety table on page 20.

Appendix A

# Production and Marketing Information Online

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:

<http://www.uky.edu/hort/documents-list-commercial-vegetable>

## 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 sometimes change. Those listed here worked as of October, 2013.

## University of Kentucky College of Agriculture

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

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

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

- <http://www.uky.edu/hort/>

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

- [www2.ca.uky.edu/entomology/dept/ent-facts.asp](http://www2.ca.uky.edu/entomology/dept/ent-facts.asp)

**Center for Crop Diversification:** Provides research updates, profiles of promising new crops, and marketing information for Kentucky.

- <http://www.uky.edu/Ag/CCD/>

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

- [www.wagwx.ca.uky.edu/](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/hort/commercial/horticulture](http://www.uky.edu/hort/commercial/horticulture)

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

- <http://www.uky.edu/Ag/IPM/manuals.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.

- [www.uky.edu/Ag/NewCrops/budgets.html](http://www.uky.edu/Ag/NewCrops/budgets.html)

## General Vegetable Production Information from Other States

**Southeastern U.S. Vegetable Crop Handbook. A collaboration of several Southeastern U.S. states contains useful production information.**

- <http://www.thepacker.com/grower/2015-southeastern-us-vegetable-crop-handbook>

**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](http://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.

- [edis.ifas.ufl.edu/TOPI\\_C Commercial\\_Vegetable\\_Production](http://edis.ifas.ufl.edu/TOPI_C Commercial_Vegetable_Production)

**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.

- [www2.msstate.edu/~ricks/index.html?#35](http://www2.msstate.edu/~ricks/index.html?#35)

## Weekly Vegetable IPM and Other Newsletters

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

- [www.uky.edu/Agriculture/kpn/kpnhome.htm](http://www.uky.edu/Agriculture/kpn/kpnhome.htm)

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

- [ipm.uiuc.edu/ivfn/index.html](http://ipm.uiuc.edu/ivfn/index.html)

## Organic Vegetable Production

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

- [attra.org](http://attra.org)

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

- [nal.usda.gov/afsic/pubs/csa/csafarmer.shtml](http://nal.usda.gov/afsic/pubs/csa/csafarmer.shtml)

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

- [ams.usda.gov/AMSv1.0/nop](http://ams.usda.gov/AMSv1.0/nop)

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

- [kyagr.com/marketing/organic-marketing.html](http://kyagr.com/marketing/organic-marketing.html)

**University of Kentucky:** Information of organic crop certification.

- [www.uky.edu/Ag/CCD/introsheets/organic-cert.pdf](http://www.uky.edu/Ag/CCD/introsheets/organic-cert.pdf)

**Sustainable Agriculture Research and Education (SARE):** A grower focused organization that is affiliated with land grant universities around the country. Excellent resource for growers.

- [sare.org](http://sare.org)

## 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.

- [www.ca.uky.edu/agc/pubs/id/id134/id134.pdf](http://www.ca.uky.edu/agc/pubs/id/id134/id134.pdf)

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

- [www.uky.edu/Ag/NewCrops/marketing.html](http://www.uky.edu/Ag/NewCrops/marketing.html)

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

- [www.marketnews.usda.gov/portal/fv](http://www.marketnews.usda.gov/portal/fv)

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

- [www.kyagr.com/marketing/farmmarket/index.htm](http://www.kyagr.com/marketing/farmmarket/index.htm)

**USDA Grading Standards:** Fruit and vegetable grading standards.

- <http://www.ams.usda.gov/grades-standards/vegetables>

**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.  
 • [procelinks.com/main.html](http://procelinks.com/main.html)

**USDA Direct Marketing Home Page:** The USDA hosts this site.  
 • <https://afsic.nal.usda.gov/alternative-marketing-and-business-practices/direct-marketing>

**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 Farmers' Market Directory, and guidelines for "Kentucky Proud" logo program.  
 • [kyagr.com](http://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](http://kyagr.com/buyky/webbuild/index.htm)  
 • [kyagr.com/buyky/cstore/cstore.htm](http://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](http://kyfb.com)

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

**Kentucky Department of Agriculture Good Agricultural Practices (GAP) Program.** Good food safety information specific to Kentucky growers.  
 • [kyagr.com/marketing/gap.htm](http://kyagr.com/marketing/gap.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. Excellent resource.  
 • [gaps.cornell.edu/educationalmaterials.html](http://gaps.cornell.edu/educationalmaterials.html)

Appendix B

## 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 pounds per acre is considered the minimum, and 200 pounds per 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 the "Vining Crops" chapter 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 pound per acre. Boron is normally applied at the rate of 1 to 2 pounds of actual boron per acre.

