Okra

Mallow family (Malvaceae): *Abelmoschus esculentus*

VARIETIES: *Okra*

Variety	Days to Maturity From Seeding	Comments
Annie Oakley II	48	Hybrid; medium green, ridged; remain tender up to 4.5 inch, spineless dwarf plants.
Cajun Delight	49	Hybrid; tender to 5 inch, 1997 All American selection.
Clemson Spineless	55	Heavy yields—almost spineless pods.

Planting and Culture

Well-drained, fertile, silt loam soils are most desirable; however, okra will grow on a wide range of soil types. Prepare a firm, friable seedbed as for other vegetable crops.

Seed okra only after the soil has warmed up (65°F) in the spring to allow good seed germination (see Appendix H). Plant four to six seeds per foot in rows 28 to 36 inches apart; thin plants to 10 to 18 inches apart in rows. Ten to 12 lb of seed are required to plant an acre. Seed should be planted 1 ½ to 2 inches deep. Planet Jr.-type planters work well for direct seeding. In addition, very high yields have been obtained with transplanted okra using black plastic mulch and drip irrigation.

Fertilizing

Apply P_2O_5, K_2O and lime according to soil test results. A total of about 80 to 90 lb N per acre is used with about half that amount applied prior to planting. Fertilizer should be applied broadcast and disked in prior to seeding. A sidedressing of nitrogen applied after the first harvest will help to prolong the harvesting period (see table at right). Soil pH should be 6.0 to 6.5.

Harvesting and Handling

Harvesting under favorable conditions should start about six days after flowering. Harvesting of the pods should be done on a regular basis (about every two days) so that the pods do not become over-mature. Regular picking increases yield. Old pods should be removed and discarded because mature pods retard future pod set. The pods should be harvested when 2 to 3½ inches long. Move harvested pods to a shady, cool area as soon as possible to maintain good quality. Fresh market okra is usually graded into the following sizes:

- Fancy—pods up to 3½ inches long
- Choice—pods 3½ to 4½ inches long
- Jumbo—pods over 4½ inches long but still tender.

Pods should be harvested from the plant with a sharp knife to make a smooth, neat cut.

Okra can be kept for fresh consumption for two weeks at a temperature of 50°F and a relative humidity of 90 to 95 percent. Okra chilled below temperatures of 50°F will turn dark and decay.

Potential yield of 12,000 lb per acre is possible; however, 8,000 to 10,000 lb per acre is considered more realistic. A bushel of okra weighs approximately 30 lb.

FERTILIZER: *Okra*

Soil Test Results *(lb/A)*		**Fertilizer Needed** *(lb/A)*
Phosphorus		**Phosphate** *(P_2O_5)*
Low	<31	181-240
Medium	31-60	91-180
High	61-80	1-90
Very High	>80	0
Potassium		**Potash** *(K_2O)*
Low	<201	151-200
Medium	201-300	101-150
High	301-450	1-100
Very High	>450	0
Nitrogen		**N**
Apply 40 to 50 lb nitrogen (N)/A before planting seed. After harvest begins sidedress plants with an additional 35 to 40 lb N/A.		

PESTICIDE SAFETY: *Okra*

	Signal[2]	Re-entry *(hrs)*	Harvest *(days)*
Insecticides			
Acramite 50 WS	C	12	3
Admire Pro	C	12	21
Bt products	C	12	0
Malathion 8	C	12	1
Provado 1.6 F	C	12	0
Sevin XLR	C	12	3
SpinTor 2 SC	C	4	1
Fungicides			
Azoxystrobin[1]	C	4	0
Kocide 2000	W	24	0
Kocide 3000			

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

Common Diseases/Management

Seed rot, damping-off. Plant fungicide-treated seed (Thiram 65W at ⅔ tsp/lb of seed), and use Apron XL at 10 to 20 cc/100 lb of seed for improved control of *Pythium.* Planting okra in warm soil that is well drained is critical. Turn cover crops under early to ensure they are well rotted before planting. Azoxystrobin can be applied at planting to help reduce losses to disease where disease pressure is high (see table for rates).

Foliar diseases and fruit rots. Take steps to aid drying of the fruit, such as avoiding low wet areas and fog pockets; do not plant okra between taller bordering plants such as corn. Removing several larger upper leaves to aid sunlight penetration and air circulation is also helpful. Fungicides may also be applied to manage these diseases; see tables for products and rates.

Fusarium wilt, Verticillium wilt. A general soil fumigant (see page 18) should be considered in fields with a history of these diseases. See tables for rates of available fumigants. Avoid solanaceous crops in the rotation (potatoes, tomatoes, tobacco, eggplant, and peppers).

Nematodes. Practice crop rotation (2 to 3 years away from solanaceous crops). Fumigants may be required. See section on Fusarium wilt for more information.

INSECT CONTROL: *Okra*

Insecticide	Product Amt/A	Comments and Seasonal Limits
Aphids		
Malathion 8	1.5 pt	Before pod set only.
Provado 1.6 F	3.8 fl oz	Limit 18.8 fl oz/A. Allow 5 days between sprays.
Japanese Beetles		
Capture 2 E	2.1 to 6.4 fl oz	Limit 12.8 fl oz/season and allow 7 days between applications.
Malathion 8	1.5 pt	Before pod set only.
Corn Earworms		
Bt products	See labels	
Capture 2 E	2.1 to 6.4 fl oz	Limit 12.8 fl oz/season and allow 7 days between applications.
Sevin XLR	1 to 1.5 qt	Limit 6 qt/A. Allow 6 to 8 days between applications.
SpinTor 2 SC	4 to 8 fl oz	Limit 27 fl oz/A.

WEED CONTROL: *Okra*

Product Amt/A	Lb A.I./A	Remarks
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
1.25 to 2 pt Treflan HFP 4 E	0.62 to 1 trifluralin	For preemergence control of annual grasses and broadleaf weeds. Apply as preplant soil incorporated. Can also be applied before or immediately after planting.

DISEASE CONTROL: *Okra*

Product	Amt/A	Seasonal Limits/A	Comments
Foliar Diseases *(Anthracnose, Leaf Spots, Powdery Mildew)*			
Azoxystrobin[1]		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule..
Amistar	2 to 5 oz		
Heritage	3.2 to 8 oz		
Quadris	6to 15.5 fl oz		
Kocide 2000	1.5 to 3 lb	n/a	Apply on a 5- to 10-day schedule when conditions favor disease. See label for mixing instructions and tank-mix precautions.
Kocide 3000	0.75 to 1.75 lb	n/a	
Seedling Rot *(Rhizoctonia)*			
Azoxystrobin[1]			
Amistar	0.125 to 0.25 oz[2]	4 apps	POST-EMERGENCE: Apply broadcast in a 7-inch band with spray directed at lower stems and surrounding soil.
	0.125 to 0.188 oz[2]	1 app	IN-FURROW: Apply in 5 to 15 gal/A, with nozzle directed to spray in furrow just before seed are covered. RESISTANCE MANAGEMENT: In-furrow treatment does not count as a foliar application.
Quadris	0.4 to 0.8 fl oz[2]		POST-EMERGENCE: See comments for Amistar.
	0.4 to 0.7 fl oz[2]		IN-FURROW: See comments for Amistar.
Verticillium/Fusarium wilt			
Chloropicrin	22 to 36.5 gal	1 app	Inject pre-plant (min 4 weeks before planting) with chisels set to 6 to 8 in depth and spaced no wider than 12 in apart. Rate listed is for broadcast application; bed applications can be made, but rate must be adjusted for smaller application area.
metam sodium 42%	37.5 to 75 gal	1 app	Products include Vapam HL, Metam CLR 42%, and Sectagon-42. Rates listed are per treated acre. Apply min 14 days before planting. May be drenched, injected, sprayed and incorporated, or applied through sprinkler irrigation systems. See label for application instructions and precautions.
Telone C-35	13 to 20.5 gal	1 app	Inject pre-plant (min 4 weeks before planting) with chisels set to 8 to 10 in depth and spaced 12 to 24 in apart. Rate listed is for broadcast application. Rate listed is per treated acre.

[1] Do not make back-to-back applications or rotate with other QoI inhibitors (FRAC Group 11). Fungicides with the same Group number have the same mode of action. Do not tank-mix products with the same Group number, and rotate among fungicides with different Group numbers to discourage resistance development.
[2] Per 1000 row-feet.

Onions

Onion family (Alliaceae): *Allium cepa* Cepa group

VARIETIES: *Onions (Green and Bulb)*

Variety	Hybrid	Days to Maturity	Comments
Green (bunching)			
Ishikura		120	A long type with long white stems
Evergreen White Bunching		120	Hardy; will overwinter; non-bulbing; long, slim, pure white stems.
Bulb			
Super Star	X	100	Very large (1 lb) bulbs; white, sweet/mild. Stores well; AAS winner.
Candy	X	110	Large bulbs; sweet mild flavor; not for storage.
Southport White Globe		110	Stores well; also used for bunching.
Brown Beauty	X	110	Sweet Spanish type; large, globular bulb; white flesh; crisp and mild flavor, not for storage.
Sweet Sandwich	X	115	Tan-yellow. Large, globe shaped, not for storage.
Redwing		115	(for trial)dark red; with thick skins, suitable for storage

Planting and Culture

Due to weed pressure, it is recommended that onion producers use transplants or sets for planting. The easiest way to grow green bunching onions is by using sets. Sets should be planted by mid-March for best results (see Appendix H).

Typically transplants can be planted into the field about 8 weeks after seeding. At this time the base of the plants should be ¼ to ½ inch in diameter. Transplants can be planted into raised beds on rows 12 inches apart with in-row spacing being between 4 to 6 inches. Some growers have had success using black plastic; however, growing onions on plastic can also increase the incidence of bacterial diseases in bulbs, particularly in hot or wet weather. Use drip irrigation as onions have poor root systems and will not achieve maximum size without adequate moisture. A well-drained soil is essential for good onion production. A soil pH between 6.0 and 6.8 is most desirable for onions.

Many growers produce onions for direct market sales. Often consumers at these markets are looking for sweet "Vidalia" type onions. In order to produce mild tasting onions for fresh consumption growers must have the correct combination of both variety and environment. Sweet, mild varieties bred specifically for fresh consumption should be chosen. In addition, onions grown with low levels of sulfur in soils or irrigation water will tend to be milder than those grown in a high sulfur environment. Growers should also be careful to choose the correct varieties for Kentucky. Intermediate or "day-neutral" type varieties perform well at this latitude.

FERTILIZER: *Onions*

Soil Test Results *(lb/A)*		**Fertilizer Needed** *(lb/A)*
Phosphorus		**Phosphate** *(P_2O_5)*
Low	<31	181-240
Medium	31-60	61-180
High	61-80	1-60
Very High	>81	0
Potassium		**Potash** *(K_2O)*
Low	<201	176-250
Medium	201-300	101-175
High	301-450	1-100
Very High	>450	0
Nitrogen		**N**
Apply 90 to 100 lb of nitrogen (N)/A to soils of relatively low fertility; broadcast and disk before planting. Decrease nitrogen application according to soil fertility. On heavily fertilized soils, apply 50 to 60 lb N/A. Once bulbing starts sidedress with 25 lb N/A every two weeks for a total of four applications.		

Harvesting, Curing, and Storing

Onions should be harvested when at least 70 percent of the bulbs in the field have gone "tops-down" (foliage has fallen). Irrigation can be stopped about one week prior to harvest. At harvest, bulbs should be undercut and pulled by hand with foliage and roots removed and put in shallow trays inside for drying. Onions can be cured outside on a dry surface for one to two weeks prior to storing. Throw out diseased or injured bulbs. A temperature of 35°F and a relative humidity of 70 to 75 percent is the most desirable for storing onions for long periods. Do not store bulbs at a high relative humidity, as is appropriate for many other vegetables. Good ventilation is essential.

PESTICIDE SAFETY: *Onions*

	Signal[4]	Re-entry *(hrs)*	Harvest *(days)*[5]
Insecticides			
Lorsban 15 G	C	24	AP
Malathion 8	C	12	3
Radiant SC	C	4	1
RESTRICTED USE			
Ammo 2.5 EC	C	12	7
Decis 1.5 EC	DP	12	1
Diazinon AG 500	C	24	14
Diazinon 50 W	C	24	14
Lannate 90 SP	DP	48	7
Lorsban 4 E	W	24	AP
Mustang Max	W	12	7
Penncap-M	W	96	15
Pounce 3.2 EC	C	12	1
Proaxis 0.5 EC	C	24	14
Warrior T	W	24	14
Fungicides			
Acrobat 50 WP	C	12	0
Aliette WDG[3]	C	12	7
Axoxystrobin[2]	C	4	0
Cabrio EG	C	12	7
Chlorothalonil[2]	D	12	7/14[1]
Cuprofix MZ Disperss[2]	C	24	7
Endura	W	12	7
Fixed coppers[2]	D	12/24	0
Maneb/Mancozeb[2]	C	24	7
Mankocide	D	24	7
Pristine	C	12	7
Quilt	C	12	14
Reason 500 SC	C	12	7
Ridomil Gold EC/SL	C	48	0
Ridomil Gold Bravo	D	48	7/21[1]
Ridomil Gold Bravo SC	W		
Ridomil Gold Copper[2]	D	48	7/10[1]
Ridomil Gold MZ	W	48	7
Rovral 4 Flowable	W	24	7
Iprodione 4L AG			
Scala	C	12	7
Sulfur[2]	C	24	0
Ultra Flourish	W	48	0

[1] Dependent on type of onion (green, bulb or dry), see label.
[2] Several formulations are marketed. See the general introduction for more details on fungicides.
[3] 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 counties.
[4] W: Warning, C: Caution, D: Danger; P: Poison
[5] AP: At planting

Green bunching onions should be pulled and put into bunches (containing five to seven plants) when they are ⅓ to 1 inch in diameter. To achieve the long white shoulders desired on green onions, the soil is hilled around plants two to three weeks before harvest.

Bulb onions are marketed wholesale in 50-lb sacks.

Common Diseases/Management

General. A wider range of chemical options are now available for onions and related crops than in the past. Dry onions and green onions are not always covered by the same pesticide labels because the residue risk is much higher with green onions (the blades are eaten in addition to the bulb). Examine labels carefully to ensure the crop/stage is covered. Onions are very susceptible to a wide range of diseases. Use production practices that maintain good air circulation in the crop.

Bacterial leaf blights, bacterial soft rots, and Botrytis neck rot. Control leaf diseases through use of fixed coppers (see tables); neck rot is suppressed by Pristine. *Plants should be gathered into windrows at harvest; neck tissues should be dry before topping and storage.* Bacterial leaf blights can be supressed by fixed coppers. Harvest promptly and avoid damage during handling to limit problems with bacterial rots. In storage, cure rapidly using forced air; heat (not above 100°F) may be required for up to 5 to 7 days during humid weather.

Damping-off, seedling blight, and smut. Purchase fungicide-treated seed or treat with either Captan 50 WP or Thiram 65 at ⅔ tsp/lb of seed. At the time of planting bulbs (sets), apply Maneb 80 at 1 lb/25 gal water for 10,000 linear ft as a coarse spray into the planting furrow. For control of Pythium damping-off, apply mefenoxam either pre-plant or banded as a soil surface spray after planting; see tables for rates and products.

Downy mildew. Apply fungicides when conditions are favorable for disease; a number of products are available (see tables for rates). Weekly applications of fixed copper have been adequate in most years in Kentucky. Under severe disease pressure, products containing mefenoxam (Ridomil Gold) or strobilurins (Quadris, Pristine) may be necessary.

Botrytis leaf blight, purple blotch, Stemphylium blight. Rotate away from onions for 3 to 4 years to reduce these diseases. Steps taken to improve air movement within the crop will aid in management, but fungicide sprays are usually needed on commercial plantings in Kentucky. Apply fungicides weekly beginning when disease first appears; chlorothalonil, Rovral 4F, or mancozeb are effective materials. Endura, Pristine, and Quadris/Amistar are now labeled at various rates for some of these diseases, but they should be used in rotation with either chlorothalonil or mancozeb. See tables for products and rates.

INSECT CONTROL: *Onions*

Insecticide	Product Amt/A	Comments and Seasonal Limits
PREPLANT/PLANTING		
Onion Maggots *(Problems with onion maggots are often associated with soils that are high in organic matter or amended with manure. Continuous planting of onions on the same ground will increase onion maggot problems. When possible, rotate with other crops. Eliminate culls and volunteer onions after harvest to reduce the overwintering population.)*		
Diazinon 50 W	4 to 8 lb	Incorporate immediately.
Lorsban 4 E	1.1 oz/1,000 feet	Dry bulb onions only, incorporate, limit 1 application.
Lorsban 15 G	3.7 oz/1,000 feet	Dry bulb only, limit 1 application.
Malathion 8	2 pt	
FOLIAR TREATMENTS		
Thrips *(In general, red onions are more susceptible to thrips injury. Monitor for thrips regularly, especially during hot, dry weather. When needed, treat during early bulb stage and use 10-25 thrips per plant as a guideline for treatment.)*		
Ammo 2.5 EC	4 to 5 fl oz	Limit 25 fl oz/A.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 9.6 fl oz/A.
Lannate 90 SP	1 lb	Limit 4 lb/A.
Mustang Max	2.88 to 4.0 fl oz	Limit 20 fl oz/season.
Penncap-M	2 pt	Limit 8 pt/A.
Pounce 3.2 EC	6 to 12 fl oz	Limit 80 oz/A. Dry bulb only.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Allow 5 days between sprays. Limit 1.92 pt/A.
Radiant SC	6 to 10 fl oz	Limit 30 fl oz/A.
Warrior T	2.56 to 3.84 fl oz	Limit 1.92 pt/A. Bulb and garlic only.

WEED CONTROL: *Onion*

Product Amt/A	Lb A.I./A	Remarks
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal of water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
1 to 1½ pt Buctril 2E	0.25 to 0.38 bromoxynil	For selective postemergence control of broadleaf weeds. Use in 50 to 70 gal of water/A. Apply when both soil and onion leaves are dry and when temperature is 70° to 85°F. Apply to onions with 2 to 5 leaves and when weeds are < 2 inches tall. Do not add surfactant. Do not irrigate within 2 days of a preemergence application or within 3 days of crop emergence.
2 oz Chateau 51WDG	0.064 flumioxazin	Apply to transplanted onions (dry bulb) between the 2-leaf and 6-leaf stage and on direct seed onions (dry bulb) between the 3-leaf and 6-leaf stage. Apply to weed-free onions (dry bulb) for preemergence control of the weeds listed. For use on all soil types with up to 5% organic matter. Do not apply more than 2 oz of Chateau WDG per acre during a single application. Do not apply more than 3 oz of Chateau WDG per acre during a single growing season. PHI = 45 days. Min. 14 days between applications.
10 to 14 pt Dacthal 6 F	7.5 to 10.5 DCPA	For preemergence control of annual grasses and small-seeded broadleaves. Can be broadcasted over transplants. Can be applied up to 14 weeks after planting at 14 pt/A rate. Do not preplant incorporate.
1 pt Fusilade-DX 2E	0.25 fluazifop-p	For selective postemergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 45 days. Max. rate is 48 fl oz/A.
2 to 3 fl oz Goal 2XL	0.032 to 0.5 oxyfluorfen	For preemergence and postemergence control of certain annual grasses and most broadleaves. For use on dry bulb onion only. Apply as a broadcast spray after onions have 2 to 4 true leaves. Spray during sunny warm weather. Applications made during or following cool, wet weather will result in more severe injury. Use 2 to 4 fl oz/A for seeded onion and 0.5 to 2 pt/A for transplanted onion in min. 40 gal of water/A. Apply within 1 day before or after transplanting. Max. rate = 2 pt/A/year. 45 day pre-harvest interval.

WEED CONTROL: *Onion*

Product Amt/A	Lb A.I./A	Remarks
1.3 to 2.7 pt Gramoxone Max 3 L	0.5 to 1 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, preemergence, or before transplanting in min. 10 gal of water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
0.5 to 1.5 pt Poast 1.5 E	0.09 to 0.27 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. PHI = 30 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
5 to 6 qt Prefar 4 E	5 to 6 bensulide	For control of annual grasses and small-seeded broadleaves. Apply preplant incorporated to a depth of 1 inch or preemergence after planting. Irrigate immediately after preemergence application.
1.8 to 3.6 pt Prowl 3.3 E	0.74 to 1.49 pendimethalin	For control of annual grasses and broadleaf weeds. Apply in min. 10 gal of water/A to plants with 2 to 9 true leaf stage. Do not apply surface preemergence or serious crop injury can result. Not for use on leek or green bunching onion. PHI = 45 days.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal of water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
6 to 16 fl oz Select 2E	0.09 to 0.24 clethodim	For selective postemergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v in min. 20 gal of water/A. PHI = 45 days.
1 to 1.25 pt Treflan HFP 4 E	0.5 to 0.62 trifluralin	For preemergence control of annual grasses and broadleaf weeds. For dry bulb use only. Apply at layby to soil between onion rows.

