

## POTATO

Potato is a cool season crop that produces best yields when temperatures average slightly below 70°F during the growing season. Potatoes will grow well on a wide range of soils and are especially well suited for New England. The best soil for potatoes is a well-drained, reasonably deep loam. Potatoes produced on light, sandy, loam soils generally have a more desirable shape and a brighter skin color than those grown on heavier clay-type soils. Poorly-drained soils favor disease development and may result in reduced plant stands, low yields and poor quality.

### Varieties

#### EARLY MATURING

**Caribe** is a purple-skinned, white-fleshed variety. This variety has resistance to some common scab and Potato Leaf Roll Virus (PLRV).

**Chippewa** has buff-colored, oval tubers. This cultivar is late blight susceptible and highly susceptible to common scab.

**Irish Cobbler** has round, buff-colored tubers with white flesh. Cobbler has resistance to Potato Virus A (PVA) and moderate resistance to blackleg and fusarium tuber rot. This cultivar is highly susceptible to Potato Virus Y (PVY) and verticillium wilt.

**Norchip** has round to oblong tubers. This cultivar is common scab resistant but is susceptible to late blight and verticillium wilt. Norchip also has a tendency toward misshapen tubers and growth cracks.

**Sunrise** has round to oblong, buff-colored tubers with white flesh. This cultivar has high specific gravity and is resistant to net necrosis, Potato Virus X (PVX) and moderately resistant to common scab. This cultivar has a high yield potential.

**Superior** and **NewLeaf Superior** (CPB resistant) is a round, white cultivar that is resistant to common scab but is susceptible to late blight and verticillium wilt.

#### MIDSEASON

**Atlantic** and **NewLeaf Atlantic** (CPB resistant) has round, buff-colored tubers with netted skin. This cultivar is resistant to golden nematode race A, PVX, net necrosis and pink eye with tolerance to common scab. It is susceptible to heat necrosis when grown on hot, sandy soils.

**Kennebec** has elliptical to oblong tubers. This cultivar has high yield potential with resistance to PVY, PVA and a moderate resistance to Blackleg. This cultivar is susceptible to verticillium wilt and pinkeye.

**Norland** has smooth, red-skinned tubers with white flesh. This cultivar is moderately resistant to common scab, PVY and PLRV. It is sensitive to air pollution (ozone).

**Red LaSoda** has round to oval tubers with bright, deep red skin with white flesh. This cultivar is moderately resistant to early blight and is heat and drought tolerant.

**Red Pontiac** is a red-skinned cultivar with oblong to round tubers. This cultivar is fairly drought tolerant.

#### LATE MATURING

**BelRus** is a medium russet-type cultivar with a heavily russeted dark skin. This cultivar is moderately resistant to common scab and verticillium wilt and highly resistant to Northern Root Knot Nematode.

**Coastal Russet** is a medium cultivar with long, slightly flat-

tened tubers with a moderately russeted skin.

**Katahdin** is a mid- to late-maturing, round white cultivar with high yield potential. This cultivar has some resistance to PVY, PLRV, PVA and is tolerant of drought conditions. This cultivar is susceptible to late blight and common scab.

**Russet Burbank** and **NewLeaf Russet Burbank** (CPB Resistant) is a russeted long-tubered cultivar with high specific gravity. It is resistant to common scab and blackleg. This cultivar is highly susceptible to PVY.

**Yukon Gold** is a medium yellow-fleshed cultivar with a yellowish, buff-colored skin. This cultivar has resistance to net necrosis, PVA and has high specific gravity; storability is excellent with long dormancy.

### Spacing and Seeding

Plant only certified or foundation seed. Certified and foundation seed has met specific conditions for production practices and disease tolerances. Planting good seed is an essential step to producing a high-quality crop.