**Zinc**—Zinc deficiency in snap beans and sweet corn may be significant in Central and South-central 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 pounds per acre when broadcast. Chelated zinc (14%) can be applied at 15 to 40 pounds per acre. For a foliar spray, use chelated zinc at ¾ to 1 pound in 100 gallons of water. See also the "Fertilizing" section of the "Sweet Corn" chapter.

Appendix C

## Conversion Tables for Use of Pesticides on Small Areas

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

DRY MATERIALS											
Approximate Rate Per:	Recommended Rate/A										
	1 lb	2 lb	3 lb	4 lb	5 lb	6 lb	8 lb	10 lb	100 lb	200 lb	400 lb
1,000 sq ft	2¼ tsp	4½ tsp	2¼ tbs	3 tbs	4 tbs	4½ tbs	2½ cup	½ cup	2¼ lb	4½ lb	9 lb
100 sq ft	¼ tsp	½ tsp	¾ tsp	1 tsp	1¼ tsp	1½ tsp	¾ tsp	2 tsp	¼ lb	½ lb	1 lb

# English Measurement Units

3 teaspoons (tsp)	=	1 tablespoon
2 tablespoons (tbs)	=	1 fluid ounce
16 tablespoons (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 (gal)

# Generic Insecticides

Active Ingredient	Generics	Manufacturer
<b>Abamectin</b> Original Product: Agri-Mek 0.15 EC (Syngenta)	Abba 0.15 EC	Adama
	Abba Ultra 0.3 EC	
	AgriMek 0.7 SC	Syngenta
	Borrada 0.15 EC	Adama
	Epi-Mek 0.15 EC	
	Nufarm Abamectin 0.15 EC	Nufarm
	Reaper 0.15 EC	Loveland
	Reaper Advance 0.15 EC	
	Temprano 0.15 EC	Chemtura
	Tide Timectin 0.15 EC	Tide Intl.
	Zoro 0.15 EC	Cheminova
<b>Acephate</b> Original Product: Orthene 90 SP (Valent)	Acephate 90 Prill	Adama
	Acephate 90 WDG	Loveland
	Acephate 90 WSP	
	Acephate 97 UP	United Phosphorous
	Bracket 90 WDG	Winfield
	Orthene 97	Amvac
<b>Bifenthrin</b> Original Product: Brigade 2 EC, Capture 2 EC (FMC)	Bifen 2 AG Gold	Direct AG Source
	Bifenture 2 EC	United Phosphorous
	Discipline 2 EC	Amvac
	Fanfare 2 EC, ES	Adama
	Revere 2 EC	Adama
	Sniper 2 EC	Loveland
	Tailgunner 2 EC	Adama
	Tundra 2 EC	Winfield
	Xpedient 2 EC	Amvac
<b>Carbaryl</b> Original Product: Sevin 4L, 80 S, SL, XLR (Bayer)	Carbaryl 4 L	Drexel, Loveland
	Prokoz Sevin SL	Prokoz
<b>Chlorpyrifos</b> Original Product: Lorsban 4 E, 15 G, 75 WDG, Advanced 3.76 E (Dow AgroSciences)	Chlorpyrifos 4 E	Adama, Drexel
	Govern 4 E	Tenkos
	Hatchet 4 E	Dow AgroSciences
	Nufos 4 E	Cheminova
	Saurus 15 G	Helena
	Vulcan 3.76 E	Adama
	Warhawk 4 E	Loveland
	Yuma 4 E	Winfield
	Whirlwind 4 E	Helena
<b>Cyfluthrin</b> Original Product: Baythroid XL 1 EC, Renounce 20 WP (Bayer)	Tombstone 2 E	Loveland
	Tombstone Helios 2 E	
<b>cypermethrin</b> Original Product: Ammo (discontinued)	Holster 2.5 EC	Loveland