DISEASE CONTROL: *Onions (Dry and Spanish)*

Product	Amt/A	Seasonal Limits/A	Comments
Bacterial Leaf Blight			
Fixed coppers		n/a	Apply on a 5- to 10-day schedule when plants reach 4 to 6 in or before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	1.8 pt		
Champ DP	0.67 to 1 lb		
Champ Formula 2 FL	0.67 to 1 pt		
Cuprofix Ultra 40 Disperss	1.25 to 3 lb		
Kocide 101	1 to 1.5 lb		
Kocide 2000	1.5 lb		
Kocide 3000	0.75 lb		
Kocide DF	1 to 1.5 lb		
Kocide 4.5 LF	1.33 pt		
Nu-Cop 50 WP	2 lb		
Nu-Cop 3 L	1.33 to 2.66 pt		
Nu-Cop 50 DF	1 to 1.5 lb		
Tenn-Cop 5 E	3 pt		
Cuprofix MZ Disperss[2]	3.5 to 5 lb	see footnote	Apply when disease appears and continue on a 4 to 7 day schedule as needed.
ManKocide[2]	1.5 to 2.25 lb	see footnote	Apply when disease appears and continue on a 3- to 7-day schedule as needed.
Botrytis Leaf Blight, Downy Mildew, Purple Blotch, Stemphylium Blight			
Acrobat 50 WP	6.4 oz	5 apps	DOWNY MILDEW ONLY. Must be tank-mixed with another downy mildew fungicide, excluding mefenoxam. Apply before disease onset, continue on a 5- to 7-day schedule.
Forum SC	6 fl oz	5 apps	
Aliette WDG	2 to 3 lb	7 apps	DOWNY MILDEW ONLY. Apply when conditions favor disease and continue on a 7- to 14-day schedule. Do not tank-mix with copper compounds.
Azoxystrobin[1]		4 apps	Use higher rates for downy mildew and Botrytis leaf blight. Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	2 to 5 oz		
Heritage	3.2 to 8 oz		
Quadris	6 to 15.5 fl oz		
Quadris Opti[1]	1.6 to 3.6 pt	3 apps	Resistance management guidelines for QoI inhibitors (FRAC Group 11) must be observed, along with seasonal limits for chlorothalonil.
Cabrio[1]	8 to 12 oz	4 apps	Use higher rates for downy mildew and Botrytis leaf blight. Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Chlorothalonil			Apply before disease onset; continue on a 7-day schedule as needed. Limit 15 lb ai/A/season.
Bravo Ultrex	0.9 to 2.7 lb	18.2 lb	
Bravo WeatherStik	1 to 3 pt	20 pt	
Echo 720	1 to 2 pt	20 pt	
Echo 90 DF	0.875 to 1.625 lb	16.7 lb	
Equus 720 SST	1 to 2 pt	20 pt	
Equus DF	0.9 to 2.7 lb	18.2 lb	
Cuprofix MZ Disperss[2]	5 to 7.25 lb	see footnote	Apply when disease appears and continue on a 4 to 7 day schedule as needed.
Endura	6.8 oz	6 apps	PURPLE BLOTCH AND BOTRYTIS LEAF BLIGHT ONLY. Apply before disease onset, continue on a 7- to 14-day schedule. No more than 2 sequential applications of Endura can be made before rotating to another mode of action.

DISEASE CONTROL: *Onions (Dry and Spanish)*

Product	Amt/A	Seasonal Limits/A	Comments
Fixed coppers		n/a	PURPLE BLOTCH AND DOWNY MILDEW ONLY. Apply on a 5- to 10-day schedule when plants reach 4 to 6 inches or before disease onset, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	1.8 pt		
Basic Copper 53	3 to 4 lb		
C-O-C-S WDG	3 to 4 lb		
Champ DP	1.33 lb		
Champ Formula 2 FL	1.33 pt		
Champion WP	2 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	4 pt		
Cuprofix Disperss	2.5 to 6 lb		
Cuprofix Ultra 40 Disperss	1.25 to 3 lb		
Kocide 101	2 lb		
Kocide 3000	0.75 lb		
Kocide 2000	1.5 lb		
Kocide DF	2 lb		
Kocide 4.5 LF	1.33 pt		
Nu-Cop 50 WP	2 lb		
Nu-Cop 3 L	1.33 to 2.66 pt		
Nu-Cop 50 DF	2 lb		
Tenn-Cop 5 E	3 pt		DOWNY MILDEW ONLY.
Mancozeb			Apply before disease appears and continue on a 4- to 7-day schedule as needed.
Dithane DF Rainshield	3 lb	32 lb	
Dithane F-45 Rainshield	2.4 qt	24 qt	
Dithane M-45	3 lb	30 lb	
Manzate 75 DF	3 lb	32 lb	
Manzate Flowable	2.4 qt	24 qt	
Manzate Pro-Stick	3 lb	32 lb	
Penncozeb 4 FL	1.6 to 2.4 qt	24 qt	
Penncozeb 75 DF	2 to 3 lb	32 lb	
Penncozeb 80 WP	2 to 3 lb	30 lb	
Maneb			Apply before disease appears and continue on a 7-day schedule as needed. Limit 22.5 lb ai/A/season.
Maneb 75 DF	2 to 3 lb	32 lb	
Maneb 80 WP	2 to 3 lb	30 lb	
Manex	1.6 to 2.4 qt	24 qt	
ManKocide[2]	2.5 lb	see footnote	Apply before disease appears and continue on a 3- to 7-day schedule as needed.
Pristine[1]	14.5 to 18.5 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User lower rates for Botrytis leaf blight.
Quilt[1]	14 to 27.5 fl oz	55.3 fl oz	PURPLE BLOTCH, BOTRYTIS LEAF BLIGHT ON DRY ONIONS ONLY. Apply before disease onset, continue on a 7- to 10-day schedule. O seasonal limits for FRAC Group 11 fungicides.
Reason[1]	5.5 fl oz	22 fl oz	DOWNY MILDEW AND PURPLE BLOTCH. Apply before disease onset, continue on a 5- to 10-day schedule.
Ridomil Gold Bravo	2 lb	4 apps	Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG Bravo. Avoid late-season applications. Observe seasonal limits for chlorothalonil.
Ridomil Gold Bravo SC	2.5 pt		
Ridomil Gold Copper	2 lb		DOWNY MILDEW ONLY. Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG Copper. Avoid late-season applications. Limit 4 apps/season.
Ridomil Gold MZ[2]	2.5 lb	4 apps	DOWNY MILDEW ONLY. Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG MZ. Avoid late-season applications.
Rovral 4 Flowable	1 to 1.5 pt	5 apps	BOTRYTIS LEAF BLIGHT, BOTRYTIS NECK ROT, PURPLE BLOTCH. Apply before disease onset and repeat at 14-day intervals.
Iprodione 4L AG			
Scala	9 to 18 fl oz		PURPLE BLOTCH AND BOTRYTIS LEAF BLIGHT ONLY. Apply before disease onset, continue on a 7- to 14-day schedule.
Pythium Damping-off, Cottony Leak			
Ridomil Gold EC	0.5 to 1 pt	1 app	PRE-PLANT: Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil. AT PLANTING: apply broadcast or banded, move into seed zone with 0.5 to 1 in of irrigation if rainfall is not expected within 24 hours.
Ultra Flourish	1 to 2 pt	1 app	

NOTE: Some of the chemicals listed above may not be labeled for green onions—check product labels carefully before use.

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

[2] Observe seasonal limits for Mancozeb.

Peas

Pea family (Fabaceae): *Pisum sativum*

Planting and Culture

Early spring plantings are a must to ensure good yields in Kentucky. The earliest plantings should be made between February 20 and March 1 or by the time the soil temperature has reached 45°F (see Appendix H). Use seed treatments to avoid decay problems.

Select soils that are well drained and adjust the pH to 6.5. Lighter, sandy loam soils are preferred because they warm up sooner.

Seed may be planted in either double or single rows. Double rows should be spaced 6 to 8 inches between rows and 18 to 24 inches between pairs of rows or adjusted to the cultivating equipment that is available. Plants in double rows will support each other. For tall-growing, indeterminate varieties, plant supports will need to be constructed.

Space single rows 24 to 36 inches apart. Seed within the row should be planted 1 to 1½ inches deep and spaced 1 inch apart. It requires between 60 and 100 lb of seed per acre, depending on spacing.

Harvesting

English peas should be picked as soon as pods are well filled but before they harden and fade in color. Two or three pickings can usually be made. Peas should be cooled and processed as soon as possible because the sugar content decreases rapidly after harvest. It is best to shell the peas just before cooking.

Edible pod or snow peas are harvested while the peas are immature. Pods reach a length of 3 to 5 inches five to seven days after flowering. Consequently, pods should be harvested every other day to prevent the development of large seeds and tough pods. Edible pod peas in plastic bags will store 10 days under refrigeration without loss of quality.

Edible pod snap peas can be harvested from the time when the peas begin to form up until the pods are well filled.

Peas should be stored at 32° to 34°F and 90 to 95 percent relative humidity.

FERTILIZER: *Peas*

Soil Test Results *(lb/A)*		**Fertilizer Needed** *(lb/A)*
Phosphorus		**Phosphate** *(P_2O_5)*
Low	<31	121-180
Medium	31-60	61-120
High	61-80	1-60
Very High	>81	0
Potassium		**Potash** *(K_2O)*
Low	<201	101-200
Medium	201-300	51-100
High	301-450	1-50
Very High	>450	0
Nitrogen		**N**
Poor soils		50-60
Fertile soils		30-40

PESTICIDE SAFETY: *Peas*

	Signal[4]	Re-entry *(hrs)*	Harvest *(days)*[5]
Insecticides			
Admire Pro	C	12	21
Bt products	C	4/12	0
Dimethoate 4 E	W	48	0
Endosulfan 3 EC	DP	24	5
Malathion 8	C	12	3
Provado 1.6 F	C	12	7
Radiant SC	C	4	3/28
Sevin XLR	W	12	3
SpinTor 2 SC	C	4	3
RESTRICTED USE			
Asana XL	W	12	3/21[1]
Baythroid XL	W	12	7
Capture 2 EC	W	12	3
Diazinon 50 W	C	24	7
Hero 1.24 EC	C	12	3
Lannate 90 SP	DP	48	1
Mustang Max	W	12	1/21[1]
Proaxis 0.5 EC	C	24	7/21[1]
Renounce 20 WP	C	12	7
Warrior T	W	24	7/21[1]
Fungicides			
Azoxystrobin[3]	C	4	0
Fixed coppers[3]	D	12/24[2]	0
Headline[1]	W	12	7/21
Ridomil Gold EC/SL	C	48	0
Sulfur[3]	C	24	0

[1] PHI depands on the type of pea, see label.
[2] Depends on type of application and product.
[3] Several formulations are marketed. See the general introduction for more details on fungicides.
[4] W: Warning, C: Caution, D: Danger; P: Poison
[5] AP: At planting

VARIETIES: *Peas (English, Edible Pod, Snap)*

Variety	Days to Mat.	Comments
English *(all are determinate)*		
Spring	57	Large pods for an early cultivar; excellent quality.
Sparkle	60	2 1/3 to 3 inch pods; heavy yielder; blunt pods.
Maestro	61	Heavy producer of 4 inch long pods; excellent quality; tolerance to Fusarium wilt, pea enation virus, bean yellow mosaic virus, and powdery mildew.
Green Arrow	68	Tolerant to downy mildew. Pods 4 to 4½ inches long.
Edible Pod[1]		
Oregon Giant (determinate)	69	Highly productive; sweet pods 4 inches long; resistant to Fusarium wilt, pea enation mosaic virus and powdery mildew.
Super Sugar Pod (indeterminate)	70	Highly productive; pods 3 inches long; Fusarium wilt resistance.
Snowflake (determinate)	72	High yielding; pods 3 to 4 inches in length; resistant to Fusarium wilt race 1, and powdery mildew.
Mammoth Melting Sugar (indeterminate)	74	Vine 34 to 40 inches tall, pods 4 inches long.
Snap		
Sugar Ann (determinate)	56	Resistant to Fusarium wilt race 1, very sweet.
Super Snappy (determinate)	65	Highly productive; 5 inch long pods; vines may need support; tolerant to powdery mildew.
Cascadia (determinate)	67	Very productive; 3 inch long pods; pods remain tender and sweet longer than other cultivars; very good disease tolerance.
Super Sugar Mel (determinate)	70	Highly productive; produces two 4 inch long pods per node; resistant to powdery mildew and pea leaf roll virus.
Sugar Snap (indeterminate)	72	Resistant to common pea wilt; an All American Selection all time winner; must be trellised; very heavy yielder.
Sugar Daddy (determinate)	72	Stringless, tolerant to pea leaf roll virus and resistant to powdery mildew.

[1] P. sativum var. macrocarpon

Common Diseases/Management

Fusarium wilt. Use resistant varieties in fields with a history of Fusarium wilt.

Anthracnose, Ascochyta leaf spot and pod blight, leaf spots, powdery mildew. Sulfur, fixed coppers, and strobilurins (Amistar, Quadris, Headline) are labeled; see tables for rates. Some resistant varieties are available. Plant disease-free seed to reduce leaf spots and pod diseases. Rotate away from legumes for 3-4 years to reduce inoculum levels in soil.

Damping-off, root rot. Rotate fields with a history of root rot for four or more years to small grains, corn, or other grasses; avoid legumes during the rotation. Purchase seed that has been commercially treated with fungicides such as Apron XL, Maxim, Captan, or thiram. Mefenoxam (Ridomil Gold EC, Ultra Flourish) can be applied at planting to suppress *Pythium*; azoxystrobin can be applied for control of *Rhizoctonia*.

White mold. Steps taken to reduce periods of wetness in the canopy are helpful. Avoid fields with a history of the disease in any crop.

Viruses. Virus diseases occur in every planting every year. Practical controls are not available; avoid planting peas next to other legumes.

INSECT CONTROL: *Peas*

Insecticide	Product Amt/A	Comments and Seasonal Limits
PREPLANT INCORPORATED		
Cutworms, Wireworms *(Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites. Wireworms can be a potential problem where peas follow grass or grass-legume sod.)*		
Diazinon 50 W	4 to 8 lb	Incorporate immediately.
PLANTER BOX		
Seedcorn Maggots *(Usually only a serious pest early in the season. Shallow planting in well-prepared seedbeds and adequate soil temperature to promote rapid germination will aid in reducing problems. Heavy cover crops or manure should be plowed early to render fields less attractive for egg laying.)*		
Kernel Guard	2 oz/bu seed	Captan-Diazinon-Lindane
FOLIAR TREATMENTS		
Alfalfa Loopers, Green Cloverworms		
Asana XL	2.9 to 9.6 fl oz	Do not feed vines, limit 19.2 fl oz/A.
Bt products	See labels.	
Capture 2 EC	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 27 fl oz/A. Allow 5 days between applications.
Lannate 90 SP	0.25 to 1 lb	Wait 5 days to feed forage. Succulent peas only. Limit 3 lb/A.
Mustang Max	2.72 to 4.0 fl oz	Limit 24 fl oz/A.
Proaxis 0.5 EC	1.92 to 3.84 fl oz	Limit 0.96 pt/A.
SpinTor 2 SC	4 to 6 fl oz	Limit 29 fl oz/A.
Warrior T	1.92 to 3.84 fl oz	Limit 0.96 pt/A.
Aphids		
Admire Pro	7 to 10.5 fl oz	Soil application. Limit 10.5 fl oz/A.
Capture 2 EC	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A.
Dimethoate 4 E	0.33 pt	Wait 21 days to feed vines. Limit 1 application.
Endosulfan 3 EC	0.67 to 1.33 qt	Limit 2 applications. Succulent peas only.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 27 fl oz/A. Allow 5 days between applications.
Malathion 8	1 to 2.5 pt	
Provado 1.6 fl oz	3.5 fl oz	Allow 7 days between sprays. Limit 10.5 fl oz/A. Do not use in combination with a soil application of Admire in the same season.
Armyworms, Cutworms		
Asana XL	5.8 to 9.6 fl oz	Do not feed vines. Limit 19.2 fl oz/A.
Baythroid XL	0.8 to 1.6 fl oz	Dry peas only, limit 6.4 fl oz/A and 3.2 fl oz per 14-day period.
Capture 2 EC	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 27 fl oz/A. Allow 5 days between applications.
Mustang Max	2.72 to 4.0 fl oz	Limit 24 fl oz/A.
Proaxis 0.5 EC	1.92 to 3.84 fl oz	Limit 0.96 pt/A.
Sevin XLR	1 to 1.5 qt	Limit 4 applications and allow at least 7 days between sprays.
SpinTor 2 SC	4 to 6 fl oz	Limit 29 fl oz/A. Armyworms only.
Warrior T	1.92 to 3.84 fl oz	Limit 0.96 pt/A.

WEED CONTROL: *Peas*

Product Amt/A	Lb A.I./A	Remarks
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal of water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
5 to 12 fl oz Assure II 0.88L	0.033 to 0.08 quizalofop	For selective postemergence control of annual grasses and suppression of perennial grasses. Apply to actively growing grasses in 10 to 15 gal of water/A. Include 1% v/v crop oil concentrate or 0.25% v/v non-ionic surfactant. Pre-harvest interval is 30 days for succulent peas and 60 days for dry peas. Maximum 14 fl oz/A/season.
1 to 2 pt Basagran 4S	0.5 to 1 bentazon	For postemergence control of annual broadleaves and suppression of yellow nutsedge. Two applications are needed for nutsedge and Canada thistle control. Do not add crop oil. Apply after peas have at least 3 pairs of leaves (or 4 nodes) or severe crop damage may occur. PHI for dry peas is 30 days and for succulent peas is 10 days. Do not apply when peas are in bloom.
1.3 pt Command 3ME	0.5 clomazone	For preemergence control of annual grasses and broadleaf weeds. Apply once in a min. 10 gal of water/A. Apply and incorporate 2 to 3 inches before planting. Use in combination with other herbicides to broaden weed control spectrum.

WEED CONTROL: *Peas*

Product Amt/A	Lb A.I./A	Remarks
1.3 to 1.7 pt Dual II Magnum 7.6 E	1.3 to 1.6 s-metolachlor	For control of most annual grasses and certain broadleaves. Apply preplant surface or incorporated or preemergence. Small grains may be planted 4½ months following this treatment. See label for other rotational crops.
1.3 to 2.7 pt Gramoxone Max 3 L	0.5 to 1 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, preemergence, or before transplanting in min. 10 gal of water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
0.5 to 2.5 pt Poast 1.5 E	0.09 to 0.48 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. Dry and succulent peas. Max. rate 4 pt/A/year. Include 1% v/v crop oil. PHI = 15 days for succulent peas and 30 days for dry peas.
1.8 to 3.6 pt Prowl 3.3 EC	0.74 to 1.49 pendimethalin	For control of annual grasses and broadleaf weeds. For use on chickpeas only. Apply before planting and incorporate 1 to 2 inches up to 60 days before planting and incorporate within 7 days of application. Do not apply surface preemergence or serious crop injury can result.
3 oz Pursuit 2L	0.05 imazethapyr	For control of annual grasses and broadleaf weeds. Can be applied preplant incorporated within 1 week before planting. Can be applied preemergence within 3 days after planting. Can be applied postemergence to plants at least 3 inches tall but before 5 nodes and before flowering. Add non-ionic surfactant 0.25% v/v.
4 fl oz Raptor 1AS	0.031 imazamox	For control of annual grasses and broadleaf weeds. Some varieties are sensitive and injury can occur. Apply postemergence to actively growing dry peas with at least 3 pairs of leaves and before bloom. Max. 1 application/season.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
7.5 lb Sonalan 10G	0.75 ethalfluralin	For preemergence control of annual grasses and broadleaves. For use on dry peas only. Apply and incorporate before planting.
1 to 2 pt Treflan HFP 4 E	0.5 to 1 trifluralin	For control of annual grasses and broadleaf weeds. Apply and incorporate in spring before planting or in fall in advance of spring planting.

DISEASE CONTROL: *Peas*

Product	Amt/A	Seasonal Limits/A	Comments
Anthracnose, Ascochyta Leaf Spot/Pod Blight, Leaf Spots			
Azoxystrobin[1]		4 foliar apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Amistar	2 to 5 oz		
Heritage	3.2 to 8 oz		
Quadris	6 to 15.5 fl oz		
Fixed coppers		n/a	Apply on a 7- to 10-day schedule, beginning before disease onset. See label for mixing instructions and tank-mix precautions.
Basic Copper 53	1.75 to 3 lb		
C-O-C-S WDG	2 to 4 lb		
COC DF	2 to 4 lb		
COC WP	2 to 4 lb		
Headline	6 to 9 fl oz	2 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Do not make back-to-back applications of Headline. User higher rates when pressure is severe.
Sulfur	7 lb	n/a	Apply when disease is first observed; continue on a 14-day schedule as needed. Phytotoxicity may occur if applications are made when air temperatures exceed 90ºF.
Powdery Mildew			
Fixed coppers		n/a	Apply on a 7- to 14-day schedule beginning at disease onset. See label for mixing instructions and tank-mix precautions.
Badge SC	1.2 to 2.8 pt		
Champ DP	1 to 2 lb		
Champ Formula 2 FL	1 to 2 pt		
Champion WP	1.5 to 3 lb		
COC DF	1.5 to 3 lb		
COC WP	1.5 to 3 lb		
Cuprofix Disperss	2 to 4 lb		
Cuprofix Ultra 40 Disperss	1 to 2 lb		
Kocide 101	1.5 to 3 lb		
Kocide 2000	1 to 2.25 lb		
Kocide 3000	0.5 to 1.25 lb		
Kocide DF	1.5 to 3 lb		
Kocide 4.5 LF	1 to 2 pt		
Nu-Cop 50 WP	1.5 to 3 lb		
Nu-Cop 3 L	1 to 4 pt		
Nu-Cop 50 DF	1.5 to 3 lb		
Tenn-Cop 5 E	3 to 4 pt		
Headline	6 to 9 fl oz	2 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Do not make back-to-back applications of Headline. User higher rates when pressure is severe.
Sulfur	3 to 20	n/a	Apply when disease is first observed; continue on a 7- to 14-day schedule as needed. Phytotoxicity may occur if applications are made when air temperatures exceed 90ºF.
Pythium Damping-off, Root Rot			
Ridomil Gold EC Ridomil Gold SL	0.5 to 1 pt	1 app	Apply pre- or post-planting as a broadcast or banded spray (7-inch band) in sufficient water to provide uniform coverage. Incorporate into the upper 2 in of soil mechanically or by rainfall/irrigation.

DISEASE CONTROL: *Peas*

Product	Amt/A	Seasonal Limits/A	Comments
Rhizoctonia Damping-off, Seedling Disease, Stem/Root Rot			
Azoxystrobin[1]			
Amistar	0.125 to 0.188 oz[2]	1 app	AT PLANTING: Apply as an in-furrow spray in 0.3 to 1 gal water/1000 row feet (5 to 15 gal/A). Spray should applied to the furrow just before seed are covered.
Quadris	0.4 to 0.7 fl oz[2]	1 app	
Amistar	0.125 to 0.25 oz[2]	4 foliar apps	POST-EMERGENCE: apply in a 7-inch (or less) band directed at the soil at the base of the plant. Arrange nozzles to provide good coverage of lower stems and soil at base of plants. Incorporation following application will improve distribution in soil. Foliar contact may occur; post-emergence sprays are considered foliar applications for resistance management purposes.
Quadris	0.4 to 0.8 fl oz[2]	4 foliar apps	

[1] *Do not make back-to-back applications or rotate with other QoI inhibitors (FRAC Group 11). Fungicides with the same Group number have the same mode of action. Do not tank-mix products with the same Group number, and rotate among fungicides with different Group numbers to discourage resistance development.*
[2] *Per 1000 row-feet.*

Peppers

Nightshade family (Solanaceae): *Capsicum annuum*

Planting and Culture

Peppers are grown primarily for fresh market in Kentucky. To be successful and make money, it is extremely important to begin by selecting a good field location. Low-lying fields next to creeks and rivers are subject to high humidity and moisture conditions resulting in serious disease risks; these areas are especially prone to bacterial leaf spot epidemics. Avoid poorly drained fields or fields where herbicides such as Scepter or atrazine products may have been used the previous season. Herbicide carryover (especially from corn and soybean herbicides) can cause serious injury to peppers (see "Weed Management" on page 9).