Active Ingredient	Generics	Manufacturer
<b>Esfenvalerate</b> Original Product: Asana XL 0.66 EC (Dupont)	S-FenvaloStar 0.66 EC	LG Life Sciences
	Zyrate 0.66 EC	Rotam NA
<b>Gamma-cyhalothrin</b> Original Product: Proaxis 0.5 EC (Loveland)	Declare Insecticide 0.5 EC	Cheminova
	Proaxis Insecticide 0.5 EC	
<b>Imidacloprid</b> Original Product: Admire Pro 4.6 F (Bayer)	Advise 2 FL	Winfield
	Mana Alias 2 F, 4 F	Adama
	Amtide Imidacloprid 2 F	AmTide
	Couraze 2 F, 4 F	Cheminova
	Imida E-AG, 1.6 F, 2 F	Cheminova
	Imidacloprid 4 SC	Willowood
	Macho 2 FL, 4 F	Albaugh
	Malice 75 WSP	Loveland
	Midash 2 SC	Sharda USA
	Montana 2 F, 4 F	Rotam NA
	NuPrid 2 F, 2 SC, 4 F Max, 4.6 F	Nufarm
	Pasada 1.6 F	Adama
	Prey 1.6 F	Loveland
	Sherpa 1.6 F	Loveland
	Widow 2 F	Loveland
	Wrangler 4 F	Loveland
<b>Lambda-cyhalo- thrin</b> Original Product: Karate 1 EC, Warrior with Zeon 1 ME, II 2 ME (Syngenta)	Grizzly Z 1 CS	Winfield
	Kendo 1 EC	Helm
	Kiaso 24 WG	Nufarm
	Lambda-CY AG	Direct AG Source
	Lambda T 1 CS	Helena
	Lambda CY 1 EC	United Phosphorous, Willowood
	Lambda-Cyhalothrin 1 EC	Nufarm
	LambdaStar 1 EC, 1 CS, PLUS 2 CS	LG Life Sciences
	Lamcap 1 CS	Syngenta
	Paradigm 1 EC	Adama
<b>Permethrin</b> Original Product: Pounce 3.2 EC (not available) (FMC)	Province 1 SC	TENKoz
	Silencer 1 EC	Adama
	Arctic 3.2 EC	Winfield
	Perm-Up 3.2 EC	United Phosphorous
	PermaStar 3.2 EC	LG Life Sciences
	Permethrin 3.2 EC	Loveland, TENKoz, Helena
	<b>Zeta-cypermethrin</b> Original Product: Mustang Max 1.5 EW (FMC)	Respect 0.8 EC

## Generic Fungicides

Active Ingredient	Generics	Manufacturer
<b>Azoxystrobin</b> Original Product: Quadris (Syngenta)	Azoxy 2SC	Willowood
	AzoxyStar	Albaugh/Agri-Star
	Azoxystrobin 100 ST	Albaugh/Agri-Star
	Satori	Loveland
<b>Chlorothalonil</b> Original Product: Bravo WeatherStik 720 SC (Syngenta)	Chloronil 720	Syngenta
	Chlorothalonil 720 SC	Arysta
	Echo 720	SipcamAdvan
	Equus 720 SST	MANA
	Initiate 720	Loveland
Original Product: Bravo Ultrex 82.5 WDG (Syngenta)	Echo 90 DF	SipcamAdvan
	Equus DF	MANA
<b>Iprodione</b> Original Product: Rovral 4F (Bayer)	Iprodione 4L AG	Arysta
	Meteor	United Phosphorus
	Nevado 4F	MANA
	Rovral 4F Fungicide	FMC
<b>Propiconazole</b> Original Product: Tilt (Syngenta)	Amtide Propiconazole 41.8% EC	AmTide
	Bumper 41.8 EC	MANA
	Bumper ES	
	Fitness	Loveland
	Propi-Star EC	Albaugh/Agri-Star
	Propimax EC	Dow
	Shar-Shield PPZ	Sharda USA
	Topaz	Winfield Solutions

Active Ingredient	Generics	Manufacturer
<b>Sulfur</b> Original Product: Various products and manufacturers	Kumulus DF	Arysta
	Microfine Sulfur	Loveland
	Microthiol Disperss	United Phosphorus
	Suffa	Drexel
	Sulfur 6L	Arysta
	Yellow Jacket Dusting Sulfur Yellow Jacket Wettable Sulfur	Georgia Gulf Sulfur
<b>Tebuconazole</b> Original Product: Folicur 3.6F (Bayer)	Monsoon	Loveland
	Onset 3.6L	Winfield Solutions
	Orius 3.6F	MANA
	Tebu-Crop 3.6F	Sharda USA
	Tebustar 3.6L	Albaugh/Agri-Star
	Tebuzol 3.6F	United Phosphorus
	Toledo	Rotam North America
<b>Thiophanate-methyl</b> Original Product: Topsin M 70WDG, 70WP, WSB (United Phosphorus)	Nufarm T-Methyl 70WSB	Nufarm
	Thiophanate-Methyl 85WDG	MANA
Original Product: Topsin 4.5FL (United Phosphorus)	Incognito 4.5F	MANA
	Nufarm T-Methyl 4.5F	Nufarm

## 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 cannot 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 [uky.edu/Horticulture/Horticulture/homeveggies.html](http://uky.edu/Horticulture/Horticulture/homeveggies.html). 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 [kyagr.com/marketing/plantmktg/organic/index.htm](http://kyagr.com/marketing/plantmktg/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.

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 pounds 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 pounds of nitrogen, 37 pounds of phosphate, and 31 pounds of potash per ton. But a ton of fresh manure at 75% moisture will contain only 27, 28, and 14 pounds of these nutrients, respectively. At 75% moisture you will be hauling around 1,500 pounds of water and only 500 pounds 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 (P<sub>2</sub>O<sub>5</sub>), and potassium (K<sub>2</sub>O) 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" table in the "Sweet 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

**Table 1. Nutrients in FRESH animal manure.**

Source	Water Content	Average Nutrient Composition (percent of fresh weight)		
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> 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) <sup>1</sup>	30	2.95	2.75	1.85

<sup>1</sup> Some broiler producers use Roxarson and Nitarsone 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 <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> 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 <sup>1</sup>	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 <sup>1</sup>	7.0	10.0	1.5
"Soft" rock phosphate	0	14.0-16.0	0
Greensand	0	0	3.0
Phytamin 800	7.0	0	0

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

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 pounds of N per acre for sweet corn preplant. When commercial fertilizers are used, this amount is applied before planting and is supplemented by a sidedressing of 40 to 50 pounds 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 pounds 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 pounds of nitrogen, look at Table 2 under poultry; the N content is 3.2%. Divide the 80 pounds by 3.2 = 25 and multiply the result by 100 = 2,500 pounds. This is the amount of poultry



manure required to obtain the 80 pounds per acre of nitrogen recommended. To convert to tons, simply divide again by 2,000 ( $2,500 \div 2,000 = 1.25$  tons).

In this example we will have obtained 80 pounds of nitrogen together with 130 pounds of phosphorus ( $P_2O_5$ ) and 45 pounds of potassium ( $K_2O$ ). The amount of  $P_2O_5$ , and  $K_2O$  are calculated for the 2,500 pounds of manure by multiplying 2,500 by the appropriate percentages in Table 2 and then dividing by 100. The amount of  $P_2O_5$ , for example, is  $2,500 \text{ pounds} \times 5.2 = 13,000$  divided by 100 = 130 pounds. For the amount of  $K_2O$ , multiply 2,500 pounds  $\times 1.8$  and then divide by 100 = 45 pounds.

### Additional Phosphorus

Now suppose that the soil is very low in phosphorus and the soil test suggests applying 180 pounds of phosphorus. We have

obtained 130 pounds of phosphorus from the poultry manure and need an additional 50 pounds, 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%  $P_2O_5$  and 3% N. Dividing 50 pounds of  $P_2O_5$  by 22 = 2.27 and multiplying by 100 = 227 pounds. Thus, 227 pounds of raw bone meal/acre will supply 50 pounds of  $P_2O_5$ . Performing a similar calculation for the N tells us that we will only obtain about 7 (6.8) pounds 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. The figures represented are averages from a range of possible values.