Growers should also locate pepper plantings as far away from tobacco plantings as possible because of the danger of aphid movement and virus disease spread from tobacco to peppers. Although tobacco ground may represent some of the best land on a farm, it is also not advisable to grow peppers after tobacco, tomatoes, eggplants, potatoes, pumpkins, or other vine crops for a period of three years because these crops are susceptible to many of the same diseases.

Soils known to be high in residual nitrogen should also be avoided to prevent peppers from producing excessive foliage at the expense of fruit. 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. Simple, hand-held electronic Cardy meters are available that growers can use to quickly determine the nitrate nitrogen status of soils and plants. These Cardy meters can be used to determine residual nitrate levels in soils prior to planting as well as to measure nitrate levels in plant sap in order to assess the efficiency of fertigation.*

Potassium and especially phosphorus are likely to accumulate in most Kentucky soils following several years of heavy applications for vegetable crops. Make sure to get your soil tested in the fall or early winter so that you will know exactly what nutrients are required.

Plow soil 8 to 10 inches deep several weeks in advance of the transplanting date. Peppers do extremely well following fescue sod. Prepare a fine seedbed by disking or roto-tilling.

Fresh Market Bell Peppers

Production with Plasticulture

Planting hybrid bell peppers on 6 to 8 inch high raised beds covered with black plastic mulch using drip irrigation has resulted in high yields of excellent quality peppers for fresh market sales. A bed shaper/plastic mulch layer and a setter that will transplant through plastic are essential for this production system. Two rows of peppers spaced 15 inches apart are planted on each bed; plants are spaced 12 to 15 inches apart within each row. The beds are usually 5 to 6 feet from center to center (approximately 14,500 plants per acre).

Since a portion of the fertilizer will be applied though the drip irrigation system (fertigation), uniform watering will ensure that plants receive adequate nutrients. While the consequences of under-watering (and therefore under-fertilizing) are obvious, many growers overlook the fact that over-watering will leach nutrients out of the root zone. Growers using trickle irrigation and plastic mulch should carefully monitor soil moisture using inexpensive tensiometers. Check these instruments daily. Don't assume that because it has rained there will be water in the root zone under plastic! For more details on how to set up a trickle irrigation system with fertilizer injection, contact your county Extension agent or irrigation supply representative.

In Kentucky, pepper plants should be transplanted to the field after danger of frost, usually around the second week of May (see Appendix H). A seven- to eight-week-old transplant is best.

Greenhouse container-grown plants are recommended for planting with mulch and trickle irrigation. Trays with 72 cells are considered economical but large enough to produce large and vigorous transplants. Using a larger transplant container (larger cell size) will usually result in better transplant survival and earlier yields.

Seed should be treated by the seed company or treated with chlorine bleach by the grower to help reduce seed transmission of bacterial leaf spot (see Appendix I). Bacterial spot remains a serious risk to pepper plantings in many parts of the state, and most growers should use resistant varieties as well as early season sprays containing fixed copper plus Maneb to reduce ephyptic populations of leaf spot bacteria. Bare root transplants are not recommended for fresh market pepper production.

**Nitrate is the form of nitrogen that is most readily available for use by crops. Soils also contain varying amounts of ammonium forms of nitrogen, which bacteria convert to nitrate forms over time. Nitrate ion meters like the Cardy do not measure ammonium nitrogen and therefore may underestimate some of the nitrogen becoming available to plants during the course of the growing season.*

VARIETIES: *Peppers*

Variety	Days to Mat.	Comments
Bell *(all are F1 hybrids)*		
Bacterial spot resistant[1]		
X3R Aristotle	70	Race 1, 2, 3 resistant; Phytophthora tolerant. Best overall performer in many Kentucky trials.
X3R Wizard	70	Race 1, 2, 3 resistant; somewhat less bacterial spot resistant than other varieties in this group; attractive fruits.
Patriot	70	For trial. Race 1, 2, 3, 5 resistant.
Excursion II	70	For trial. Race 1, 2, 3 resistant; TSWV, PVY, TMV resistant; slightly elongated.
Revolution	74	For trial. Race 1, 2, 3, 5 resistant; CMV resistant; somewhat Phytophthora tolerant; may flatten in very hot weather.
Heritage	74	For trial. Race 1, 2, 3, 5 resistant; TSWV resistant.
5776		For trial (Seminis); Race 1, 2, 3, 5 resistant.
X3R Red Knight	65-70	Race 1, 2, 3 resistant; TMV and PVY tolerant. Early, quick from green to red—similar to "King Arthur"; recommended for mature red production.
4 Star	75	Race 1, 2, 3 resistant; PepMoV, TMV, TEV, PVY resistant; very high yielding. Light to medium green; perhaps best suited to red pepper production or food service markets.
Bacterial spot susceptible		
King Arthur	65-70	Very large fruit. Virus resistant/tolerant (TMV,PVY,TEV); claimed to be heat tolerant. Early; turns quicker from green to red. Fruit appearance variable; best suited to food service and processing.
Vivaldi	65	Very early, elongated fruit; TMV tolerant. Green to red.
Phytophthora resistant/tolerant (see also Aristotle and Revolution above)		
Paladin	70-75	Not resistant to bacterial spot; high yielding and attractive in disease-free trials.
Colored/Specialty Bell		
Early Sunsation	70	Green to yellow; bacterial spot resistant (races 1,2,3) and PVY tolerant.
Blushing Beauty	65-70	Resistant to bacterial spot races 1,2,3. Matures green to ivory to orange to red.
Ivory	65-70	Creamy white to deep yellow. Mostly three lobed fruit.
Valencia	72	Orange, blocky, very good color; TMV tolerant.
Oriole	74	Light orange, blocky.
Mandarin	68-72	Dark orange, long fruits; susceptible to Alternaria fruit rot.
Lilac	68	Lavender to red.
Purple Beauty	70	Dark purple, large, well-shaped fruit. Matures from green to purple to red.
Cherry		
Red Cherry Large	75	Very hot—1¼ inch diameter fruits.
Super Sweet Cherry	75	High yielding, sweet.
Pimento		
Pimento L	75	Large fruits.
Pimento Elite (hybrid)	87	For trial; less heart-shaped than Pimento L.
Jalapeño *(all are F1 hybrids)*		
X3R Ixtapa	70	Bacterial spot resistant (races 1, 2, 3); some purpling in cool weather; susceptible to ozone injury.
El Jefe	72	For trial; bacterial spot resistant (races 1, 2, 3); dark green.
Coyame	70	Excellent fruit appearance.
Mitla	70	Dark green to red—fruit 3 to 3½ inches long.
Summer Heat 6000	70	Attractive, slightly curved fruits.
Grande	70-75	Large fruits, thick walled; fruit 3½ to 4 inches long; TEV, PVY tolerant.
VTR 56	74	Attractive, large fruits, dark green.
Argiset 4002	65	Large fruits without cracking, light green.
Hybrid No. 7	60-65	High yielding; large ("Grande") type.
Ballpark	70	Longest jalapeño in trials. Relatively mild; cylindrical, blunt.
Banana and Wax		
Banana Supreme	65-70	"Sweet;" uniform and productive. Fruit 6 to 7 inches long, tapered.
X3R Hot Spot	65-70	Hot banana; like "Inferno" but with bacterial spot resistance (races 1,2,3).
Hungarian Yellow Wax	65-70	Yellow to orange red. Medium hot. Fruit 6 to 6½ inches long, tapered.
Santa Fe Grande	65	Very hot, pale yellow, jalapeño-like fruits.
Italian/Cubanelle		
Corno di Toro	70-75	Very attractive, light to medium green.
Key West X3R	70-75	Bacterial spot resistant (races 1, 2, 3); light green.
Aruba	65	High yielding, large fruit size; light green to pale yellow.
Poblano/Ancho		
Ancho Villa	70	High yielding and large, attractive 4-lobed fruit; but light to medium green.
Ancho Ranchero	75	Large, variable, light to dark green fruits.
Ancho San Martin	80	Smaller, medium to dark green fruits.
Anaheim		
Navojoa	70	*High yielding with long, light to medium green fruits.*
Garden Salsa	70	*Attractive, medium green fruits.*
Anaheim TMR 23	75	*Light green fruits; TMV tolerant.*
Serrano		
Tuxtlas	70	*High yielding and attractive fruits.*
Serrano del Sol	65-70	*High yielding and attractive fruits.*
Bandido	65-70	*For trial; TEV and PVY resistant.*

[1] *Many varieties with resistance to at least 3 races of the bacterial spot pathogen are commercially available; some newer varieties also have resistance to race 5. Most of these have been tested at two or more locations by the University of Kentucky. We recommend that only bacterial spot resistant varieties be used. See "Common Diseases and Management" for more information on management of this important disease.*

When transplanting, use one-half pint of a starter solution around the roots of each plant. Use 3 lb of a 10-52-17 or similar analysis fertilizer in 50 gallons of water for the starter mix.

Poor fruit set and deformed fruit may result when nighttime temperatures drop below 60°F or when daytime temperatures exceed 90°F. Varieties differ considerably in their response to temperature extremes.

Most types of **hot and specialty peppers** can be grown using the same techniques and spacings as for bell peppers; however, some types require **staking and tying**. Serrano peppers, anaheims, poblanos, and some cubanelle varieties should be staked and tied when using plasticulture and high plant populations. Tomato stakes are placed every 6 to 10 feet on each side of the double-row beds. Tomato twine is looped and tightened around each stake at 7 to 9 inches above the soil to "fence-in" the plants. Second and third stringings can be used higher on the stakes as needed during the season. Shorter (2½ to 3 ft) stakes are sometimes used for very tall bell pepper varieties or where bell pepper plantings are exposed to high winds to reduce sunburn to fruit.

Note: See *Kentucky Pepper Integrated Crop Management Grower Manual* (IPM-13) for more detailed information on bell pepper production and pest management. Growers and cooperatives are strongly advised to use UK's degree-day model, pheromone traps, and regular scouting to monitor second generation European corn borer populations in July. The degree-day model is available on the Web at <www.uky.edu/Ag/Entomology/entfacts/fldcrops/ef06.htm>.

Peppers for Processing

Currently there are few processing peppers being produced in Kentucky. Peppers grown for processing are usually transplanted 16 inches apart in single rows 36 to 42 inches apart. This will require about 10,000 plants per acre. If pimento peppers are grown, space plants 18 to 22 inches apart in rows 40 to 42 inches apart (7,500 plants per acre). Although processing peppers have traditionally been grown on bare ground in Kentucky, several growers in recent years have doubled their profits by using higher plant populations, hybrid varieties, and black plastic mulch with drip irrigation.

Given the higher cost of the raised bed/plasticulture production system, most processors do not object to growers selling a portion of the crop as fresh greens. In fact, it has become very common for growers to sell the first harvests as green peppers for the fresh market and sell later-maturing fruits as red peppers for processors. Yields can be dramatically increased with plastic and drip irrigation, especially in a dry season. Growers contracting with a processor, however, are advised to check with the processing company regarding varieties; the benefits of mulch and drip irrigation will not be as great with open-pollinated varieties supplied by some processors. Techniques (including double-row spacings) for using this system with processing peppers are the same as those described above for fresh market peppers.

MARKETING CONTAINERS: *Peppers*

Pepper Type	Container Weight	Volume	No. Fruit/ Container
Long hot	30 lb	1 bu	
Jumbo bells	30 lb	1-1/9 bu	40-45
Extra Large bells	30 lb	1-1/9 bu	55-65
Large bells	30 lb	1-1/9 bu	65-75
Medium bells	30 lb	1-1/9 bu	75-90
Cubanelle	30-32 lb	1-1/9 bu	
Specialty hot peppers[1]	16 lb	1/2 bu	variable

[1] *Including most of the small-fruited hot and specialty peppers in the "Varieties" table.*

Fertilizing

For fresh market bell pepper production on most medium-textured soils where plastic mulch and drip irrigation are being used, we recommend that all of the phosphorus, all the potassium, and 30 to 50 percent of the nitrogen requirement be applied prior to bedding and laying plastic.

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. The fertigated portion of the total nitrogen requirement can be divided into equal amounts (remaining nitrogen requirement divided by the number of weeks until final harvest) and injected weekly as in the fertigation table (based on 14,500 plants per acre). Growers with very sandy soils should also consider applying 50 to 60 percent of their potassium requirement in weekly increments through the drip system in addition to nitrogen.

Growers should always have annual soil test results on which to base phosphorus and potassium applications. Potassium and especially phosphorus are likely to accumulate in most Kentucky soils following several years of heavy applications for vegetable crops or tobacco. A pH range of 6.5 to 7.0 is best for peppers, and liming may be required if soil pH falls below 6.0. For bare ground plantings on soils known to be relatively poor, apply 50 lb of nitrogen per acre preplant. Apply one-half at plowing and one-half just prior to transplanting and disk into the soil. On more fertile soils, apply 25 to 30 lb of nitrogen per acre prior to planting.

For processing bell pepper production where plastic mulch is not used, sidedressing or banding additional nitrogen to either side of the plant when the first fruit begin setting is essential for good yields. Apply 30 lb of nitrogen per acre at the first sidedressing. A second sidedressing of 30 lb of nitrogen two weeks later should also be made.

FERTILIZER: *Peppers*

Soil Test Results *(lb/A)*		**Fertilizer Needed** *(lb/A)*
Phosphorus		**Phosphate** *(P_2O_5)*
Low	<31	81-100
Medium	31-60	61-80
High	61-80	1-60
Very High	>80	0
Potassium		**Potash** *(K_2O)*
Low	<201	81-100
Medium	201-300	61-80
High	301-450	1-60
Very High	>450	0
Nitrogen		**N**
Peppers use approximately 100 to 150 lb of N/A. Apply 25 to 50 lb of N/A preplant. Rate to use will vary depending on previous crop and general fertility of the soil. Following sod, apply 50 lb of N prior to planting. After fruit begin setting, sidedress with another 30 to 50 lb of N/A. Two weeks later, make an additional application of 30 to 50 lb of N/A. For N fertigation, see comments in text and specific recommendations in the fertigation table.		

Harvesting

Mature green peppers ready for harvest will be firm and will have attained their maximum size. Fresh market green peppers are normally harvested before they lose their dark green color. Harvest peppers for processing when red ripe.

Peppers should be handled carefully when picking and dumping to avoid bruising and punctures. Hard and rough picking containers may cause skin breakage or punctures and should be avoided. Do not use plastic bags because peppers will heat up and quickly decay.

Pack only clean, undamaged, insect- and disease-free peppers. Peppers are graded into "U.S. Fancy" (not less than 3 inches in diameter and not less than 3 ½ inches long) and U.S. No. 1 (not less than 2 ½ inches in diameter or length).

All grades must have similar varietal characteristics, be firm, fairly well shaped, and free from damage caused by freezing injury, hail, scars, sunburn, disease, insects,

FERTIGATION RECOMMENDATIONS: *Bell Peppers*

Based on a total season N recommendation of 125 lb actual N/A with 50 lb N/A applied preplant and the remaining N (125 - 50 = 75 lb) divided into equal amounts to be fertigated on a weekly basis (75 lb ÷ 12 weeks = 6 lb 4 oz N per week). The dose for 1,000 plants is based on a plant population of 14,500 plants/A (i.e., double rows on 6 ft centers with plants 12 in apart in the rows). Either the moderate (75 lb) or high (100 lb) N rate can be selected below. For seasons extending beyond 12 weeks a maintenance dose of 1 to 1.5 lb N/week is adequate.

Total Fertigated N Requirement[1]	Actual N/wk *(lb/A)*	Ammonium nitrate *(lb/A/wk)*	Ammonium nitrate *(lb/1,000 plants/wk)*	Calcium nitrate *(lb/A/wk)*	Calcium nitrate *(lb/1,000 plants/wk)*
75 lb/A	6 lb 4 oz	19	1 lb 5 oz	40	3
100 lb/A	8 lb 5 oz	25	1 lb 12 oz	54	4

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

mechanical, or other means. Free copies of USDA standards for grades of peppers and other fruit and vegetables are available on the Web at <www.ams.usda.gov/standards/vegfm.htm> or can be obtained free of charge by writing: USDA, Agricultural Marketing Service, Fruit and Vegetable Division, Standardization Section, P.O. Box 96456, Room 2049-S, Washington, D.C. 20090-6456.

Storage

Cool peppers to 45° to 50°F by putting them in the cooler as soon as possible after harvest; cool rooms with forced-air equipment will greatly speed the process and extend shelf life. Once fruit are precooled, hold them at 45° to 50°F with a relative humidity of 90 to 95 percent. Peppers suffer chilling injury when stored at temperatures below 40°F. Symptoms of chilling injury are browning at the calyx end and surface pitting. Peppers are usually packed in 1⅑ bushel waxed corrugated cartons (30 to 33 lb) or in bushel crates (28 to 30 lb) according to the preference of your particular market.

Common Diseases/Management

General Practices. Diseases are a major factor in pepper production in Kentucky. Select varieties with resistance to bacterial leaf spot. The most important diseases targeted with a spray program are bacterial leaf spot, anthracnose, and Phytophthora; new fungicide options are available to manage certain disease problems. A sample fungicide spray program for peppers is included at the end of this section.

Alternaria Fruit Rot, Anthracnose, Leaf Spots/Blights. Use disease-free seed and/or transplants. Rotate for 3 to 4 years to crops not related to peppers and control solanaceous (nightshade family) weeds during the rotation. Plow down crop residues immediately after harvest. Apply fungicides weekly; maneb, fixed coppers, Endura (*Alternaria* only), and strobilurins (Quadris/Amistar, Cabrio, Flint) are labeled (see tables for rates and timings).

Bacterial Soft Rot of Fruit. Control insect pests (especially European corn borer) and spotting diseases to minimize wounding. Where acceptable, pack fruit without washing. If wash water is used in packing operations, it should contain 25 ppm of available chlorine. See "Post-Harvest Decays" on page 19. Fixed coppers applied for management of bacterial leaf spot during the harvest season can reduce the incidence bacterial soft rot.

Bacterial Leaf Spot (BLS). The bacterium causing this disease is seed-borne, transplant-borne, and overwinters on-site and nearby in weeds and crop residues. Control must focus on preventing introduction and slowing spread of the bacterium rather than eradication after it occurs. Fortunately, resistant varieties are available. General guidelines for control of BLS include:

- Use Resistant Varieties. Resistant varieties should be used where possible for both fresh market and processing. There are multiple races of the BLS pathogen. See the Variety table for a list of suggested resistant cultivars.
- Practice crop rotation. Do not grow peppers after peppers or related crops (tobacco, tomatoes, eggplants, potatoes) for two to three years. Also exclude small grains from the rotation in the year before peppers are to be planted. Control broadleaf weeds during the rotation and around field borders.
- Disk all crop residues into the soil promptly after harvest to encourage more rapid decline of the bacterium. If cover crops are used, plow them under very early in the spring to minimize carryover.
- Do not work wet plants. Spraying wet plants with high pressure equipment may encourage disease spread by blowing bacteria around the field.
- Use disease-free seed and transplants. Select disease-free seed and treat them with household bleach (see Appendix I). If transplants are grown in outdoor seedbeds, make frequent applications (every 3 to 5 days) of agricultural streptomycin (Agri-Mycin 17%) at 200 ppm or 2 teaspoons/gal of water beginning at the first true leaf stage. Streptomycin is not labeled for this use in the greenhouse, but can be applied on plants that have

PESTICIDE SAFETY: *Peppers*

	Signal[4]	Re-entry *(hrs)*	Harvest *(days)*
Insecticides			
Actara 25 WDG	C	12	0
Acramite 50 WS	C	12	3
Admire 2 F	C	12	21
Assail 30 SG	C	12	7
Avaunt 30 DG	C	12	3
Beleaf 50 SG	C	12	0
Bt products	C	4/12	0
Confirm 2 F	C	4	7
Dibrom 8	D	24	1
Dimethoate 4 E	W	48	0
Endosulfan 3 EC	DP	24	1/4[2]
Fulfill 50 DF	C	12	0
Intrepid 2 F	C	4	1
Knack 0.86 EC	C	12	4
Malathion 8	C	12	3
Oberon 2 SC	C	12	7
Orthene 75 S	C	24	7
Platinum 2 SC	C	12	30
Provado 1.6 F	C	12	0
Radiant SC	C	4	1
Sevin XLR	W	12	3
Spintor 2 SC	C	4	1
Trigard 75 WP	C	12	0
Venom 70 SG	C	12	1/21[2]
RESTRICTED USE			
AgriMek 0.15 EC	W	12	7
Asana XL	W	12	7
Baythroid XL	W	12	7
Capture 2 E	W	12	7
Decis 1.5 EC	DP	12	1
Dimilin 25 W	C	12	7
Hero 1.24 EC	C	12	7
Lannate 90 SP	DP	48	3
Mustang Max	W	12	1
Pounce 3.2 EC	C	12	3
Proaxis 0.5 EC	C	24	5
Proclaim 5 WDG	C	48	7
Renounce 20 WP	C	12	0
Vydate L	DP	48	7
Warrior T	W	24	5
Fungicides			
Acrobat 50 WP	C	12	0
Forum SC			
Agri-Mycin 17	C	12	0
Firewall			
Azoxystrobin[3]	C	4	0
Cabrio EG	C	12	0
Endura	W	12	0
Evito	C	12	3
Flint	C	12	3
Fixed coppers[3]	D	12/24[1]	0
Maneb[3]	C	24	7
Ridomil Gold EC/SL	W	48	7
Ridomil Gold Copper	D	48	7
Sulfur[3]	C	24	0
Tanos	C	12	3
PCNB[3]	W	12	0
Ultra Flourish	W	12	7

[1] *Formulations vary, so check label carefully.*
[2] *Depending on rate or type of application.*
[3] *Several formulations are marketed. See the general introduction for more details on fungicides.*
[4] *W: Warning, C: Caution, D: Danger; P: Poison*

been moved outside the greenhouse for hardening prior to transplanting. This product is not labeled for field use. Fixed copper is labeled for both outdoor and greenhouse transplant production. Do not expect the high degree of control with fixed coppers as is possible with streptomycin. Many bacterial strains are controlled by both materials; however, some strains are resistant to streptomycin, while others are resistant to copper. Some strains have tolerance to both streptomycin and copper. Consequently, multiple tools are needed in the control program. If you purchase transplants, make sure that they are certified "disease-free."