## Appendix H

# 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 to 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 to 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.

### 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 to 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

**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

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.

# 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:

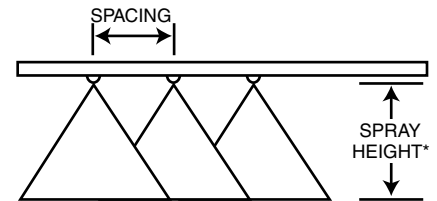
- Using the table to the right, select the distance to catch discharge based on the row or nozzle spacing of your sprayer.
- Measure that distance in the field to be sprayed.

- Note the time in seconds spent to drive the measured distance at the desired throttle setting (constant speed).
- Catch the nozzle discharge for the noted time (#3 above) in a measuring cup or other container graduated in fluid ounces.
- 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).
- 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

Tee Jet™ is a registered trademark of Spraying Systems Co. of Wheaton, Illinois.

# 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 influ-

enced 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 10) that the last frost (at or below 32°F) will occur on or before the date listed for "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 planting dates for Eastern, Central and Western Kentucky.**

Crops	Earliest Date <sup>1</sup>			Latest Date <sup>1,2</sup>		
	Eastern	Central	Western	Eastern	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	Jun 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

<sup>1</sup> Dates are for direct seeding unless otherwise indicated under "Crops" column.

<sup>2</sup> 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 frost dates in Kentucky.**

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

\*Weather station had missing data. Dates were estimated using data from surrounding stations.

# Relative Efficacy of Insecticides Against Common Arthropod Pests of Vegetable Crops in the Southeastern United States

Not all insecticides listed below are registered on all vegetable crops—check the label before applying to a specific crop.