- Maintain proper fertility. The disease can be minimized by maintaining high fertility while being careful not to over-fertilize with N.
- Spray on a schedule (see fungicide sample program). Chemical applications made before symptoms are evident are the key to keeping bacterial populations low. Start sprays immediately after transplanting using fixed copper plus Maneb or Manex (see tables for products and rates). Continue at seven-day intervals during wet weather to reduce buildup and spread of the bacterium in the field.

Blossom End Rot. Maintain uniform soil moisture throughout the growing season and avoid damaging roots by cultivation, fertilization, or by diseases. In general, foliar applications of calcium do not alleviate blossom end rot; however, calcium levels in soil should be maintained.

Phytophthora Blight. An integrated management approach is required. Good soil drainage is critical to control; avoid wet fields, wet sites in fields, and fog-pockets. Plant into well-drained soils on properly formed, raised beds to minimize soil moisture and the pooling of water around plants. Avoid excessive irrigation, and if possible, do not use surface water in irrigation systems as the pathogen can be spread easily. Remove infected plants and destroy them immediately (bury or burn them) and practice sanitation (avoid moving equipment and yourself between infested fields and "clean" fields). *Phytophthora capsici*, the causal agent of Phytophthora blight, has many hosts. Rotations of 3 to 4 years away from cucurbits and solanaceous plants (peppers, tomatoes, eggplant, potatoes, and tobacco) can be effective in reducing pathogen populations. Where Phytopthora blight is common, make a pre-plant incorporated application of mefenoxam and follow up with additional applications at 30 and 60 days after transplanting; see tables for rates and application directions. Products such as Ridomil Gold Copper, Acrobat/Forum 50 WP + maneb, copper + maneb, and Tanos are effective against foliar and fruit phases of Phytophthora blight. A few Phytophthora-resistant pepper varieties are now available, including 'Paladin', 'Revolution', 'Conquest' and 'Aristotle', but horticultural characteristics and possible susceptibility to bacterial spot must also be taken into account (see variety table). Please note that the level of resistance to Phytophthora in these varieties varies; no variety is immune to Phytophthora blight. For example, 'Paladin' has a high level of resistance to the crown rot phase of Phytophthora blight, but very little resistance against foliar and fruit blight caused by *Phytophthora*. 'Aristotle' has moderate resistance to Phytophthora crown rot, and low resistance to foliar and fruit rots caused by this pathogen.

Southern Blight. Avoid fields with a history of this disease and rotate problem fields with sod crops. Deep plow to bury sclerotia and crop debris. Bury cover crops early to ensure they are well rotted before transplanting. Remove and destroy infected plants promptly. PCNB (Terraclor) can be drenched around plants at transplanting or applied in-furrow to suppress southern blight; see tables for products, rates, and instructions.

Tomato Spotted Wilt Virus (TSWV) and Impatiens Necrotic Spot Viruses (INSV). Ensure that transplants are from fields or greenhouses certified to be free of TSWV and INSV. Local transplant producers should take steps to reduce spread of TSWV and INSV by following recommended thrips control measures and by not producing pepper transplants in houses where ornamentals are being produced or sold. Maintain a good thrips control program in the field. TSWV-resistant varieties are also available (see variety table).

Virus Complex. Tobacco etch, Potato Virus Y, Tobacco Ring Spot Virus, Alfalfa Mosaic, Tobacco Mosaic, and Cucumber Mosaic are the viruses most common in Kentucky peppers. Grow virus-resistant varieties if these have horticulturally acceptable yields and fruit characteristics. In addition to the varieties listed in the Variety Selection tables, Gator Belle, Bell Boy, Bell Captain, and Super Sweet 860 are resistant to tobacco mosaic; the long green chile Tam Mild Chile-2 has resistance to tobacco mosaic, potato virus Y, and tobacco etch. Eliminate broadleaf weeds and other virus hosts within 150 feet of the field prior to transplanting. Locate fields between plantings of corn or other non-host field crops in which weeds are killed before peppers are transplanted. Do not grow peppers within 150 feet of tobacco. If tobacco and peppers must be planted in close proximity, locate the pepper planting upwind of the tobacco. Use virus-resistant tobacco varieties, and carefully control aphids in the tobacco crop. Control aphids in peppers, especially in transplant production and in later plantings. Spraying weekly with stylet oils (3 qts/100 gal) has been helpful in some states (see labels). Reflective mulches may be of value in reducing virus incidence.

Sample Fungicide Program for Field-Grown Pepper *(Refer to fungicide tables in this section for product rates; read product labels carefully before application).*

FROM TRANSPLANTING UNTIL MID-LATE BLOOM
Copper + Maneb
7-day schedule during dry to normal conditions
3- to 5- day schedule during wetter-than-normal conditions or when disease pressure is severe
MID-LATE BLOOM THROUGH HARVEST
Copper + Maneb
7-day schedule during dry to normal conditions
3- to 5- day schedule during wetter-than-normal conditions or when disease pressure is severe
Alternate weekly (or twice weekly) sprays of copper + maneb with Amistar/Quadris, Cabrio, or Tanos beginning prior to fruit set to suppress Anthracnose (apply on a 7- to 14-day schedule; limit of 4 applications of any combination of Amistar/Quadris, Cabrio, or Tanos).
Apply Ridomil Gold EC and Ridomil Gold / Copper, or Acrobat 50W if Phytophthora blight is a concern.

INSECT CONTROL: *Peppers[1,2]*

Insecticide	Product Amt/A	Comments and Seasonal Limits
SOIL TREATMENT		
Aphids, Flea Beetles, Thrips *(Do not use a foliar spray of Actara, Assail, Provado, or Venom in combination with a soil application of Admire, Platinum, or Venom in the same season.)*		
Admire Pro	10 to 14 fl oz	See label for application alternatives (sidedress, in-furrow, banded, or drip or trickle irrigation). Limit 14 fl oz/A.
Platinum 2 SC	5 to 8 fl oz	See label for application alternatives (sidedress, in-furrow, banded, or drip or trickle irrigation).
Venom 70 SG	5 to 6 oz	Limit 12 oz/A.
FOLIAR TREATMENT		
Aphids		
Actara 25 WDG	2 to 3 oz	Limit 8 oz/A. Allow 5 days between applications.
Assail 30 SG	2 to 4 fl oz	Limit 16 oz/A, limit 4 applications.
Beleaf 50 SG	2 to 2.8 oz	Limit 8.4 oz/season, allow 7 days between applications.
Dimethoate 4	0.5 to 0.67 pt	
Endosulfan 3 EC	1.33 to 2.67 pt	Limit 2 applications.
Fulfill 50 DF	2.75 oz	Limit 5.5 oz/A. Allow 7 days between applications.
Malathion 8	1.5 pt	
Orthene 75 S	0.67 to 1.33 lb	Limit 2-2/3 lb/A on bell types.
	0.67 lb	Limit 1-1/3 lb on non-bell type peppers.
Provado 1.6 F	3.75 fl oz	Limit 18.75 fl oz/A.
Venom 70 SG	1 to 4 oz	Limit 6 oz/A. Allow 7 days between applications for foliar applications
Beet Armyworm *(First detected in Kentucky in 1993, this insect can cause serious pepper losses when present. A Southern insect that doesn't usually occur in Kentucky. Large larvae cannot be controlled effectively with insecticides. Monitor for this insect and treat when larvae are small.)*		
Avaunt 30 WDG	3.5 oz	Limit 14 oz/A. Allow at least 5 days between applications.
Proclaim 5 WDG	2.4 to 4.8 oz	Limit 28.87 oz/A, allow at least 7 days between applications.
Confirm 2 F	6 to 16 fl oz	Limit 64 fl oz/A.
Dimilin 25 W	4 to 8 oz	Limit 5 applications of 24 oz/A.
Intrepid 2 F	4 to 16 fl oz	Limit 64 fl oz/A.
Radiant SC	5 to 10 fl oz	Limit 34 fl oz/A. Allow 4 days between applications.
Spintor 2 SC	4 to 8 fl oz	Limit 29 fl oz/A.
XenTari	0.5 to 2 lb	
Cutworms *(Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.)*		
Capture 2 E	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A. Allow 7 days between applications.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 27.4 fl oz/A. Allow 7 days between applications.
Mustang Max	2.24 to 4.0 fl oz	Limit 24 fl oz/A. Allow at least 7 days between applications.
Sevin XLR	2 qt	Limit 7 applications and allow at least 7 days between sprays. Limit 8 qts per season.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.
Warrior T	1.92 to 3.2 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.
Flea Beetles		
Actara 25 WDG	2 to 3 oz	Limit 8 oz/A. Allow 5 days between applications.
Asana XL	5.8 to 9.6 fl oz	Limit 67.2 fl oz/A.
Capture 2 E	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A. Allow 7 days between applications.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A. Allow 5 days between applications.
Endosulfan 3 EC	1.33 to 2.67pt	Limit 2 applications.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 27.4 fl oz/A. Allow 7 days between applications.
Mustang Max	2.24 to 4.0 fl oz	Limit 24 fl oz/A. Allow at least 7 days between applications.
Pounce 3.2 EC	4 to 8 fl oz	Limit 64 fl oz/A. Bell peppers only.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.
Sevin XLR	0.5 to 1 qt	Limit 7 applications and allow at least 7 days between sprays. Limit 6 qts per season.
Warrior T	2.56 to 3.84 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.
Thrips		
Baythroid XL	2.8 fl oz	Limit 16.8 fl oz/A/season. Allow 7 days between applications
Capture 2 E	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A. Allow 7 days between applications.
Spintor 2 SC	4 to 8 fl oz	Limit 29 fl oz/A.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.
Warrior T	2.56 to 3.84 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.
European Corn Borer *(Key insect pest of peppers. Use pheromone traps to monitor for adult activity. Begin applications when trap catches exceed 10 moths per week. Advisories are also issued to county Extension offices when the damaging second generation borer larvae are likely to appear in Kentucky.)*		
Asana XL	5.8 to 9.6 fl oz	Limit 67.2 fl oz/A.
Baythroid XL	1.6 to 2.8 fl oz	Limit 16.8 fl oz/A. Allow 7 days between applications.
Capture 2 E	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A. Allow 7 days between applications.
Confirm 2 F	6 to 16 fl oz	Limit 64 fl oz/A.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A. Allow 5 days between applications.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 27.4 fl oz/A. Allow 7 days between applications.
Intrepid 2 F	4 to 16 fl oz	Limit 64 fl oz/A.
Orthene 75 S	1 to 1.33 lb	Bell peppers only.
Mustang Max	2.24 to 4.0 fl oz	Limit 24 fl oz/A. Allow at least 7 days between applications.
Pounce 3.2 EC	8 fl oz	Limit 64 fl oz/A. Bell peppers only.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.
Radiant SC	5 to 10 fl oz	Limit 34 fl oz/A. Allow 4 days between applications.
Sevin XLR	1 to 2 qt	Limit 7 applications and allow at least 7 days between sprays. Limit 8 qts per season.
Spintor 2 SC	3 to 6 fl oz	Limit 29 fl oz/A.
Warrior T	2.56 to 3.84 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.

INSECT CONTROL: *Peppers[1,2]*

Insecticide	Product Amt/A	Comments and Seasonal Limits
Stink Bugs		
Actara 25 WDG	3 to 4 oz	Limit 8 oz/A. Allow 5 days between applications.
Baythroid XL	1.6 to 2.8 fl oz	Limit 16.8 fl oz/A/season. Allow 7 days between applications
Capture 2 E	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A. Allow 7 days between applications.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 14.4 fl oz/A. Allow 5 days between applications.
Hero 1.24 EC	4 to 10.3 fl oz	Limit 27.4 fl oz/A. Allow 7 days between applications.
Mustang Max	3.2 to 4.0 fl oz	Limit 24 fl oz/A. Allow at least 7 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.
Warrior T	2.56 to 3.84 fl oz	Limit 2.88 pt/A. Allow 5 days between applications.

[1] See also Kentucky Pepper Integrated Crop Management Grower Guide (IPM-13) for more information on scouting and insect pest management.
[2] To view color pictures of the pests, see: http://www.uky.edu/Ag/IPM/picturesheets/pepperinsects.pdf

WEED CONTROL: *Pepper*

Product Amt/A	Lb A.I./A	Remarks
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal of water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
0.67 to 2.67 pt Command 3ME	0.25 to 1 clomazone	For preemergence control of annual grasses and broadleaves. Apply and incorporate 1 to 2 inches before transplanting. Use in combination with other herbicides like Treflan or Devrinol to broaden the weed control spectrum. Can be used on bell, hot, pimento, and sweet peppers but not on banana peppers. Be sure to set transplants with their roots below chemical barrier when transplanting.
8 to 14 pt Dacthal 6 F	6 to 10.5 DCPA	For preemergence control of annual grasses and small-seeded broadleaves. Over the top application 4 to 6 weeks after transplanting is safe to plants. Plants should be well established.
2 to 4 lb Devrinol 50 DF	1 to 2 napropamide	For control of annual grasses and broadleaves. Apply before transplanting and water-in or incorporate to a depth of 1 to 2 inches. Can be applied on bareground middles between beds of plastic 24 hours before rain or if watered-in or incorporated. To avoid injury, do not replant with crops not specified on the label until 12 months if using the 4-lb rate.
0.5 to 1.3 pt Dual II Magnum 7.6 E	0.48 to 1.3 s-metolachlor	This special needs label is held by the Kentucky Vegetable Growers Assn., and you must be a member to use this herbicide on peppers and to receive a copy of the label. To become a member, call the UK Department of Horticulture at 859-257-3374. Apply as a surface broadcast application before transplanting or within 48 hours after transplanting. Can be used as pre- or post-transplant directed, shielded spray to row middles. Use a min. 10 gal water/A. Use the high rate on silt and clay soils or high organic matter soils.
1 to 2 pt Goal 2XL	0.25 to 0.5 oxyfluorfen	For preemergence and postemergence control of certain annual grasses and most broadleaves. For fallow bed preparation only. Best if used with glyphosate for control of winter annual broadleaf weeds. Min. 30 days between application and transplanting.
1.3 to 2.7 pt Gramoxone Max 3 L	0.5 to 1 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, preemergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
0.5-2.5 pt Poast 1.5 E	0.09-0.49 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. PHI = 20 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
5 to 6 qt Prefar 4 E	5 to 6 bensulide	For control of grasses and broadleaf weeds. Apply preplant and incorporate to 1 to 2 inch depth. Apply preemergence only if it can be watered in within 36 hours. Max. rate of 6 qt/season.
1.5 to 2 pt Prowl H2O 3.8 E	0.7 to 1 pendimethalin	For preemergence control of broadleaves and grasses. Apply preplant and incorporate prior to transplanting pepper or as a post-directed application to established plants. PHI = 70 days.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 3 days before seeding and min. 30 days before planting any non-labeled crop.
0.5 to 1 oz Sandea 75 DF	0.023 to 0.047 halosulfuron	For control of annual broadleaf weeds and yellow nutsedge. Can be applied in row middles of direct-seeded or transplanted eggplant. Avoid contact with the crop or with plastic if plastic mulch is used. Max. 2 applications/crop and 2 oz/A/season.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
6 to 8 fl oz Select 2E	0.09 to 0.12 clethodim	For selective postemergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 8 fl oz/application. Min. 14 days interval between applications. PHI = 20 days.
1.25-2 pt Treflan HFP 4 E	0.62-1 trifluralin	For preemergence control of annual grasses and broadleaf weeds. For transplanted pepper use only. Apply as preplant soil incorporated before transplanting.

DISEASE CONTROL: *Peppers*

Product	Amt/A	Seasonal Limits/A	Comments
Alternaria Fruit Rot, Anthracnose, Leaf Blights			
Azoxystrobin[1]		4 apps	ANTHRACNOSE ONLY. Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	2 to 5 oz		
Heritage	3.2 to 8 oz		
Quadris	6 to 15.5 fl oz		
Cabrio[1]	8 to 12 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Endura	2.5 to 3.5 oz	6 apps	ALTERNARIA ONLY. Apply before disease onset, continue on a 7- to 14-day schedule. No more than 2 sequential applications of Endura can be made before rotating to another mode of action.

DISEASE CONTROL: *Peppers*

Product	Amt/A	Seasonal Limits/A	Comments
Fixed coppers		n/a	Apply before disease onset, continue on a 7- to 10-day schedule, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	1.8 to 2.8 pt		
Basic Copper 53	3 to 4 lb		
C-O-C-S WDG	2 to 4 lb		
Cuprofix Ultra 40 Disperss	1.25 to 3 lb		
Kocide 101	2 to 3 lb		
Kocide 2000	1.5 to 2.25 lb		
Kocide 3000	0.75 to 1.25 lb		
Kocide DF	2 to 3 lb		
Kocide 4.5 LF	1.33 to 2 pt		
Tenn-Cop 5 E	3 to 4.5 pt		
Flint[1]	2 to 4 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Maneb			Apply at first fruit cluster and continue on a 7-to 10-day schedule as needed. Limit 14.4 lb ai/A/season.
Maneb 75 DF	1.5 to 3 lb	19.2 lb	
Maneb 80 WP	1.5 to 3 lb	18 lb	
Manex	1.2 to 2.4 qt	14.4 qt	
Tanos[1]	8 to 10 oz		Tanos must be tank-mixed with a multi-site inhibitor (FRAC Group M) appropriate for the target disease. Apply before disease onset, continue on a 5- to 7-day schedule. Limit 72 oz/A/season.
Bacterial Leaf Spot			
Agri-Mycin 17 Firewall	16 oz/100 gal	n/a	PRE-TRANSPLANT TREATMENT: Apply when seedlings are in 2-leaf stage and continue on 4- to 5-day intervals until transplanting. Not for field use.
Fixed coppers		n/a	Apply before disease onset, continue on a 5- to 10-day schedule, depending upon product and conditions. Performance will be enhanced by tank mixing with maneb. See label for mixing instructions and tank-mix precautions.
Badge SC	1.8 to 2.8 pt		
Basic Copper 53	3 to 4 lb		
Champ DP	1.33 to 2 lb		
Champ Formula 2 FL	1.33 to 2 pt		
Champion WP	2 to 3 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	3 to 6 pt		
Cuprofix Disperss	2.5 to 6 lb		
Cuprofix Ultra 40 Disperss	1.25 to 3 lb		
Kocide 101	2 to 3 lb		
Kocide 2000	1.5 to 2.25 lb		
Kocide 3000	0.75 to 1.25 lb		
Kocide DF	2 to 3 lb		
Kocide 4.5 LF	1.33 to 2 pt		
Nu-Cop 50 WP	2 to 3 lb		
Nu-Cop 3 L	1.33 to 4 pt		
Nu-Cop 50 DF	2 to 3 lb		
Tenn-Cop 5 E	3 to 4.5 pt		
Tanos[1]	8 to 10 oz	72 oz	Tanos must be tank-mixed with a multi-site inhibitor (FRAC Group M) appropriate for the target disease. Apply before disease onset, continue on a 5- to 7-day schedule.
Phytophthora Blight			
Acrobat 50 WP	6.4 oz	5 apps	Must be tank-mixed with another Phytophthora fungicide. Apply before disease onset, continue on a 5- to 10-day schedule. Rotate to another fungicide after 2 consecutive applications. Limit 5 apps/season.
Forum SC	6 fl oz	5 apps	
Ridomil Gold EC	0.5 to 1 pt	3 pt	SURFACE APPLICATION (pre-plant or at planting): Apply 1 pt/A to soil as a broadcast spray or in a 12- to 16-inch band; incorporate mechanically before planting into the upper 2 inches of soil or at-planting with 0.5 to 1 in of irrigation if rainfall is not expected within 24 hours. Make 1 additional 1-pt/A application 30 days later, directing spray at the base of plants and surrounding soil. DRENCH APPLICATION: Apply 0.5 to 1 pt/A pre-plant or at planting in 20 gal/A of water; make 2 supplemental applications at 2 to 4 oz/A beginning 14 days after initial treatment and continuing on a 14-day schedule.DRIP IRRIGATION (pre-plant or post-planting): Inject 1 pt/A through drip irrigation at planting, make up to 2 sequential applications at 30 day intervals after the first application.
Ridomil Gold SL			
Ultra Flourish	2 to 4 pt	6 pt	Multiply Ridomil rate X 2 for Ultra Flourish. See notes for Ridomil Gold for application types.
Ridomil Gold Copper	2.5	4 apps	Apply 30 days after soil application of Ridomil Gold EC and continue on a 10- to 14-day interval. Observe seasonal limits for mefenoxam.
Tanos[1]	8 to 10 oz	72 oz	FOLIAR AND FRUIT PHASE ONLY. Tanos must be tank-mixed with a multi-site inhibitor (FRAC Group M) appropriate for the target disease. Apply before disease onset, continue on a 5- to 7-day schedule.
Southern Blight			
Evito 480 SC[1]	3.8 to 5.7 fl oz	4 apps	Apply before onset of disease and continue applications on a 7 to 10-day interval as needed.
Terraclor 75 WP	3 lb/100 gal	1 app	Apply 0.5 pt of solution per plant at transplanting; maintain agitation to keep material in suspension.
Terraclor Flowable	4.5 pt/100 gal	1 app	

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

Potatoes

Nightshade family (Solanaceae): *Solanum tuberosum*

Potatoes are grown in Kentucky as an early crop for fresh market and for sales to potato chip companies for chipping. Opportunity also exists for the production of small red "new potatoes," russets, heirlooms, and other specialty or "gourmet" types for local markets, sales to restaurants, or sales to local/area wholesalers. Sales of very small "baby" or "mini" potatoes are also possible and command premium prices in some markets.

Planting and Culture

Loam soils are most desirable for good potato yields, though potatoes can be grown on a wide range of soil types. Select a well-drained soil. Sod ground should be treated with a soil insecticide prior to planting to control grubs and wireworms.

Optimum planting times are from March 15 to April 10 for early potatoes and from June 15 to July 15 for a late crop (see Appendix H).