Chemical class (IRAC)	Common name	Example Product	Greenhouse use	Flea beetles	Colorado potato beetle*	Cucumber beetles	Corn earworm*	European corn borer	Fall armyworm	Cabbage looper	Imported cabbageworm	Diamondback moth*	Squash vine borer	Beet armyworm*	Stink/Harlequin bugs	Squash bug	Aphids*	Thrips	Western flower thrips	Maggots	Whiteflies*	Cutworms	Wireworms	White grubs	Spider mites*
1A	carbaryl	Sevin		3	1	2	1	2	1	1	2	1	1	x	x	x	x	1	x	x	x	1	x	x	x
	methomyl	Lannate		1	x	x	2	2	2	2	2	2	x	1	2	2	1	3	2	x	1	x	x	x	x
1B	malathion	Malathion		2	1	2	1	1	1	1	2	1	1	x	1	1	1	1	x	1	x	1	x	x	x
	chlorpyrifos	Lorsban		x	x	x	1	1	1	1	2	1	1	x	x	x	x	1	x	3	x	2	3	2	x
	acephate	Orthene	No	x	x	x	1	3	2	1	2	x	x	x	x	x	2	2	x	x	1	2	x	x	x
	diazinon	Diazinon	No	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x	1	2	1	x
	dimethoate	Dimethoate		2	x	1	x	x	x	x	x	x	x	x	2	1	3	3	1	x	x	-	-	-	-
3	permethrin	Pounce		2	1	2	2	1	2	2	3	1	3	x	1	2	1	1	x	x	x	2	x	x	x
	alphacypermethrin	Fastac		3	1	3	2	3	2	2	3	1	3	x	1	2	1	1	x	x	x	2	x	x	x
	zeta cypermethrin	Mustang Max		3	1	3	2	3	2	2	3	1	3	x	1	2	1	2	x	x	x	3	x	x	x
	cyfluthrin	Baythroid/Renounce		2	1	2	2	2	1	2	3	1	3	x	1	2	1	1	x	x	x	3	x	x	x
	lambda cyhalothrin	Warrior		3	1	3	2	3	2	2	3	1	3	x	1	2	1	2	x	x	x	3	x	x	x
	esfanvalerate	Asana XL		3	2	2	2	2	1	2	3	1	2	x	1	1	1	1	x	x	x	2	x	x	x
	gamma cyhalothrin	Proaxis		3	1	3	2	3	2	2	3	1	3	x	1	2	1	2	x	x	x	3	x	x	x
	fenpropathrin	Danitol		2	x	2	2	1	1	3	1	2	x	1	2	1	1	1	x	x	1	2	x	x	1
	bifenthrin	Brigade/Capture		3	1	3	2	2	1	1	3	1	3	x	2	2	1	2	x	1	1	3	2	1	1
4A	imidacloprid	Admire		3	2	3	x	x	x	x	x	x	x	x	1	2	3	2	x	2	2	x	1	2	x
	acetamiprid	Assail		2	3	2	x	x	x	x	x	x	1	x	1	1	3	2	x	x	2	x	x	x	x
	clothianidin	Belay/Clutch		3	3	2	x	x	x	x	x	x	x	x	x	2	x	x	2	x	x	1	2	x	x
	thiamethoxam	Platinum/Actara	No	3	2	2	x	x	x	x	x	x	x	x	2	2	3	1	x	2	2	x	1	1	x
	dinotefuran	Venom/Scorpion		3	3	2	x	x	x	x	x	x	x	3	3	1	2	x	x	2	x	x	x	x	x
4C	sulfoxaflor	Closer		x	x	x	x	x	x	x	x	x	x	x	1	x	3	x	x	x	2	x	x	x	x
		Transform	No	x	x	x	x	x	x	x	x	x	x	x	1	x	3	x	x	x	2	x	x	x	x
4D	flupradifurone	Sivanto		x	x	x	x	x	x	x	x	x	x	x	x	x	3	x	x	x	2	x	x	x	x
5	spinetoram	Radiant	No	x	3	x	3	3	2	2	3	2	2	2	x	x	x	3	2	x	x	1	x	x	x
6	emamectin benzoate	Proclaim	No	x	x	x	2	2	2	3	3	3	2	3	x	x	x	x	x	x	x	1	x	x	1
	abamectin	AgriMek		x	3	x	x	x	x	x	x	x	x	x	x	x	x	2	1	x	x	x	x	x	3
7C	pyriproxyfen	Knack/Distance		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x	x	x	x
9B	pymetrozine	Fulfill		x	x	x	x	x	x	x	x	x	x	x	x	x	3	x	x	x	1	x	x	x	x
9C	flonicamid	Beleaf		x	x	x	x	x	x	x	x	x	x	x	x	3	x	x	x	x	x	x	x	x	x
10	etoxazole	Zeal		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2
11	Bt	Dipel, various		x	x	x	1	1	1	2	3	1	1	1	x	x	x	x	x	x	x	x	x	x	x
		XenTari		x	x	x	1	1	1	2	2	2	1	2	x	x	x	x	x	x	x	x	x	x	x
15	novaluron	Rimont		x	3	x	3	3	3	2	3	1	2	3	1	1	x	2	2	x	2	x	x	x	x
16	buprofezin	Courier		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x	x	x	x
18	methoxyfenozide	Intrepid		x	x	x	2	2	3	3	3	1	2	3	x	x	x	x	x	x	x	x	x	x	x
20B	acequinocyl	Kanemite		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	3
21A	fenpyroximate	Portal	No	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2
	tolfenpyrad	Torac		2	x	x	1	x	1	1	2	x	x	1	x	x	2	2	1	x	1	x	x	x	x
22	Indoxacarb	Avaunt		1	2	1	3	2	2	3	3	2	2	3	x	x	x	x	x	x	x	1	x	x	x
23	spiromesifen	Oberon		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	x	x	x	1
	spirotriamat	Movento	No	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x	x	x	2	x	x	x	x
25	cyflumetofen	Nealta		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2
28	rynaxypyr	Coragen		x	3	x	3	3	3	3	3	3	2	3	x	x	x	1	x	x	2	1	x	x	x
	cyantraniliprole	Exirel/Verimark	No	2	3	x	3	3	3	3	3	3	2	3	x	x	2	1	1	x	2	x	x	x	x
	flubendiamide	Synapse/Belt	No	x	2	x	3	3	2	3	3	3	2	3	x	x	x	x	x	x	x	1	x	x	x
	bifenazate	Acramite/Floramite		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	3

\* Resistance may exist in some areas

x Ineffective or insufficient data

1 Somewhat effective

2 Effective

3 Very Effective

# Pesticide Emergency Telephone Numbers

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## 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) 262-8200

## 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.