Planting should be made in rows 30 to 36 inches apart with a seed piece dropped each 10 to 12 inches in the furrow. Seed planted in mid-March should be planted 2 to 3 inches deep. The late crop should be planted 4 to 5 inches deep. Seed pieces should be 1 ½ to 2 ounces in size. Only certified disease-free seed stock should be purchased. Freshly cut seed should be planted as soon as possible after cutting. Seed may be pre-cut several days in advance of planting if proper storage conditions are provided so the seed pieces can "heal over." A storage temperature of 60°F for 10 days to two weeks before planting will help initiate sprout activity and encourage more rapid emergence.

Fifteen to 18 (100-lb) bags of seed potatoes are usually needed to plant an acre. Potatoes should not follow potatoes or other solanaceous crops (tomatoes, tobacco, peppers) on the same ground year after year. Follow a three- or four-year rotation program.

When planting, there will be a small ridge of soil developed over each row. Dragging across the ridges just before the sprouts break through helps to eliminate weeds and allows the potato sprouts to more easily break through compacted soil.

Production with Plasticulture

Potatoes can also be grown on raised beds with black plastic and drip irrigation. Growers have obtained higher and earlier yields of better quality potatoes with plasticulture; potatoes grown on plastic mulch are also easier to dig at harvest. Potatoes can also be grown under high tunnels for even earlier harvests.

All fertilizer can be applied prior to planting or half the nitrogen requirement can be applied before planting with the remainder divided into equal doses fertigated weekly. Planting holes can be made in plastic mulch using a waterwheel setter and seed pieces dropped in the holes and covered with soil by hand. Kentucky growers have used two rows per bed with 18 inches between rows and 9 to 12 inches between plants within the rows and 5 feet between bed centers. Pennsylvania growers have used double rows 13 inches apart with 8 inches between plants in the rows. Closer spacings promote higher percentages of smaller tubers and should be used to produce potatoes to be sold as "new," "gourmet," "baby," or "mini" potatoes (see also "Harvesting and Handling" on the next page). Vine killing can be more problematic for some specialty potato varieties. In addition to chemical dessicants, a plastic mulch lifter can be used to undercut the plants to assist in vine killing prior to digging.

Fertilizing

Fertilize and lime based on soil test results; a soil pH of 6.0 to 6.5 is considered most desirable for maximum availability of nutrients for potatoes. However, potato scab will usually be more serious at high pH levels. There will normally be less scab when the pH is between 5.0 to 5.2. Potatoes grown for chipping should be grown at the higher pH and those for fresh market at the lower pH if scab is a problem.

It is suggested that one-half of the fertilizer used at planting be broadcast prior to planting and disked in. Band the remaining fertilizer 2 to 3 inches to the side and slightly below the seed piece. Fertilizer should not come in contact with the seed piece. Sidedress with 50 to 75 lb of actual nitrogen (N) per acre when plants are 4 to 8 inches tall or at lay-by.

VARIETIES: *Potatoes*

Variety	Comments
Superior	White skinned, early maturing. Has resistance to scab. Tubers are oval to oblong. Suitable for table use and chipping.
Norchip	White skinned, midseason maturity. Tubers are round to oblong in shape with shallow eyes—very suitable for chipping. Moderate resistance to scab. Variety has a heavy tuber set and seed should be spaced 12 inches apart in row.
Kennebec	White skinned, midseason maturity. Heavy yielding but rough in shape. A good general purpose potato.
Dark Red Norland	Red skinned, early maturing. Rounded tubers, deep red color, shallow eyes--very suitable for table and "new" potatoes.
Norkota	White russet. Midseason maturity. Excellent baking-type potato.
Yukon Gold	Yellow flesh. Round, medium-early maturing. Good appearance; somewhat susceptible to common scab.
"Gourmet" Varieties[1]	
Red Gold	Light red skin, yellow flesh, midseason maturity. Good yields of high quality tubers; not suitable for long term storage.
Rose Gold	Pink skin, light yellow flesh, midseason maturity. Good yields of high quality tubers; not suitable for long term storage.
All Red	Red skin, pink flesh, early-midseason maturity; nice skin color.
All Blue	Purple skin and flesh, midseason maturity; long, rough tubers.
Butte	Russet skin, white flesh, midseason-late maturity; attractive and uniform "baby" russet tubers. Rank vine growth.
Russian Banana	White skin, light yellow flesh, midseason maturity; long, thin "sweetpotato" shapes; unique taste.
Swedish Peanut	White skin, golden yellow flesh, midseason maturity; shorter, teardrop "sweetpotato" shapes with shallow eyes; unique taste. Rank vine growth.

[1] *We have observed that seed quality (disease incidence and trueness to type) of some varieties of "gourmet" or specialty potatoes varies considerably from one seed source to the next and from year to year from the same source. Because of the danger of freezing in shipment, it is also difficult to obtain seed of some of these varieites in time for early plantings in Kentucky. Buy only high quality certified seed and check with the supplier on earliest shipment dates, etc.*

FERTILIZER: *Potatoes*

Soil Test Results *(lb/A)*		**Fertilizer Needed** *(lb/A)*
Phosphorus		**Phosphate** *(P_2O_5)*
Low	<31	181-240
Medium	31-60	91-180
High	61-80	61-90
Very High	>80	60
Potassium		**Potash** *(K_2O)*
Low	<201	251-300
Medium	201-300	101-250
High	301-450	51-100
Very High	>450	50
Nitrogen		**N**
Total of 150 lb nitrogen/A is recommended. Apply 75 to 100 lb of nitrogen/A at time of planting and apply a sidedressing of 50 to 75 lb N/A when plants are 4 to 8 inches tall or at lay-by.		

Harvesting and Handling

When to dig potatoes will depend on the price and method of selling. For local market, it may be desirable to dig before vines die back. Vines of potatoes grown for storage should be dead before digging. Potatoes dug when immature are very susceptible to skinning and bruising. Using chemical desiccants to artificially kill the plant tops will aid in earlier harvest and promote a firmer skin set. Harvesters or diggers should have digger chain speed adjusted to minimize injury to tubers. Protect freshly dug potatoes from hot sun and drying winds. Smaller-sized "new" or gourmet potatoes are often dug by hand.

If tablestock potatoes are to be stored and kept for long periods, the storage facility should be clean and sanitized. Potatoes should be held at 55°F for two weeks at a relative humidity of 90 percent, and then the temperature should be lowered to 40°F with a relative humidity of 85 to 90 percent.

Washing potatoes for fresh market is desirable. Chlorine at the rate of 150 to 200 parts per million should be added to the water to help destroy surface disease organisms. Potato tubers should dry before bagging, especially into plastic, to reduce chances of bacterial soft rot. Do not wash potatoes going into storage.

Sprouting in storage can be reduced by spraying potato plants while still in the field with maleic hydrazide. Apply to the plants when tubers are 1 ½ to 2 inches in diameter. Read the product label for directions and precautions.

Potatoes are marketed in a variety of containers with several grade specifications. Russet potatoes are usually packed in consumer packs, count cartons, or large institutional packs. The most valuable potatoes are generally 8 to 14 ounce tubers packed in 50 lb cardboard boxes or "count cartons." Each carton has a number that tells how many tubers are in a box. These are sold to retail stores and restaurants and are typically used for baking. Red and white potatoes are sold in a wider range of sizes per container ("non-size" Grade A) including 5, 8, 10, and 50 lb plastic, poly mesh, paper, and burlap bags. Prices for 50 lb cartons of graded U.S. No. 1 potatoes can triple those for 50 lb bags of U.S. No. 1 non-size potatoes.

New potatoes are usually B size (1 ½ to 2 ¼ inches in diameter) tubers while gourmet, "baby," or "creamer" potatoes may be even smaller (1 to 1 ½ inches in diameter). "Fingerling" potatoes are sorted by length and range from 2 to 3 ½ inches long. Specialty potatoes are often sold for premium prices and are packed in small mesh bags, vented poly bags, baskets, cartons, tray packs or clamshells.

Common Diseases/Management

Blackleg, seed-piece rots, and tuber-borne diseases. Planting quality seed pieces prevents losses to certain potato diseases. Do not save seed; local diseases build up quickly. Keep in mind that certified seed may still carry pathogens at low levels.

Seed potatoes should be allowed time to become physiologically active by warming at 65° to 70°F for two to three weeks prior to planting. Buy seed tubers that have been treated prior to storage with thiabendazole (Mertect 340F) to reduce *Fusarium*. Plant whole seed tubers, if possible; seed-piece decay can be reduced greatly by this practice. For cut seed-pieces, treat with fungicide immediately, allowing time for the fungicide to dry and plant within six hours after cutting for best results. If cut seed must be held over, let them dry in open slatted crates for two days before

PESTICIDE SAFETY: *Potatoes*

	Signal[4]	Re-entry *(hrs)*	Harvest *(days)*[5]
Insecticides			
Acramite 4 SC	C	12	14
Actara 25 WDG	C	12	14
Admire Pro	C	12	AP
Assail 30 SG	C	12	7
Avaunt 30 WDG	C	12	7
Beleaf 50 SG	C	12	7
Clutch 50 WDG	C	12	14
Dimethoate 4 E	W	48	0
Endosulfan 3 EC	DP	24	1
Fulfill 50 WDG	C	12	14
Imidan 70 WP	W	24	7
Malathion 8	C	12	0
Novodor FC	C	4	0
Oberon 2 SC	C	12	7
Platinum 2 SC	C	12	AP
Provado 1.6 F	C	12	7
Radiant SC	C	4	7
Rimon 0.83 EC	W	12	14
Sevin XLR	W	12	7
SpinTor 2 SC	C	4	7
Venom 70 SG	C	12	7
RESTRICTED USE			
AgriMek 0.15 EC	W	12	14
Asana XL	W	12	7
Baythroid XL	W	12	0
Decis 1.5 EC	DP	12	3
Furadan 4 F	DP	48	14
Lannate 90 SP	DP	48	6
Leverage 2.7	W	12	7
Mustang Max	W	12	1
Penncap-M	W	96	5
Pounce 3.2 EC	C	12	14
Renounce 20 WP	C	12	0
Thimet 20 G	DP	48	90
Vydate L	DP	48	7

PESTICIDE SAFETY: *Potatoes*

	Signal[4]	Re-entry *(hrs)*	Harvest *(days)*[5]
Fungicides			
Acrobat 50 WP Forum SC	C	12	4
Agri-Mycin 17 Firewall	C	12	0
Azoxystrobin[2]	C	4	14
Bravo ZN	W	48	7
Chlorothalonil[2]	D	12	7
Cuprofix MZ Disperss	C	24	14
Curzate 60 DF	W	12	14
Endura	W	12	30
Evito 480 SC	C	12	7
Fixed coppers[2]	D	12/24[1]	0
Flouronil	D	48	14
Gavel 75 DF	C	48	14
Gem	C	12	7
Headline	W	12	3
Maneb/Mancozeb[2]	C	24	14
Maxim Potato Seed Protectant	C	12	0
Moncut 70 DF	C	12	0
PCNB[2]	W	12	0
Polyram	C	24	14
Quadris Opti	W	12	14
Ranman	C	12	7
Reason 500 SC	C	12	14
Ridomil Gold Bravo Ridomil Gold Bravo SC	D W	48	14
Ridomil Gold Copper	D	48	14
Ridomil Gold EC/SL	C	48	0
Ridomil Gold MZ	C	48	14
Rovral 4 Flowable Iprodione 4L AG	C	12	14
Scala	C	12	7
Sulfur[2]	C	24	0
Tanos	C	12	14
Thiophanate-methyl[2]	C	12	21
Ultra Flourish	W	48	0
RESTRICTED USE			
Super Tin 80 WP	D	48	7

[1] Safety information varies by product; read the label carefully.
[2] Several formulations are marketed. See the general introduction for more details on fungicides.
[4] W: Warning, C: Caution, D: Danger; P: Poison
[5] AP: At planting

bagging. Avoid bruising of seed during handling. Dust seed pieces with maneb, mancozeb, or Maxim (see tables for rates and use directions). Soaking seed pieces in a solution of streptomycin sulfate (Agri-Mycin 17) solution at 0.5 lb/100 gallons for 30 minutes (prior to applying the seed treatment dusts) will assist in controlling blackleg.

Early blight. Early blight, caused by *Alternaria solani*, is a major cause of early defoliation of potatoes in Kentucky and its control requires a good preventive fungicide spray program. Two year rotations away from potatoes, tomatoes, eggplant, and tobacco are helpful. Minimize stress on plants by avoiding poorly drained sites and irrigating when necessary. Maintain adequate soil fertility, particularly N and K. See tables for registered fungicide products and rates. Several materials labeled for early blight will also control late blight. These include strobilurins (Quadris/Amistar, Headline), chlorothalonil, mancozeb, fixed coppers, and mefenoxam-containing products (Ridomil Gold Bravo, RG MZ, RG Copper); available products and rates are summarized below. When using mefenoxam or strobilurins, follow all resistance management guidelines provided on the label.

Late Blight. In general, temperatures in the Commonwealth are too high during the normal growing season to support late blight even when leaf wetness is ideal. To minimize problems with late blight, plant certified seed, destroy all cull piles, and do not plant in fields with volunteer potatoes. Eliminate volunteer potatoes and volunteer tomatoes on the farm. Do not harvest until the vines are completely dead. If late blight appears near harvest, quickly kill vines using a labeled vine-killer. When applied as part of a regular program, any of the fungicides for early blight (except Rovral or Endura) should provide adequate control of late blight (see tables). Under severe conditions in Kentucky, shorten spray intervals and increase gallonage per acre to improve coverage. Fixed coppers are more effective on late blight than on early blight and are an excellent option for early in the season.

Nematodes. Avoid problem fields if at all possible until they can be properly rotated to non-host crops. If problem sites must be used, fumigate prior to planting (see "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 18). With low populations, adequate control can be obtained with Vydate L at 1 to 2 gal/20 gal. of water per acre applied in seeding furrows at 1 to 2 oz/100 ft of treated row or with Mocap 15G at 20 lb per acre applied in a 12-inch band on the side of the row at planting. Rotation for 2-3 years with grasses is also effective in reducing nematode numbers.

Rhizoctonia stem canker and black scurf. Avoid heavily infested fields, plant uncontaminated seed, and be sure that the previous crop residues are well rotted prior to planting. At-planting applications of azoxystrobin, Moncut 70DF, and PCNB will also reduce losses to *Rhizoctonia*; see tables for rates and products.

Scab. Scab is less problematic in slightly acidic soil; maintain a soil pH of 5.0-5.2, especially if the field was planted to potatoes within the last three years. Rotate away from potatoes for 3-4 years in scab-prone fields. Scab is favored by additions of manure or organic matter immediately prior to planting. This makes scab a significant threat in organic production. Cover crops should be turned well in advance of planting to ensure decomposition. Maintain soil moisture at or near field capacity during tuber formation. Keeping the pH low to discourage scab development is more valuable than seed treatment. In cases where a higher pH is required, some improvement in scab control can be achieved from using seed piece treatments (maneb, mancozeb) to suppress seed-borne inoculum.

Verticillium wilt. Use certified seed and seed treatments to minimize introduction of *Verticillium* into clean fields. Rotate to small grains or other grasses to slow population buildup. Control weeds during rotations. The presence of other root pests, such as nematodes, may favor Verticillium wilt. *Nematodes must be controlled if this wilt pathogen is present*. Pre-plant soil fumigation is also an option for heavily infested fields (see "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 18).

Viruses. A high level of control is possible with use of high-quality, certified seed. The potential of potatoes serving as a *source of viruses for tobacco* is an important thing to consider if both are being planted on the same farm. The nearer the two crops are planted, the greater the risk of Potato Virus Y and Tobacco Etch. Keep potatoes 150-200 yards away from other solanaceous crops, and control insect vectors (aphids, leafhoppers). The level of common strains of PVY associated with Kentucky tobacco crops has also increased markedly. Therefore, when selecting certified seed, one should also consider the certification standards being used. Speak to local suppliers about this issue before they contract to buy seed potatoes. Consider more than the price of the seed—also consider the benefit to other crops when seed potatoes with lower virus incidences are used.

INSECT CONTROL: *Potatoes*

Insecticide	Product Amt/A	Comments and Seasonal Limits
PREPLANT INCORPORATE		
Wireworms, Cutworms		
Diazinon 50 W	4 to 8 lb	Incorporate immediately.
AT PLANTING		
Wireworms, Flea Beetles, Colorado Potato Beetle, Aphids *(Do not use a foliar spray of Actara, Assail, Clutch, Provado, or Venom following a soil application of Admire, Platinum, or Venom.)*		
Admire Pro	5.7 to 8.7 fl oz	For Colorado potato beetle, aphids, and flea beetles. Limit one application.
Platinum 2 SC	5 to 8 fl oz	For Colorado potato beetles and flea beetles. Limit one application.
Thimet 20 G	11.3 oz/1,000 row ft	
Venom 70 SG	6.5 to 7.5 oz	For Colorado potato beetle and flea beetles. Limit one application.
FOLIAR TREATMENTS		
Grasshoppers		
Asana XL	5.8 to 9.6 fl oz	Limit 67.2 fl oz/A.
Dimethoate 4 E	0.5 to 1 pt	
Mustang Max	3.2 to 4 fl oz	Limit 24 fl oz/season, allow at least 4 days between applications.

INSECT CONTROL: *Potatoes*

Insecticide	Product Amt/A	Comments and Seasonal Limits
European Corn Borer		
Asana XL	5.8 to 9.6 fl oz	Limit 67.2 fl oz/A.
Baythroid XL	1.6 to 2.8 fl oz	Limit 16.8 fl oz/A. Allow 5 days between applications.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 24 fl oz/A. Allow 3 days between sprays.
Mustang Max	1.76 to 4 fl oz	Limit 24 fl oz/season, allow at least 4 days between applications.
Pounce 3.2 EC	4 to 8 fl oz	Limit 64 fl oz/A.
Radiant SC	6 to 8 fl oz	Limit 32 fl oz/A. Allow 7 days between applications.
Rimon 0.83 EC	9 to 12 fl oz	Limit 2 applications.
SpinTor 2 SC	3 to 6 fl oz	Limit 21 fl oz/A.
Colorado Potato Beetle, Flea Beetle *(Colorado Potato Beetle is the key insect pest of potato. This pest has the ability to develop resistance to all major classes of insecticides. Do not tank mix insecticides with the same mode of action and frequently rotate among insecticides with different modes of action to discourage resistance. Treat when an average of more than 1 larva/adult is found per plant on plants less than 6 inches tall or when 2 or more larvae/adults are found on larger plants. IRAC Codes: Insecticides followed by the same number share the same mode of action.)*		
Actara 25 WDG (4A)	1.5 oz	Limit 3 oz/A. Allow 7 days between applications.
Agri-Mek 0.15 EC (6)	8 to 16 fl oz	Limit 32 fl oz/A. Do not make more than 2 sequential applications.
Assail 30 SG (4A)	1.5 to 4.0 oz	Limit 4 applications and 16 oz per season. Allow 7 days between applications.
Avaunt 30 WDG (22)	3.5 to 6.0 oz	Limit 24 oz/A. Allow 5 days between sprays.
Baythroid XL (3)	1.6 to 2.8 fl oz	Limit 16.8 fl oz/A. Allow 5 days between applications.
Clutch 50 WDG (4A)	1.0 to 1.5 oz	Limit 3 applications, allow 7 days between applications.
Endosulfan 3 EC (2A)	1.33 to 2.67 pt	Limit 6 applications or 4 qt/A.
Imidan 70 W (1B)	1.33 lb	Machine harvested potatoes only.
Novodor FC (11C)	1 to 4 qt	For larvae only.
Provado 1.6 F (4A)	3.75 fl oz	For Colorado potato beetle. Limit 15 fl oz/A. Allow 7 days between applications.
Radiant SC (5)	6 to 8 fl oz	Limit 32 fl oz/A. Allow 7 days between applications.
Rimon 0.83 EC (15)	9 to 12 fl oz	Limit 2 applications.
Sevin 80 S (1A)	1.25 to 2.5 lb	Limit 6 applications and allow at least 7 days between sprays.
SpinTor 2 SC (5)	3 to 6 fl oz	Limit 21 fl oz/A.
Venom 70 SG (4A)	1 to 1.5 oz	Limit 4.5 oz/A.
Leafhoppers		
Actara 25 WDG	1.5 oz	Limit 3 oz/A. Allow 7 days between applications.
Asana XL	2.9 to 5.8 fl oz	Limit 67.2 fl oz/A.
Assail 30 SG	1.5 to 4 oz	Limit 4 applications and 16 oz per season. Allow 7 days between applications.
Baythroid XL	0.8 to 1.6 fl oz	Limit 16.8 fl oz/A. Allow at least 5 days between applications.
Decis 1.5 EC	1.5 to 2.4 fl oz	Limit 24 fl oz/A. Allow 3 days between sprays.
Dimethoate 4 E	0.5 to 1 pt	
Endosulfan 3 EC	1.33 to 2.67 pt	Limit 6 applications or 4 qt/A.
Mustang Max	1.76 to 4 fl oz	Limit 24 fl oz/season, allow at least 4 days between applications.
Penncap-M	2 to 4 pt	
Pounce 3.2 EC	4 to 8 fl oz	Limit 96 fl oz/A.
Sevin XLR	0.5 to 1 qt	Limit 6 applications and allow at least 7 days between sprays.

WEED CONTROL: *Potato*

Product Amt/A	Lb A.I./A	Remarks
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 11.6 fl oz/A. PHI = 7 days.
8 to 14 pt Dacthal 6 F	6 to 10.5 DCPA	For preemergence control of annual grasses and small-seeded broadleaves. Apply at or after planting or after drag-off. Layby applications can be made up to 9 weeks after planting.
1 to 2 pt Dual II Magnum 7.6 E	0.95 to 1.9 s-metolachlor	For control of most annual grasses and certain broadleaf weeds and yellow nutsedge. Apply preplant incorporated, preemergence. Dual Magnum may delay maturity and/or reduce yield of 'Superior' and other early maturing potato varieties if cold, wet soil conditions occur after treatment. See label for incorporation directions. 60-day pre-harvest interval.
1.2 pt Dual II Magnum 7.6 E + 1.5 to 2 lb Lorox 50 DF	1.2 s-metolachlor + 0.75 to 1 linuron	For control of most annual grasses and certain broadleaf weeds and yellow nutsedge. Apply after planting but before crop emergence. See Dual Magnum label for rotational crops restrictions. Dual Magnum may delay maturity and/or reduce yield of Superior and other early maturing potato varieties if cold, wet soil conditions occur after treatment. See Lorox label for specific rates on different percent organic matter soils and soil textures.
1.2 to 2 pt Dual II Magnum 7.6 E + 1 to 2 pt Sencor 4 F	1.2 to 1.9 s-metolachlor + 0.5 to 1 metribuzin	For control of most annual grasses and certain broadleaf weeds and yellow nutsedge. Apply after planting or after drag-off but before crop emergence. See Dual Magnum label for rotational crops restrictions. Dual Magnum may delay maturity and/or reduce yield of Superior and other early maturing potato varieties if cold, wet soil conditions occur after treatment.
3.5 pt Eptam 7 E	3 EPTC	For control of annual grasses and broadleaf weeds and suppression of yellow nutsedge. Apply before planting. Incorporate immediately 2 to 3 inches. Superior variety is sensitive to Eptam under stress conditions.
1 to 2 pt Goal 2XL	0.25 to 0.5 oxyfluorfen	For preemergence and postemergence control of certain annual grasses and most broadleaves. For fallow bed preparation only. Best if used with glyphosate for control of winter annual broadleaf weeds. Min. 60 days between application and planting.
0.7 to 1.3 pt Gramoxone Max 3 L	0.26 to 0.5 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply up to ground cracking to emerged weeds but before crop emergence; may be used instead of drag-off operation for emerged weeds and before using pre-emergence herbicides. Add non-ionic surfactant 0.25% v/v.
1.5 to 2.5 lb Lorox 50 DF	0.75 to 1.25 linuron	For control of annual grasses and broadleaf weeds. Apply after planting but before crop emerges. Plant seed at least 2 inches deep. Best results if rainfall or irrigation is applied within 2 weeks of application.
1 to 1.5 oz Matrix 25 DF	0.016 to 0.023 rimsulfuron	For preemergence control of broadleaves and grasses. Apply immediately after hilling, drag-off, or reservoir tillage. ⅓ to 1" rainfall or irrigation is needed for activation. Do not use on potato grown for seed. Matrix can also be applied chemigation. See label for details.

WEED CONTROL: *Potato*

Product Amt/A	Lb A.I./A	Remarks
14 to 18 fl oz Outlook 6 E	0.6 to 0.8 dimethenamid-p	For preemergence control of broadleaves and grasses. Apply after planting or after drag-off or as chemigation. Leave a 35 ft untreated buffer and endangered plant populations in the following counties: Barren, Boone, Hardin, Laurel, Rockcastle, Wolfe. PHI = 40 days.
0.5 to 2.5 pt Poast 1.5 E	0.09 to 0.48 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. PHI = 30 days. Max. rate of 2.5 pt/application and 5 pt/season.
1.8 to 3.6 pt Prowl 3.3 E	0.74 to 1.49 pendimethalin	For control of annual grasses and broadleaf weeds. Can be applied preemergence after planting or after drag-off. Can be applied preemergence and incorporated within 7 days of application. Can be applied early postemergence to plants up to 6 inches tall only if plants are not under stress from cold/wet or hot/dry conditions.
1.5 to 2 pt Prowl 3.3 E + 0.75 to 1 pt Sencor 4 F	0.61 to 0.83 pendimethalin + 0.38 to 0.5 metribuzin	For broader spectrum of weed control. Apply after planting but before potatoes and weeds emerge. Do not incorporate. Do not apply postemergence to crop.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
6 to 16 fl oz Select 2E	0.1 to 0.25 clethodim	For selective postemergence control of annual grasses and suppression of perennial grasses. Add crop oil 1% v/v or 1 to 2 qt/A liquid fertilizer or AMS to enhance control of difficult grasses. PHI = 30 days.
0.3 to 1.3 lb Sencor 75 DF	0.2 to 1 metribuzin	For control of annual grasses and broadleaf weeds. Apply preemergence broadcast after planting. Do not incorporate. Can be used postemergence (0.3 to 0.6 lb/A) or as a split-application not to exceed 1.3 lb/A/season on white-skinned varieties (except Atlantic, Chip Belle, Bel Chip, and Shepody) that are not early maturing. Do not use on early maturing or red-skinned varieties. PHI = 60 days.
1.25 to 2 pt Treflan HFP 4 E	0.62 to 1 trifluralin	For preemergence control of annual grasses and broadleaf weeds. Apply and incorporate after planting but before emergence, following drag-off, or after potato plants have fully emerged.
2.3 fl oz Weedone LV4 3.84 EC	0.07 2,4-D	For selective postemergence control of broadleaf weeds. This is a low volatility formulation of 2,4-D. Still, caution should be exercised near sensitive crops such as tomato and grape. For use on red potatoes only. Crop response depends on variety. Apply in 5 to 25 gal water/A to plants in the pre-bud stage (about 7 to 10 inches high) and a second application about 10 to 14 days later.
Pre-Harvest Vine Killing		
3.2 to 5.8 fl oz Aim 1.9 EW	0.05 to 0.09 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be broadcast alone or with other desiccant before harvest. Two applications may be necessary, with a min. 7 to 14 days between applications. Use min. 20 gal water/A and crop oil 1% v/v. Max. rate 11.6 fl oz/A. PHI = 7 days.
10 lb Copper Sulfate Crystal	10 Copper sulfate	To enhance vine kill, use 10 to 100 gal water. Can be mixed with diquat to enhance vine kill.
1.5 to 2 qt Desicate II 2 EC	0.75 to 1 endothall	For use as a vine desiccant. Apply in 5 to 40 gal water/A. Use high rate on lush vines. Add 1 pt crop oil concentrate/A under cool conditions. Apply 10 to 14 days before harvest.
1 to 2 pt Reglone 2 EC	0.25 to 0.5 diquat	For non-selective contact kill of grasses and broadleaf weeds and top-kill of perennial weeds. Apply to mature potato vines as a preharvest desiccation treatment in 20 gal water/A. Make a second application within 5 days if necessary. Include non-ionic surfactant 0.25% v/v. PHI = 7 days.
3 pt Rely 1L	0.38 glufosinate	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Do not use on potatoes grown for seed. Apply in 20 to 100 gal water/A. Max. 1 application/season. PHI = 9 days.

DISEASE CONTROL: *Potatoes*

Product	Amt/A	Seasonal Limits/A	Comments
Blackleg, Seed-piece Rots, Tuber-borne Diseases			
Agri-Mycin 17 Firewall	8 oz/100 gal	1 app	Soak seed pieces in solution for several minutes and treat with fungicide.
Dithane DF	2.5 lb /100 gal	1 app	Soak seed pieces in solution for several minutes and place in clean container following treatment. Plant as soon as possible.
Maneb—10 lb/100 gal		1 app	
Maxim MZ	0.5 lb/cwt	1 app	Dust seed pieces and plant as soon as possible.
Maxim Potato Seed Protectant			
Black Scurf, Rhizoctonia Stem Canker			
Azoxystrobin[1]		6 foliar apps	Can be applied in-furrow or post-emergence. Post-emergence applications are counted as foliar treatments for resistance management. See label for specific instructions.
Amistar	0.125 to 0.25 oz[3]		
Quadris	0.4 to 0.8 oz[3]		
Moncut 70 DF	0.7 to 1.1	1 app	Apply in-furrow in 3 gal/A of water. Direct spray over seed piece and surrounding soil before covering.
PCNB		1 app	Apply in-furrow in 10 to 20 gal/A of water. Direct spray over seed piece and surrounding soil before covering.
Terraclor 75 WP	3.45 to 6.9 oz[3]		
Terraclor Flowable	5.2 to 10.4 fl oz[3]		
Early Blight, Late Blight, White Mold *(Sclerotinia Blight)*			
Acrobat 50 WP	4 to 6.4 oz	32 oz	LATE BLIGHT ONLY. Must be tank-mixed with another Phytophthora fungicide. Apply before disease onset, continue on a 5- to 10-day schedule.
Forum SC	4 to 6 fl oz	30 fl oz	
Azoxystrobin[1]		6 apps	EARLY/LATE BLIGHT ONLY. Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	2 to 5 oz		
Heritage	3.2 to 9.6 oz		
Quadris	6 to 15.5 fl oz		

DISEASE CONTROL: *Potatoes*			
Product	**Amt/A**	**Seasonal Limits/A**	**Comments**
Chlorothalonil			EARLY/LATE BLIGHT ONLY. Apply before disease onset; continue on a 5- to 10-day schedule.
Bravo Ultrex	0.7 to 1.36 lb	13.6 lb	
Bravo WeatherStik	0.75 to 1.5 pt	15 pt	
Bravo ZN	1.25 to 2.25 pt	21.5 pt	
Echo 720	0.75 to 1.5 pt	15 pt	
Echo 90 DF	0.625 to 1.25 lb	12.5	
Equus 720 SST	0.75 to 1.5 pt	15 pt	
Equus DF	0.7 to 1.36 lb	13.6 lb	
Cuprofix MZ Disperss[2]	1.4 to 4.75 lb	see footnote	EARLY/LATE BLIGHT ONLY. Apply when disease appears and continue on a 3- to 10-day schedule as needed.
Curzate 60 DF	3.2 oz	7 apps	LATE BLIGHT ONLY. Must be tank-mixed with a multi-site inhibitor (FRAC Group M). Apply before disease onset, continue on a 5- to 7-day schedule.
Endura	2.5 to 10 oz	4 apps	EARLY BLIGHT AND WHITE MOLD ONLY. Apply before disease onset, continue on a 7- to 14-day schedule. No more than 2 sequential applications of Endura can be made before rotating to another mode of action.
Evito 480 SC[1]	3.8 fl oz	6 apps	EARLY/LATE BLIGHT ONLY. Apply before onset of disease and continue applications on a 7 to 10-day interval as needed.
Fixed coppers		n/a	EARLY/LATE BLIGHT ONLY. Apply when plants are 6 inches tall and continue on a 5- to 10-day schedule, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Badge SC	0.9 to 3.7 pt		
Basic Copper 53	3 to 6 lb		
C-O-C-S WDG	1.5 to 4 lb		
Champ DP	0.67 to 2.67 lb		
Champ Formula 2 FL	0.67 to 2.67 pt		
Champion WP	1 to 4 lb		
COC DF	3 to 4 lb		
COC WP	3 to 4 lb		
Copper-Count-N	3 to 6 pt		
Cuprofix Disperss	1.25 to 6 lb		
Cuprofix Ultra 40 Disperss	0.75 to 3 lb		
Kocide 101	1 to 4 lb		
Kocide 2000	0.75 to 3 lb		
Kocide 3000	0.5 to 1.75 lb		
Kocide DF	1 to 4 lb		
Kocide 4.5 LF	0.66 to 2.66 pt		
Nu-Cop 50 WP	1 to 4 lb		
Nu-Cop 3 L	0.66 to 4 pt		
Nu-Cop 50 DF	1 to 4 lb		
Tenn-Cop 5 E	3 pt		
Gavel 75 DF[2]	1.5 to 2 lb	6 apps	Apply when conditions favor disease and continue on a 5- to 10-day schedule.
Gem[1]	6 to 8 oz	6 apps	EARLY/LATE BLIGHT ONLY. Apply before disease onset, continue on a 7- to 10-day schedule.
Headline[1]	6 to 12 fl oz	6 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Mancozeb			EARLY/LATE BLIGHT ONLY. Apply when plants reach 4 to 6 in and continue on a 5- to 10-day schedule as needed. Limit 11.2 lb ai/A/season.
Dithane DF Rainshield	0.5 to 2 lb	15 lb	
Dithane F-45 Rainshield	0.8 to 3.2 pt	11.2 qt	
Dithane M-45	0.5 to 2 lb	14 lb	
Manzate 75 DF	1 to 2 lb	15 lb	
Manzate Flowable	0.4 to 1.6 qt	11.2 qt	
Manzate Pro-Stick	0.5 to 2 lb	15 lb	
Penncozeb 4 FL	0.4 to 1.6 qt	11.2 qt	
Penncozeb 75 DF	0.5 to 2 lb	15 lb	
Penncozeb 80 WP	0.5 to 2 lb	14 lb	
Maneb			EARLY/LATE BLIGHT ONLY. Apply before disease appears and continue on a 5- to 10-day schedule as needed. Limit 11.2 lb ai/A/season.
Maneb 75 DF	1.5 to 2 lb	14.9 lb	
Maneb 80 WP	1.5 to 2 lb	14 lb	
Manex	0.8 to 1.6 qt	11.2 qt	
ManKocide[2]	1.5 to 5 lb	see footnote	EARLY/LATE BLIGHT ONLY. Apply before disease appears and continue on a 3- to 10-day schedule as needed.
Polyram 80 DF	1.5 to 2 lb	14 lb	EARLY/LATE BLIGHT ONLY. Apply before disease appears and continue on a 5- to 10-day schedule as needed.
Quadris Opti[1]	1.6 pt	6 apps	EARLY BLIGHT/LATE BLIGHT. Apply before disease onset, continue on a 5- to 14-day schedule. Resistance management guidelines for QoI inhibitors (FRAC Group 11) must be observed, along with seasonal limits for chlorothalonil.
Ranman SC	1.4 to 2.75 fl oz	10 apps	LATE BLIGHT. Apply before disease onset, continue on a 7- to 10-day schedule. Do not apply back to back; alternate with a fungicide having a different mode of action.
Reason[1]	5.5 to 8.2 fl oz	24.6 fl oz	EARLY BLIGHT/LATE BLIGHT. Apply before disease onset, continue on a 5- to 10-day schedule.
Ridomil Gold Bravo	2 lb	3 apps	EARLY/LATE BLIGHT ONLY. Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG Bravo. Observe seasonal limits for chlorothalonil.
Ridomil Gold Bravo SC	2.5 pt		
Ridomil Gold Copper	2 lb	3 apps	LATE BLIGHT ONLY. Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG Copper.
Ridomil Gold MZ[2]	2.5 lb	3 apps	EARLY/LATE BLIGHT ONLY. Apply before disease onset, continue on a 14-day schedule. Rotate to another mode of action between applications of RG MZ.
Rovral 4 Flowable	1 to 2 pt	4 apps	EARLY BLIGHT/WHITE MOLD ONLY. Apply before disease onset, continue on a 7- to 21-day schedule.
Iprodione 4L AG			

DISEASE CONTROL: *Potatoes*

Product	Amt/A	Seasonal Limits/A	Comments
Scala	7 fl oz	35 fl oz	EARLY BLIGHT ONLY. Apply before disease onset, continue on a 7- to 14-day schedule. Tank-mix with another fungicide labeled for early blight.
Super Tin 80 WP	1.87 to 3.75 oz	11.25 oz	EARLY/LATE BLIGHT ONLY. Apply before disease appears and continue on a 7-day schedule as needed.
Tanos[1]	6 to 8 oz	6 apps	EARLY/LATE BLIGHT ONLY. Tanos must be tank-mixed with a multi-site inhibitor (FRAC Group M) appropriate for the target disease. Apply before disease onset, continue on a 5- to 10-day schedule.
Thiophanate-methyl			WHITE MOLD ONLY. Apply before row closure and continue on a 7- to 14-day schedule. Do not make back-to-back applications of thiophanate-methyl products.
Thiophanate-Methyl 85 WDG	0.8 to 1.2 lb	3.2 lb	
Topsin 4.5 FL	20 to 30 fl oz	80 fl oz	
Topsin M 70 WP	1 to 1.5 lb	4 lb	
Topsin M WSB	1 to 1.5 lb	4 lb	

[1] Do not make back-to-back applications or rotate with other QoI inhibitors (FRAC Group 11). Fungicides with the same Group number have the same mode of action. Do not tank-mix products with the same Group number, and rotate among fungicides with different Group numbers to discourage resistance development.
[2] Observe seasonal limits for mancozeb.
[3] Per 1000 row-feet

Rhubarb

Buckwheat family (Polygonaceae): *Rheum rhabarbarum*

VARIETIES: *Rhubarb*

Variety	Comments
Canada Red	Hardy, with cherry-red tender stalks.
Tilden Strain	Thin, very red tender stalks.
MacDonald	Vigorous, very productive, some root rot resistance.

Planting and Culture

Rhubarb is a cool-season crop. It thrives on a well-drained soil that is deep and fertile.

Rhubarb plants (pieces of the crown) should be transplanted in rows 4 to 5 feet apart with plants spaced 3 feet apart in the row. The crown pieces should be planted so that there are 2 to 3 inches of soil covering the pieces. Transplant crowns in early March or in late August (see Appendix H).

Harvesting

Rhubarb may be harvested for a short period during the second year and a full harvest period (8 to 10 weeks) during the third growing season and thereafter. Pull the stalks rather than cut them.

Common Diseases/Management

Crown rot. Use disease-free transplants and *plant into well-drained soils high in organic matter.* This disease is *stress related*, so maintain optimal soil fertility (see "Planting and Culture," above); do not over-harvest. At harvest, pull stalks rather than cut them to reduce entry sites and the food base for pathogens.

Damping-off. Mefenoxam (Ridomil Gold and Ultra Flourish) can be applied preplant to manage damping-off and root rots caused by *Pythium*. Planting into well-drained soils is an important control measure.

Leaf spots and blights. Rhubarb is generally disease-free; however, strobilurins (Quadris/Amistar, Cabrio, Flint) are labeled for a number of foliar diseases; see tables for rates. Control weeds in and around the field. Remove yellowed leaves promptly during the season. *Fall maintenance is important*—remove all leaf material in the fall to reduce pathogen populations and use fall fertilization to encourage spring growth.

FERTILIZER: *Rhubarb*

Soil Test Results *(lb/A)*		**Fertilizer Needed** *(lb/A)*
Phosphorus		**Phosphate** *(P_2O_5)*
Low	<31	240
Medium	31-60	180
High	61-80	120
Very High	>80	60
Potassium		**Potash** *(K_2O)*
Low	<201	200
Medium	201-300	150
High	>300	100
Nitrogen		**N**
If 15 to 20 tons of manure have been applied/A and worked into the soil before transplanting crowns, apply an additional 50 lb of nitrogen.		

PESTICIDE SAFETY: *Rhubarb*

	Signal[3]	Re-entry *(hrs)*	Harvest *(days)*
Insecticides			
Admire Pro	C	12	45
Assail 30 SG	C	12	7
Confirm 2 F	C	4	7
Fulfill 50 WDG	C	12	7
Intrepid 2 F	C	4	1
SpinTor 2 SC	C	4	1
Trigard 75 WP	C	12	7
Venom 70 SG	C	12	7/21[1]
RESTRICTED USE			
Agri-Mek 0.15 EC	W	12	7
Mustang Max	W	12	1
Pounce 3.2 EC	C	12	1
Proclaim 5 WDG	C	48	7
Fungicides			
Aliette WDG[4]	C	12	3
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	0
Evito 480 SC	C	12	3
Flint	C	12	7
Ridomil Gold EC/SL/GR	C	48	0
Ultra Flourish	W	48	0

[1] PHI depends on the type of application, see label.
[2] Several formulations are marketed. See the general introduction for more details on fungicides.
[3] W: Warning, C: Caution, D: Danger; P: Poison
[4] 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.

INSECT CONTROL: *Rhubarb*

Stalk Borer and Rhubarb Curculio are controlled by cultivating field margins to keep weed populations low. Remove all curly dock, the normal host of the curculio. For various leaf- and stalk-feeding insects, use Mustang or Pounce as needed.

WEED CONTROL: *Rhubarb*

Product Amt/A	Lb A.I./A	Remarks
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
1.3 to 2.7 pt Gramoxone Max 3 L	0.5 to 1 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, preemergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
0.5 to 1.5 pt Poast 1.5 E	0.09 to 0.27 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. PHI = 30 days. Max. rate of 1.5 pt/application and 3 pt/season.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
6 to 8 fl oz Select 2E	0.09 to 0.12 clethodim	For selective postemergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 8 fl oz/application. Min. 14 days interval between applications. PHI = 30 days.

DISEASE CONTROL: *Rhubarb*

Product	Amt/A	Seasonal Limits/A	Comments
Damping-off *(Pythium)*			
Ridomil Gold EC	1 to 2 pt	1 app	Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 in of soil mechanically (pre-plant) or with irrigation (pre- and at-planting) if rainfall is not expected within 24 hours of treatment.
Ridomil Gold SL			
Ridomil Gold GR	20 to 40 lb	1 app	
Ultra Flourish	2 to 4 pt	1 app	
Downy Mildew			
Aliette WDG	2 to 5 lb	7 apps	Apply when conditions favor disease and continue on a 7- to 21-day schedule. Limit 7 apps/season. Do not tank-mix with copper compounds.
Azoxystrobin[1]		4 apps	Use higher rates for downy mildew. Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	4 to 5 oz		
Heritage	6.4 to 8 oz		
Quadris	12 to 15.5 fl oz		
Cabrio[1]	12 to 16 oz	4 apps	Use highest rate for downy mildew. Apply before disease onset, continue on a 7- to 14-day schedule.
Flint[1]	2 to 3 oz	4 apps	Apply before disease onset, continue on a 14-day schedule. Limit 4 apps/season.
Leaf Spots *(Alternaria, Anthracnose, Cercospora), Powdery Mildew*			
Azoxystrobin[1]		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	2 to 5 oz		
Heritage	3.2 to 8 oz		
Quadris	6 to 15.5 fl oz		
Cabrio[1]	12 to 16 oz	4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Evito 480 SC[1]	5.7 fl oz	4 apps	Apply before disease onset, continue applications on a 7 to 10-day interval as needed.
Flint[1]	2 to 3 oz	4 apps	Apply before disease onset, continue on a 14-day schedule.

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

Root Crops

(Beets, Carrots, Parsnips, Radishes, Turnips)

Planting and Culture

- **Beets**—Plant in rows 18 to 24 inches apart and ½ inch deep. Seed 8 to 10 lb per acre for bunching. Seed will germinate between 40° and 85°F. Optimum temperature is 65° to 75°F. Color and quality are best when the plant develops during cool temperatures (50° to 60°F, see Appendix H). The sugar content of beets will be lower when grown in warm weather and they will have a lighter color. Hot weather produces white bands in the roots. Beets are sensitive to soil acidity and should be grown at a pH between 6.2 and 7.0.
- **Carrots**—Plant in rows 18 to 24 inches apart and ¼ to ½ inch deep. Seed 2 to 4 lb per acre. Seed are often variable in germination and emergence resulting in non-uniform stands. Seed germinate slowly and it is necessary to maintain adequate moisture. Select deep, sandy loam soils for best results. Carrots generally are misshapen when grown on heavy or rocky soils. Prepare soil deep. Use low raised beds.
- **Parsnips**—Plant in rows 18 to 24 inches apart and ¼ to ½ inch deep. Seed 2 to 3 lb per acre. Prepare soil similar to that for carrots. Always use new seed because germination of one year or older seed is poor.
- **Radishes**—Plant seed in rows 15 inches apart and ¼ to ½ inch deep. Plant 12 to 15 seed per foot of row. Seed 10 to 15 lb per acre. Seed germinate in 3 to 4 days at a soil temperature of 65°F or above. Best quality and shape of roots are attained when the crop grows and matures at 50° to 65°F.
- **Turnips**—Plant seed in rows 14 to 18 inches apart with seed 2 to 3 inches apart in the rows and ¼ to ½ inch deep. Plant 1 to 2 lb of seed per acre. Best quality and yields are obtained under moderately cool temperatures. See also the Greens chapter.

VARIETIES: *Root Crops*

Variety	Days to Mat.	Comments
Beets[1]		
Red Ace (Hybrid)	53	Early maturing, very smooth skin, excellent quality, very sweet, heat resistant, tolerant of Cercospora Leaf Spot.
Chiogga	55	Attractive red and white striped interior, sweet flavor.
Warrior	57	Sweet, dark uniform red interior.
Ruby Queen	60	Excellent quality, very sweet, excellent for canning.
Golden Beet	55	(for trial) Specialty beet with orange flesh.
Carrots[2]		
Choctaw (Hybrid)	55	Early, Imperator hybrid, with a deep orange interior.
Navajo (Hybrid)	57	Imperator hybrid, widely adapted and uniform.
Purple Haze	73	Purple exterior, orange interior, Imperator hybrid good for markets, AAS winner.
Parsnips[3]		
Harris Model	120	Smooth, white roots.
Radishes[4]		
Small round types		
Cherry Belle	24	
Scarlet Globe	24	
Oriental Radishes		
Fancy Free Altari	30-35	Small; short thin top with bulbous base; tender, fall crop.
Minowase Summer Cross	50	Long white daikon, mild flavor, juicy and tender, fusarium resistant, stands heat, fall crop.
Misato Rose Flesh or Red Meat	60	Round, 4 inches in diameter, white with light green shoulders and a dark pink interior; very tender, pungent skin, mild and sweet interior, excellent for eating fresh, garnishing, and pickling. Fall production only, plant in August or September.
Tsukushi Spring Cross	60	Medium long, slender, light green shoulder, uniform shape, size.
Tae-Baek	70	Short white barrel-shaped roots with a green shoulder, somewhat pungent, for heavier soils, highly disease tolerant, fall crop.
Turnips[5]		
Hakurei (hybrid)	38	Early, all white, best harvested young (2 inch diameter).
Purple Top White Globe	58	Smooth, globe shaped roots.

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

FERTILIZER: *Root Crops*

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

Fertilizing

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

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

Harvesting

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

Common Diseases/Management

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

Beets

Damping-off and seed rot. Sow in a well-prepared seed bed—raised beds will improve disease control. Purchase seed treated with thiram or dust with 1 level teaspoon/lb of seed. For damping-off diseases caused by *Pythium* and *Phytophthora*, apply Ridomil Gold EC or Ultra Flourish at planting (see tables for rates and use directions).

Leaf spots, blights, and rust. Rotate to grasses for three to four years between beet crops. For leaf spots/blights, apply fixed copper fungicides weekly or strobilurins (Quadris/Amistar, Cabrio); see tables for rates. For rust, apply sulfur at regular intervals. Ensure good air movement by keeping tall plants away from beets.

Carrots/Parsnips

Damping-off, seed rot, and root rots. Plant fungicide-treated seed into well-drained, well-prepared, raised beds and Thiram 75 WP at 1 tsp/lb of seed. Apply mefenoxam to the soil at 0.5 to 1 lb/treated acre for control of *Pythium* diseases (damping-off, forking, cavity spot), and azoxystrobin can be applied in-furrow to control diseases caused by *Rhizoctonia* (damping-off, canker, root rot); see tables for rates and application instructions.

Leaf spots and blights. Practice rotation to unrelated crops for two or more years. Spray fixed copper if bacterial blight is involved as part of the complex. If bacterial blight is not involved, use one of the following preventive fungicides: chlorothalonil, strobilurins (Amistar/Quadris, Cabrio, or Flint), Endura (carrot only) or Rovral 4F (for Alternaria leaf blight only on carrot). See tables for rates and products. For powdery mildew on carrot, use sulfur or one of the strobilurins; use of sulfur at high rates can rapidly lower soil pH. Varieties resistant to some of these leaf diseases are available.

White mold and southern blight. Long-term crop rotation to corn or grasses for three to four years, deep plowing to bury sclerotia, and pre-emergence weed control are more important control measures than fungicides. Azoxystrobin (Quadris/Amistar) will suppress southern blight on carrot.

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

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

PESTICIDE SAFETY: *Root Crops*

	Signal[2]	Re-entry (hrs)	Harvest (days)				
			Beets	Carrots	Parsnips	Radishes	Turnips
Insecticides							
Actara 25 WDG	C	12	7	7	7	7	7
Admire Pro	C	12	21	21	21	21	21
Confirm 2 F	C	4	-	-	-	-	7
Lorsban 75 WG	W	24	-	-	-	AP	30
Lorsban 4 E	W	24	-	-	-	AP	30
Lorsban 15 G	C	12	-	-	-	7	14
Malathion 8	C	12	7	7	7	7	-
Platinum 2 SC	C	12	AP	-	-	-	-
Provado 1.6 F	C	12	7	7	7	7	7
Radiant SC	C	4	7	3	3	3	3
Sevin XLR	W	12	7	7	7	7	-
SpinTor 2 SC	C	4	3	-	-	-	-
Endosulfan 3 EC	DP	24	-	7	-	-	-
RESTRICTED USE							
Asana XL	W	12	-	7	-	7	-
Baythroid XL	W	12	0	0	0	0	0
Decis 1.5 EC	DP	12	3	3	3	3	3
Diazinon AG500	C	24	14	14	-	14	-
Diazinon 50 W	C	24	3	3	-	3	-
Lannate 90 SP	DP	48	0/10[1]	1	-	-	-
Renounce 20 WP	C	12	0	0	0	0	0

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

Radish

Black rot. This bacterial disease is seedborne and best controlled by using hot-water seed treatment. See "Vegetable Seed Treatments" on page 16. Avoid other cole crops in the rotation.

Damping-off. Use Captan 50 WP or thiram at 1 tsp/lb of seed, or buy fungicide-treated seed. Use mefenoxam as a pre-plant soil treatment; see tables for rates and products.

Leaf spots, downy mildew, white rust. Take steps to ensure good air movement, such as using an open row spacing and avoiding taller plants nearby. A number of fungicide products can be used to manage foliar diseases (see table). If Ridomil Gold was used pre-plant, then Ridomil Gold/Copper can be used in foliar applications for white rust control, should this disease develop.

PESTICIDE SAFETY: *Root Crops*

	Signal[3]	Re-entry (hrs)	Harvest (days)[1]
Fungicides			
BEETS			
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	0
Fixed coppers[2]	D	12/24	1
Flint	C	12	7
Ridomil Gold EC/SL	C	48	0
Sulfur[2]	C	24	0
Ultra Flourish	W	48	0
CARROTS			
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	0
Chlorothalonil[2]	D	12	0
Endura	W	12	0
Fixed coppers[2]	D	12/24	0
Flint	C	12	7
Pristine	C	12	0
Quadris Opti	W	12	0
Ridomil Gold Bravo	D	48	7
Ridomil Gold Bravo SC	W		
Ridomil Gold EC/SL	C	48	0
Ridomil Gold Copper	D	48	7
Rovral 4 Flowable	C	24	0
Iprodione 4L AG			
Sulfur[2]	C	24	0
Ultra Flourish	W	48	0
PARSNIPS			
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	0
Chlorothalonil[2]	D	12	10
Fixed coppers[2]	D	12-48	0
Flint	C	12	7
Ridomil Gold EC/SL	C	48	0
Ultra Flourish	W	48	0
RADISH			
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	0
Ridomil Gold Copper	D	48	7
Ridomil Gold EC/SL	C	48	0
Ultra Flourish	W	48	0

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

INSECT CONTROL: *Root Crops*

Insect/Insecticide	Product Amt/A	Comments and Seasonal Limits
BEETS		
Aphids		
Malathion 8	2.5 pt	
Beet Armyworm		
SpinTor 2 SC	4 to 8 fl oz	Limit 29 fl oz/season. See resistance management information on label.
Lannate 90 SP	0.5to 1 lb	Limit 4 lb/A.
Cutworms		
Sevin 5% B	40 lb	
Flea Beetles		
Sevin XLR	0.5 to 1 qt	Limit 6 applications and allow at least 7 days between sprays.
CARROTS		
Aphids		
Endosulfan 3 EC	0.67 to 1.33 qt	Limit 1 application.
Cutworms		
Asana XL	5.8 to 9.6 fl oz	Limit 96 fl oz/A.
Baythroid XL	1.6 fl oz	Limit 5 applications.

INSECT CONTROL: *Root Crops*

Insect/Insecticide	Product Amt/A	Comments and Seasonal Limits
Leafhoppers *(Treat fields and field margins to control these disease vectors. Beginning when plants are 3 inches tall.)*		
Baythroid XL	1.6 to 2.8 fl oz	Limit 5 applications.
Lannate 90 SP	0.5 to 1 lb	Limit 7 lb/A.
Sevin XLR	0.5 to 1 qt	Limit 6 applications and allow at least 7 days between sprays.
PARSNIPS		
Aphids		
Malathion 8	2 pt	
Armyworms, Stink Bugs, Plant Bugs		
Sevin XLR	1 to 2 qt	Limit 6 applications and allow at least 7 days between sprays.
Flea Beetles		
Sevin XLR	0.5 to 1 qt	Limit 6 applications and allow at least 7 days between sprays.
Crickets, Cutworms, Sowbugs		
Sevin 5% B	40 lb	
RADISHES & TURNIPS		
Aphids		
Malathion 8	2 pt	Radishes only.
Cutworms		
Baythroid XL	1.6 to 2.8 fl oz	Limit 5 applications.
Flea Beetles		
Asana XL	5.8 to 9.6 fl oz	Radishes only. Limit 9.2 oz/A.
Baythroid XL	1.6 to 2.8 fl oz	Limit 5 applications.
Root Maggots		
Lorsban 15 G	3.3 oz/1,000 feet	Furrow application at planting.
Lorsban 4 E	1 oz/1,000 feet	Use at least 40 GPA.

WEED CONTROL: *Root Crops*

Product Amt/A	Lb A.I./A	Remarks
All Root Crops		
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
0.5 to 2.5 pt Poast 1.5 E	0.09 to 0.49 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. PHI = 60 days. Max. rate of 2.5 pt/application and 5 pt/season.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
6 to 8 fl oz Select 2E	0.09 to 0.12 clethodim	For selective postemergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 8 fl oz/application. Min. 14 days interval between applications. PHI = 30 days.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
Individual Crops		
2 to 2.64 qt Ro-Neet 6 E (Table Beet only)	3 to 4 cycloate	For control of annual grasses and broadleaf weeds. Apply before, at, or after planting and incorporate immediately (within minutes) to a depth of 2 to 3 inches. Max. 1 application/season.
0.25 to 0.5 pt Stinger 3 L (Beet and Turnip only)	0.09 to 0.18 clopyralid	For selective postemergence control of broadleaf weeds. Apply to garden beet in min. 10 gal water/A. Max. 1 broadcast applications/season. PHI = 30 days.
3 to 6 pt Spin-aid 1.3 E (Red Beet only)	0.5 to 1 phenmedipham	For selective postemergence control of broadleaf weeds in red table beets only. Apply to plants with 4 to 6 true leaves and that are not under stress and weeds with 2 true leaf stage. Do not add a surfactant.
1pt Fusilade-DX 2E (Carrot only)	0.25 fluazifop-p	For selective postemergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 45 days. Max. rate is 48 fl oz/A.
1.3 to 2.7 pt Gramoxone Max 3 L (Carrot and Turnip only)	0.5 to 1 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, preemergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
1.5 to 3 lb Lorox 50 DF (Carrot and Parsnip only)	0.75 to 1.5 linuron	For control of annual grasses and broadleaf weeds. Apply postemergence as a non-directed spray to carrots > 3 inches tall. Apply before annual grasses exceed 2 inches high and before broadleaves exceed 6 inches high. Check label regarding varietal tolerance. Do not apply when temperature is above 85°F. PHI = 14 days.
0.3 lb Sencor 75 DF (Carrot only)	0.2 metribuzin	For control of annual grasses and broadleaf weeds. Apply broadcast over the tops to plants with 5-6 true leaves but before weeds are 1 inch tall. A second application can be made 3 weeks later. Do not apply within 3 days of stress conditions such as cool, wet and cloudy weather or hot days or after any other chemical to avoid injury. PHI = 60 days.
1.25 to 2 pt Treflan HFP 4 E (Carrot and Radish only)	0.6 to 1 trifluralin	For control of annual grasses and broadleaf weeds. Apply and incorporate in spring before planting.
6 to 14 pt Dacthal 6 F (Radish only)	4.5 to 10.5 DCPA	For preemergence control of annual grasses and small-seeded broadleaves. Apply at seeding or up to 3-leaf stage. Soil should be clean cultivated before application. Apply in 20 to 30 gal water/A. PHI = 25 days.

DISEASE CONTROL: *Root Crops*

Product	Amt/A	Seasonal Limits/A	Comments
BEETS, RADISH			
Damping-off *(Pythium)*			
Ridomil Gold EC	1 to 2 pt	1 app	Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil mechanically (pre-plant) or with irrigation (pre- and at-planting) if rainfall is not expected within 24 hours of treatment. Will control white rust on radish.
Ridomil Gold SL			
Ultra Flourish	2 to 4 pt	1 app	
Downy Mildew			
Fixed coppers		n/a	BEETS ONLY. Apply on a 7- to 10-day schedule when conditions favor disease. See label for mixing instructions and tank-mix precautions.
Basic Copper 53	2 to 4 lb		
C-O-C-S WDG	3 to 4 lb		
COC DF	2 to 4 lb		
COC WP	2 to 4 lb		
Nu-Cop 50 DF	1 to 2 lb		
Leaf Spots *(Alternaria, Anthracnose, Cercospora), Rust, White Rust*			
Azoxystrobin[1]		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Amistar	2 to 5 oz		
Heritage	3.2 to 8 oz		
Quadris	6.0 to 15.5 fl oz		
Cabrio[1]	8 to 16 oz	3 apps	Apply before disease onset, continue on a 7- to 14-day schedule.
Fixed coppers		n/a	BEETS ONLY. Apply on a 7- to 10-day schedule after seeding/transplanting or when conditions favor disease. See label for mixing instructions and tank-mix precautions.
Badge SC	1.8 to 4.6 pt		
Basic Copper 53	2 to 4 lb		
C-O-C-S WDG	3 to 4 lb		
Champ DP	1.33 to 2.67 lb		
Champ Formula 2 FL	1.33 to 2.67 pt		
Champion WP	2 to 5 lb		
COC DF	2 to 4 lb		
COC WP	2 to 4 lb		
Copper-Count-N	3 to 6 pt lb		
Cuprofix Disperss	2.5 to 6 lb		
Cuprofix Ultra 40 Disperss	1.25 to 3 lb		
Kocide 101	2 to 5 lb		
Kocide 2000	1.5 to 3.75 lb		
Kocide 3000	0.75 to 2 lb		
Kocide DF	2 to 5 lb		
Kocide 4.5 LF	1.33 to 3.33 pt		
Nu-Cop 50 WP	2 to 5 lb		
Nu-Cop 3 L	1.33 to 6.66 pt		
Nu-Cop 50 DF	2 to 5 lb		
Tenn-Cop 5 E	3 pt		
Flint[1]	2 to 3 oz	4 apps	BEETS ONLY. Apply before disease onset, continue on a 14-day schedule. Limit 4 apps/season.
Ridomil Gold Copper	2 lb	4 apps	RADISH ONLY. For control of white rust, apply 45 to 50 days after pre-plant application of Ridomil Gold EC or Ultra Flourish; make up to 3 additional applications on a 14-day schedule.
Sulfur	3 to 20 lb	n/a	BEETS ONLY. Apply on a 14- to 30-day schedule, beginning when symptoms are first observed or when conditions favor disease. Phytotoxicity may occur when sulfur is applied when air temperatures exceed 90°F.
CARROTS, PARSNIPS			
Damping-off, Seed Rot, Root Rots, Southern Blight			
Azoxystrobin[1]			
Amistar	0.125 to 0.25 oz[2]	4 foliar apps	POST-EMERGENCE: Apply broadcast in a 7-inch band with spray directed at lower stems and surrounding soil. RESISTANCE MANAGEMENT: Counts as a foliar application. Limit 4 applications of azoxystrobin or other QoI inhibitors.
	0.125 to 0.188 oz[2]	1 app	IN-FURROW: Apply in 5 to 15 gal/A, with nozzle directed to spray in furrow just before seed are covered. RESISTANCE MANAGEMENT: In-furrow treatment does not count as a foliar application.
Quadris	0.4 to 0.8 fl oz[2]	4 foliar apps	POST-EMERGENCE: See comments for Amistar.
	0.4 to 0.7 fl oz[2]	1 app	IN-FURROW: See comments for Amistar.
Ridomil Gold EC	1 to 2 pt	1 app	PYTHIUM DISEASES ONLY. Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 inches of soil mechanically (pre-plant) or with irrigation (pre- and at-planting) if rainfall is not expected within 24 hours of treatment.
Ridomil Gold SL			
Ultra Flourish	2 to 4 pt	1 app	
Ridomil Gold Bravo	1.5 to 2 lb	4 apps	PYTHIUM DISEASES ONLY. Not for use on parsnips. Apply 45 to 50 days after pre-plant application of Ridomil Gold EC or Ultra Flourish; make up to 3 additional applications on a 14-day schedule. Observe seasonal limits for chlorothalonil.
Ridomil Gold Bravo SC	1.5 to 2.5 pt		
Ridomil Gold Copper	2 lb	4 apps	PYTHIUM DISEASES ONLY. Not for use on parsnips. Apply 45 to 50 days after pre-plant application of Ridomil Gold EC or Ultra Flourish; make up to 3 additional applications on a 14-day schedule.
Foliar Diseases *(Alternaria, Cercospora Leaf Spots, Leaf Blights)*			
Azoxystrobin[1]		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Will also suppress southern blight.
Amistar	2 to 5 oz		
Quadris	6 to 15.5 fl oz		
Cabrio[1]	8 to 12 oz	3 apps	Apply before disease onset, continue on a 7- to 14-day schedule.

DISEASE CONTROL: *Root Crops*

Product	Amt/A	Seasonal Limits/A	Comments
Chlorothalonil			CARROT ONLY. Apply before disease onset; continue on a 7- to 10-day schedule as needed. Limit 15 lb ai/A/season.
Bravo Ultrex	1.4 to 1.8 lb	18.2 lb	
Bravo WeatherStik	1.5 to 2 pt	20 pt	
Echo 720	1.5 to 2 pt	20 pt	
Echo 90 DF	1.25 to 1.625 lb	16.7 lb	
Equus 720 SST	1.5 to 2 pt	20 pt	
Equus DF	1.4 to 1.8 lb	18.2 lb	
Endura	4.5 oz	5 apps	CARROT ONLY. Apply before disease onset, continue on a 7- to 14-day schedule. No more than 2 sequential applications of Endura can be made before rotating to another mode of action.
Fixed coppers		n/a	CARROT ONLY. Apply on a 7- to 14-day schedule after seeding/transplanting or when conditions favor disease. See label for mixing instructions and tank-mix precautions.
Badge SC	1.8 pt		
Basic Copper 53	2 to 4 lb		
C-O-C-S WDG	2 to 4 lb		
Champ DP	1.33 lb		
Champ Formula 2 FL	1.33 pt		
Champion WP	2 lb		
COC DF	3 to 6 lb		
COC WP	3 to 6 lb		
Copper-Count-N	4 to 6 pt		
Cuprofix Disperss	2.5 lb		
Cuprofix Ultra 40 Disperss	1.25 lb		
Kocide 101	2 lb		
Kocide 2000	1.5 lb		
Kocide 3000	0.75 lb		
Kocide DF	2 lb		
Kocide 4.5 LF	1.33 pt		
Nu-Cop 50 WP	2 lb		
Nu-Cop 3 L	1.33 to 2.66 pt		
Nu-Cop 50 DF	2 lb		
Tenn-Cop 5 E	3 to 4.5 pt		
Flint[1]	2 to 3 oz	4 apps	Apply before disease onset, continue on a 14-day schedule.
Pristine[1]	8 to 10.5 oz	6 apps	Apply before disease onset, continue on a 7- to 14-day schedule. Will suppress southern blight.
Quadris Opti[1]	2.4 pt	6 apps	CARROT ONLY. Apply before disease onset, continue on a 7- to 14-day schedule. Observe seasonal limits for chlorothalonil.
Rovral 4 Flowable	1 to 2 pt	4 apps	CARROT ONLY. For control of Alternaria, apply when conditions favor disease. Repeat applications can be made at 7- 14-day intervals.
Iprodione 4L AG			
Sulfur	3 to 12	n/a	CARROT ONLY. Apply on a 14-day schedule, beginning when symptoms are first observed or when conditions favor disease. Phytotoxicity may occur when sulfur is applied when air temperatures exceed 90°F.

[1] Do not make back-to-back applications or rotate with other QoI inhibitors (FRAC Group 11). Fungicides with the same Group number have the same mode of action. Do not tank-mix products with the same Group number, and rotate among fungicides with different Group numbers to discourage resistance development.
[2] Per 1000 row-feet.

Southernpeas (Cowpeas)

Pea family (Fabaceae): *Vigna unguiculata*

Planting and Culture

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

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

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

VARIETIES: *Southernpeas*

Variety	Days to Mat.	Comments
Mississippi Silver	64	Peas are large, light green to cream in color; semi-vining; a crowder type.
Mississippi Purple	69	Replacement for Mississippi Shipper, large seeded disease resitant, a crowder type
Queen Anne	75	A blackeye type; bush type plant.

Fertilizing

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

FERTILIZER: *Southernpeas*

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

Harvesting and Handling

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

Common Diseases/Management

Damping-off, seed rots, and root rots. Rotation away from legumes for two years (mainly to corn, small grains, or grass) is recommended. Treat seed with Apron XL at 10 to 20 cc/100 lb of seed. Plant seed into warm, well-drained soils to ensure rapid germination and emergence. See the chapter on beans for information on controlling root rots that are common to both beans and southernpeas. See tables for specific product recommendations.

Powdery mildew, rust, and leaf spots. Practice crop rotation to non-legumes for at least two years prior to planting. Chlorothalonil is labeled for use on crops that are to be harvested as dry peas (pods removed). This should control most leaf spots and rust and should also suppress powdery mildew. The first spray should be made at early flowering. Azoxystrobin can be used on succulent or dry cowpeas and will control a number of foliar diseases. Sulfur can be applied for powdery mildew. See tables for more information.

PESTICIDE SAFETY: *Southernpeas*

	Signal[4]	**Re-entry** *(hrs)*	**Harvest** *(days)*
Insecticides			
Admire Pro	C	12	21
Avaunt 30 DG	C	12	7
Provado 1.6 F	C	12	7
Sevin XLR	W	12	3/21[1]
RESTRICTED USE			
Asana XL	W	12	21
Baythroid XL	W	12	3
Capture 2 EC	W	12	3
Proaxis 1.6 F	C	24	7/21[1]
Warrior T	W	24	7/21[1]
Fungicides			
Azoxystrobin[2]	C	4	0
Bravo ZN	W	48	14
Chlorothalonil[2]	D	12	14
Endura	W	12	7/21[1]
Fixed coppers[2]	D	12/24[3]	24
Headline	W	12	21
Maneb[2]	C	24	30
PCNB[2]	W	12	0
Quadris Opti	W	12	14
Ridomil Gold EC/SL	C	48	0
Ridomil Gold PC GR	C	48	0
Rovral 4 Flowable	C	24	0
Iprodione 4L AG			
Sulfur[2]	C	24	0
Thiophanate-methyl[2]	C	12	14-28[1]

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

INSECT CONTROL: *Southernpeas*

Insect/Insecticide	**Product Amt/A**	**Comments and Seasonal Limits**
PREPLANT INCORPORATED		
Wireworms, Cutworms *(Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites. Wireworms can be a potential problem where southernpeas follow grass or grass-legume sod.)*		
FOLIAR TREATMENTS		
Aphids		
Capture 2 EC	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A.
Cowpea Curculio		
Baythroid XL	2.1 fl oz	Limit 10.5 fl oz/A, 2.1 fl oz per 5-day interval.
Capture 2 EC	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A.
Sevin XLR	1.5 qt	Limit 4 applications and allow at least 7 days between sprays.
Plant Bugs, Stink Bugs, Leaf-feeding Caterpillars		
Baythroid XL	2.1 fl oz	Limit 10.5 fl oz/A, 2.1 fl oz per 5-day interval.
Capture 2 EC	2.1 to 6.4 fl oz	Limit 12.8 fl oz/A.
Sevin XLR	1 to 1.5 qt	Limit 4 applications and allow at least 7 days between sprays.
SpinTor 2 SC	4 to 6 fl oz	Limit 29 fl oz/A. Caterpillars only.

WEED CONTROL: *Southernpeas*

Product Amt/A	**Lb A.I./A**	**Remarks**
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
5 to 12 fl oz Assure II 0.88L	0.033 to 0.08 quizalofop	For selective postemergence control of annual grasses and suppression of perennial grasses. Apply to actively growing grasses in 10 to 15 gal water/A. Include 1% v/v crop oil concentrate or 0.25% v/v non-ionic surfactant. Pre-harvest interval is 30 days for succulent peas and 60 days for dry peas. Maximum 14 fl oz/A/season.
6 to 14 pt Dacthal 6 F	4.5 to 10.5 DCPA	For preemergence control of annual grasses and broadleaves. Apply at time of planting. Can be preplant incorporated
1.3 to 1.7 pt Dual II Magnum 7.6 E	1.3 to 1.6 s-metolachlor	For control of most annual grasses and certain broadleaves. Apply preplant surface or incorporated or preemergence. Small grains may be planted 4½ months following this treatment. See label for other rotational crops.
1.3 to 2.7 pt Gramoxone Max 3 L	0.5 to 1 paraquat	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, preemergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v.
0.5 to 2.5 pt Poast 1.5 E	0.09 to 0.48 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. Dry and succulent peas. Max. rate 4 pt/A/year. Include 1% v/v crop oil. PHI = 15 days for succulent peas and 30 days for dry peas.

WEED CONTROL: *Southernpeas*

Product Amt/A	Lb A.I./A	Remarks
1.8 to 3.6 pt Prowl 3.3 E	0.74 to 1.49 pendimethalin	For control of annual grasses and broadleaf weeds. Apply before planting and incorporate 1 to 2 inches up to 60 days before planting and incorporate within 7 days of application. Do not apply surface preemergence or serious crop injury can result.
4 oz Pursuit 2L	0.07 imazethapyr	For control of annual grasses and broadleaf weeds. Can be applied preplant incorporated within 1 week before planting. Can be applied preemergence within 3 days after planting. Can be applied postemergence to plants at least 3 inches tall but before 5 nodes and before flowering. Add non-ionic surfactant 0.25% v/v.
4 fl oz Raptor 1AS	0.031 imazamox	For control of annual grasses and broadleaf weeds. Some varieties are sensitive and injury can occur. Apply postemergence to actively growing dry southernpeas with at least 3 pairs of leaves and before bloom. Max. 1 application/season.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
0.5 to 1 oz Sandea 75 DF	0.023 to 0.046 halosulfuron	For preemergence and postemergence control of broadleaves and yellow nutsedge. Apply to row middles before or after weeds emerge. PHI = 30 days.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
7.5 lb Sonalan 10G	0.75 ethalfluralin	For preemergence control of annual grasses and broadleaves. For use on dry peas only. Apply and incorporate before planting.
1.25 to 2 pt Treflan HFP 4 E	0.62 to 1 trifluralin	For preemergence control of annual grasses and broadleaf weeds. Apply as preplant soil incorporated.

DISEASE CONTROL: *Southernpeas*

Product	Amt/A	Seasonal Limits/A	Comments
Anthracnose, Leaf Spots, Powdery Mildew, Downy Mildew			
Azoxystrobin[1]		4 apps	NOT FOR DOWNY OR POWDERY MILDEW. Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Amistar	2 to 5 oz		
Quadris	6 to 15.5 fl oz		
Chlorothalonil			DRY PEA PRODUCTION ONLY. Apply at early bloom or when conditions favor disease.
Bravo Ultrex	1.25 to 1.8 lb	7.3 lb	
Bravo WeatherStik	1.375 to 2 pt	8 pt	
Bravo ZN	2 to 3 pt	11.5 pt	
Echo 720	1.375 to 2 pt	8 pt	
Echo 90 DF	1.25 to 1.8 lb	6.7 lb	
Equus 720 SST	1.375 to 2 pt	8 pt	
Equus DF	1.25 to 1.8 lb	7.3 lb	
Fixed coppers		n/a	Apply on a 5 to 10 or 7 to 14 day schedule, depending upon product and conditions. See label for mixing instructions and tank-mix precautions.
Basic Copper 53	2 to 4 lb		
C-O-C-S WDG	2 to 4 lb		
Cuprofix Disperss	1.5 to 3.5 lb		
Quadris Opti[1]	1.6 to 2.4 pt		DRY PEA PRODUCTION ONLY. Apply before disease onset, continue on a 7- to 14-day schedule.
Thiophanate-methyl			Apply when 10 to 30% of plants have at least one open bloom OR when conditions favor disease, continue on a 4- to 7-day schedule (no later than peak bloom). Do not make back-to-back applications of thiophanate-methyl.
Topsin 4.5 FL	20 to 40 fl oz	80 fl oz	
Topsin M 70 WP	1 to 2 lb	4 lb	
Topsin M WSB	1 to 2 lb	4 lb	
Sulfur	5 to 25 lb	n/a	Apply when rust is first observed; continue on a 7- to 14-day schedule as needed. Phytotoxicity may occur if applications are made when air temperatures exceed 90ºF.
Rust			
Azoxystrobin[1]		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Amistar	2 to 5 oz		
Quadris	6 to 15.5 fl oz		
Chlorothalonil			DRY PEA PRODUCTION ONLY. Apply at early bloom or when conditions favor disease.
Bravo Ultrex	1.25 to 1.8	7.3 lb	
Bravo WeatherStik	1.375 to 2 pt	8 pt	
Bravo ZN	2 to 3 pt	11.5 pt	
Echo 720	1.375 to 2 pt	8 pt	
Echo 90 DF	1.25 to 1.8	6.7 lb	
Equus 720 SST	1.375 to 2 pt	8 pt	
Equus DF	1.25 to 1.8	7.3 lb	
Headline[1]	6 to 9 fl oz	2 apps	Apply before disease onset, continue on a 7- to 14-day schedule as needed. User higher rates when pressure is severe.
Sulfur	5 to 25	n/a	Apply when rust is first observed; continue on a 7- to 14-day schedule as needed. Phytotoxicity may occur if applications are made when air temperatures exceed 90ºF.
Pythium Damping-off, Seedling Disease, Root Rot			
Ridomil Gold EC Ridomil Gold SL	0.5 to 1 pt	1 app	Apply pre- or post-planting as a broadcast or banded spray (7-inch band) in sufficient water to provide uniform coverage. Incorporate into the upper 2 in of soil mechanically or by rainfall/irrigation. Can be tank-mixed with azoxystrobin or PCNB to provide additional protection against Rhizoctonia.
Rhizoctonia Damping-off, Seedling Disease, Stem And Root Rot			
Azoxystrobin[1]			
Amistar	0.125 to 0.188 oz[2]	1 app	AT-PLANTING TREATMENT: Apply at planting as an in-furrow spray in 0.3 to 1 gal water/1000 row feet (5 to 15 gal/A). Spray should applied to the furrow just before seed are covered.
Quadris	0.4 to 0.7 fl oz[2]	1 app	

DISEASE CONTROL: *Southernpeas*

Product	Amt/A	Seasonal Limits/A	Comments
Rhizoctonia Seedling Disease, Stem Rot			
Azoxystrobin[1]		4 foliar apps	POST-EMERGENCE TREATMENT: For post-emergence treatments, apply in a 7-inch (or less) band directed at the soil at the base of the plant. Arrange nozzles to provide good coverage of lower stems and soil at base of plants. Incorporation following application will improve distribution in soil. Foliar contact may occur; post-emergence sprays are considered foliar applications for resistance management purposes.
Amistar	0.125 to 0.25 oz[2]		
Quadris	0.4 to 0.8 fl oz[2]		

[1] *Do not make back-to-back applications or rotate with other QoI inhibitors (FRAC Group 11). Fungicides with the same Group number have the same mode of action. Do not tank-mix products with the same Group number, and rotate among fungicides with different Group numbers to discourage resistance development.*
[2] *Per 1000 row-feet.*

Sweetpotatoes

Bindweed family (Convolvulaceae): *Ipomoea batatas*

Planting and Culture

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

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

The commercial grower often produces his own plants by bedding 10 to 12 bushels of sweetpotatoes for each acre of plants to be set. The sweetpotatoes are usually bedded about seven weeks before the field setting date in May or June (see Appendix H). Use only disease-free sweetpotatoes. They should be treated to reduce surface-borne disease problems before being placed in the bed.

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

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

The best transplanting results are obtained by using freshly pulled plants. These "slips" may be set by hand, but most commercial Kentucky growers use a one-row tobacco setter that applies about ½ pint of water with each slip. Large commercial growers use a two-row plant setter. A starter solution is preferred to water. Add 3 lb of 10-52-17 fertilizer to 50 gallons of water and use about ½ pint of this starter solution per slip (plant).

Rows should be spaced 3 to 3½ feet apart and plants should be spaced in the row every 12 to 16 inches. A spacing of 12 inches apart and 36 inches between rows requires about 15,000 plants to set an acre. Replace missing plants to avoid oversized roots.

VARIETIES: *Sweetpotatoes*

Variety	Comments
Beauregard	Copper skin, deep orange flesh, slow to sprout, moist flesh, very high yield.
Centennial	Orange skin color and flesh color; moist flesh, good storage life; good yields.
Excel	Medium copper skin, medium orange moist flesh, excellent sweet flavor, very high yielding.
Jewell	Light copper skin, deep orange flesh, fair slip producer, excellent flavor.
O'Henry	White skin, cream flesh, uniform shape, very high yield.

Fertilizing

Sweetpotatoes grow well at a soil pH of 5.0 to 6.8. Broadcast all fertilizer and disk into soil well before transplanting.

FERTILIZER: *Sweetpotatoes*

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

Harvesting

Sweetpotatoes continue to grow until the vines are killed by frost. Therefore, you should harvest the crop when the greatest number of 6 to 8 ounce potatoes are found in the hill. Sample digging will provide this information. A good practice is to clip the vines before harvesting. The crop can then be harvested with less damage to the potatoes. Use a turn plow or a potato plow to expose the roots with the least possible injury. Plow out one row at a time and pick up the potatoes. Grade potatoes in the field and place them in containers that are to be put in storage. For large scale production, mechanical harvesting machinery can be used economically.

Curing and Storing

Stack crates or baskets in the storage space. Place them 6 to 8 inches off the floor and 12 to 15 inches from the walls to allow for adequate ventilation. Curing requires 7 to 10 days if the temperature can be maintained at 80° to 85°F with 70 to 90 percent relative humidity. After curing is completed, the potatoes should be kept in a place as near 55°F as possible with a relative humidity of 85 percent. Higher market prices occur during the winter months and usually permit the grower who stores his crop to increase his profits substantially.

Preparing for Market

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

Common Diseases/Management

Transplant production beds. Purchase either certified transplants or produce your own plants. Start with certified, disease-free roots planted in a commercial growing mix or in new sand for best results. If this is not possible, consider the following measures: Sanitize beds or greenhouses; if bedding material is reused or if soil is used, then work up the material to a depth of 8 to 10 inches and steam sterilize (180°F for 30 minutes) or fumigate. Fumigants for this use include chloropicrin and metam-sodium applied as a drench or injected. See "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 18 for more information.

Before bedding, dip "seed" roots for two minutes into a solution of Mertect 340F or Botran 75W and plant immediately. See tables for rates and use directions. Soil or media temperatures in the beds should be maintained at around 80°F to encourage rapid plant growth and reduce rotting. Using sprouts that are cut above the soil line is a great aid in reducing certain transplant-borne diseases.

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

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

Nematodes. Use rotation for two or more years to tall fescue. Pre-plant nematicides are options. See "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 18 for more information.

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

Pox. Practice crop rotation as recommended for black rot and maintain acid soils (below pH 5.5) for fields routinely used for sweetpotatoes to prevent pathogen buildup. Use disease-free roots and transplants. Soil fumigation may be necessary for serious cases-see Nematodes in this section for information on fumigants.

PESTICIDE SAFETY: *Sweetpotatoes*

	Signal[2]	Re-entry (hrs)	Harvest (days)[3]
Insecticides			
Actara 25 WDG	C	12	14
Admire Pro	C	12	125
Assail 30 SG	C	12	7
Endosulfan 3 EC	DP	24	1
Fulfill 50 DF	C	12	14
Lorsban 4 E	W	24	125
Lorsban 15 G	C	12	125
Lorsban 75 WP	W	48	125
Malathion 8	W	12	3
Oberon 2 SC	C	12	7
Platinum 2 F	C	12	AP
Provado 1.6 F	C	12	7
Rimon 0.83 EC	W	12	14
Sevin XLR	W	12	7
SpinTor 2 SC	C	4	7
RESTRICTED USE			
Baythroid XL	W	12	0
Decis 1.5 EC	DP	12	3
Mustang Max	W	12	1
Renounce 20 WP	C	12	0
Vydate L	DP	48	AP
Fungicides			
Azoxystrobin[1]	C	4	14
Botran 75 W	C	12	0
Evito 480 SC	C	12	7
Headline	W	12	3
Maxim 4 FS	C	0	0
Mertect 340 F	C	12	0
Reason 500 SC	C	12	14
Ridomil Gold EC/SL	C	48	0
Scala SC	C	12	17
Ultra Flourish	W	48	0

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

INSECT CONTROL: *Sweetpotatoes*

Insect/Insecticide	Product Amt/A	Comments and Seasonal Limits
PREPLANT INCORPORATED		
Wireworms		
Lorsban 15 G	13.5 lb	Limit 1 application.
Lorsban 4 E	4 pt	Limit 1 application.
Flea Beetles, Tortoise Beetles		
Baythroid XL	1.6 to 2.8 fl oz	Limit 2.8 fl oz per 5 day interval and 16.8 fl oz per season. For flea beetles.
Endosulfan 3 EC	0.67 qt	Limit 3 applications.
Mustang Max	1.76 to 4 fl oz	Limit 24 fl oz/season and allow 4 days between applications.
Sevin XLR	1 to 2 lb	Limit 8 applications and allow at least 7 days between sprays.
Leafhoppers		
Actara 25 WDG	1.5 oz	Limit 3 oz/A. Allow 7 days between applications.
Baythroid XL	0.8 to 1.6 fl oz	Limit 2.8 fl oz per 5 day interval and 16.8 fl oz per season.
Malathion 8	1 to 1.75 pt	
Mustang Max	1.76 to 4 fl oz	Limit 24 fl oz/season and allow 4 days between applications.
Provado 1.6 F	3.5 fl oz	Limit 10.5 fl oz/A. Allow 7 days between sprays.
Sweetpotato Weevil *(Prior to planting, dip sweetpotato cuttings in suspension of Sevin XLR at a rate of 2.6 fl oz/gal water.)*		
Baythroid XL	1.6 to 2.8 fl oz	Limit 2.8 fl oz per 5 day interval and 16.8 fl oz per season.

WEED CONTROL: *Sweetpotatoes*

Product Amt/A	Lb A.I./A	Remarks
0.5 to 1.5 fl oz Aim 1.9 EW	0.008 to 0.023 carfentrazone	For contact postemergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied postemergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 11.6 fl oz/A. PHI = 7 days.
1.3 to 4 pt Command 3ME	0.48 to 1.5 clomazone	For preplant incorporated or preemergence control of annual grasses and broadleaves. Use a maximum of 1.5 pt/A in a single application after transplanting and before weed emergence. PHI = 95 days, 125 days if more than 3.3 pt was applied.
8 to 14 pt Dacthal 6 F	6 to 10.5 DCPA	For preemergence control of annual grasses and small-seeded broadleaves. Apply at transplanting and layby. Can be broadcasted over plants. Layby applications can be made up to 6 weeks after planting. Do not incorporate.
2 to 4 lb Devrinol 50 DF	1 to 2 napropamide	For control of annual grasses and broadleaf weeds. Apply before transplanting and water-in or incorporate to a depth of 1 to 2 inches in 10 to 50 gal water/A. Can be applied immediately after transplanting. To avoid injury, do not replant with crops not specified on the label until 12 months if using the 4-lb rate.
1 pt Fusilade-DX 2E	0.25 fluazifop-p	For selective postemergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 55 days. Max. rate is 48 fl oz/A.
0.5 to 2.5 pt Poast 1.5 E	0.09 to 0.48 sethoxydim	For control of actively growing grasses only. Use high rate on johnsongrass. PHI = 30 days. Max. rate of 2.5 pt/application and 5 pt/season.
16 to 22 fl oz Roundup Weather-Max 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective postemergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
1 to 10% Scythe 4.2L	pelargonic acid	For non-selective contact control of annual grasses and broadleaf weeds. Use in min. 10 gal water/A if mixed with other herbicides or a min. 75 gal if used alone. Do not allow contact with crop foliage. Can be mixed with Roundup. See label for amount of Scythe to use depending on the desired spray volume.
6 to 16 fl oz Select 2E	0.09 to 0.24 clethodim	For selective postemergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. PHI = 30 days.
0.5 to 1 oz Valor 51DG	0.024 to 0.032 flumioxazin	For postemergence control of broadleaf weeds and yellow nutsedge. For use on 'Beauregard' variety only. Apply 2 to 5 days before transplanting. Do not use greenhouse grown transplants. Max. rate 2.5 oz/A.

DISEASE CONTROL: *Sweetpotatoes*

Product	Amt/A	Seasonal Limits/A	Comments
Damping-off *(Pythium)*			
Ridomil Gold EC	1 to 2 pt	1 app	Apply to soil as a broadcast spray or in a 7-inch band; incorporate into the upper 2 in of soil mechanically (pre-plant) or with irrigation (pre- and at-planting) if rainfall is not expected within 24 hours of treatment.
Ridomil Gold SL			
Ultra Flourish	2 to 4 pt	1 app	
Foliar Diseases			
Azoxystrobin[1]		4 apps	Apply before disease onset, continue on a 7- to 14-day schedule. User higher rates when pressure is severe.
Amistar	2 to 5 oz		
Quadris	6 to 15.5 fl oz		
Evito 480 SC[1]	3.8 fl oz	6 apps	Apply before disease onset, continue on a 7- to 10-day schedule.
Headline[1]	6 to 9 fl oz	2 apps	Apply before disease onset, continue on a 7- to 14-day schedule as needed. User higher rates when pressure is severe.
Reason[1]	5.5 to 8.2 fl oz	16.4 fl oz	Apply before disease onset, continue on a 5- to 10-day schedule.
Scala	7 fl oz	35 fl oz	Apply before disease onset, continue on a 7- to 14-day schedule.
Scurf, Black Rot, Sclerotinia Blight, Post-harvest Rot			
Botran 75 W	2 lb/15 gal water	1 app	SEED DIP: For control of scurf, dip seed in solution for 10 to 15 seconds and plant immediately. Discard unused solution daily.
	3 to 3.75 lb/1000 sq ft	1 app	PLANT BED APPLICATION: For control of Sclerotinia blight, spray or sprinkle solution over bedded seed before covering.
	0.5 to 1 lb/100 gal water	1 app	POST HARVEST DIP: Dip harvested tubers in solution, or spray; do not rinse after treatment. Use low rate for dip. For suppression of rhizopus rot.
Maxim 4 FS	0.08 to 0.16 oz/cwt	1 app	Dip seed pieces in a water-based slurry; spread and allow to dry.
Mertect 340 F	3.3 qt/100 gal water	1 app	Dip seed pieces in solution for 1-2 minutes; plant immediately afterward. Discard solution when it becomes dirty or volume becomes too low to treat.

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