Seed should be stored at 38 to 40°F with relative humidity maintained at 95%. Seed taken from cold storage should not be planted or cut immediately. Seven to 14 days prior to cutting or planting, tubers should be warmed gradually to 50 to 55°F. Good ventilation and 90% relative humidity should be maintained during this process. Cut seed pieces should be blocky, have at least one eye and weigh 1-1/2 to 2 oz.

#### AMOUNT (CWT.) OF SEED REQUIRED TO PLANT ONE ACRE

34 Inch Rows				36 Inch rows			
Inches Between Seed in Row	Wt. of Seed Pieces (ozs.)			Inches Between Seed in Row	Wt. of Seed Pieces (ozs.)		
	1-1/2	1-3/4	2		1-1/2	1-3/4	2
6	29	34	39	6	27	32	37
8	22	25	29	8	20	24	27
10	17	20	23	10	16	19	22
12	14	17	19	12	14	16	18
15	11	14	16	15	11	13	14

The more uniform in size and weight the seed being planted, the more accurate the planter will perform. The ideal seed-bed for planting potatoes is warm, medium field capacity in moisture content, and of uniform texture allowing good soil air movement. Soil temperatures should be 50 to 60°F in order to encourage cut seed wound healing and rapid growth. DO NOT plant cut seed in soil below 45°F as seed piece decay will be encouraged.

A well-prepared seedbed is desirable and will facilitate accurate planting. Overpreparation of the seedbed should be avoided because of crusting and compaction problems.

#### SUGGESTED SEED SPACING

Cultivar	Spacing in the Row
Kennebec	6 to 8 inches
Katahdin, Superior, Green Mountain and Irish Cobbler	7 to 10 inches
Russet Burbank, BelRus	12 to 16 inches

Close spacing in the row, 6 to 8", aids in reducing tuber size and increases the number of tubers set. Using close spacing can reduce the occurrence of hollow heart and growth cracks. Seed pieces should be planted 2 to 4" below the soil level; this will reduce problems with sunburned tubers. For rapid emergence, no more

than 2" of soil should cover the seed piece after planting. Where seed is planted deeper than 2", drag-off, or the removal of the excess soil from the top of the hill, may be employed to encourage rapid emergence. Rapid emergence should be encouraged to reduce problems with soil-borne diseases such as *rhizoctonia*.

### Lime

Lime and fertilizer rates should be applied relative to soil test results and the potato cultivar to be planted. Fertilizing according to soil test results may save money and will increase quality and yields. If the cultivar to be raised is common scab resistant, soil pH should be maintained at pH 6.0. This will facilitate not only potato growth but also rotation crops. If the cultivar to be raised is common scab susceptible, then the soil pH should be maintained at pH 5.0 to 5.2. Growers should be aware that acid scab, a scab organism that is active at low soil pH, is found in some areas; in these situations, soil pH should be raised to pH 6.0 and a scab resistant cultivar utilized.

### Fertilizer

Nitrogen is the most critical element from the standpoint of yield and quality. Excessive nitrogen can delay maturity, decrease quality and adversely affect fry color for process growers. Too little nitrogen will reduce yields. On most varieties, the amount of nitrogen per acre is usually 140 to 150 pounds. Slightly higher rates can be used on late-maturing varieties such as Russet Burbank and slightly less on early-maturing varieties such as Kennebec.

### Cultivation and Hilling

Hilling and cultivation operations are suggested to begin after the plants begin to emerge and should be completed prior to the plants filling half of the row, so as to not cause foliar or root damage. Hilling allows the use of a shallow planting depth to speed plant emergence, while providing the soil depth necessary later in the season for proper tuber development and protection from sunlight and adverse temperatures. Discs, rolling cultivators, hilling listers or implements with winged cultivator teeth may be used. For best results, hills should be flat and broad rather than narrow and peaked. Cultivation during hilling aids in mechanical weed control and some soil-applied herbicides can be incorporated at this time.

### Sprout Inhibitors

Sprout inhibitors should be used only in conjunction with good storage management. Federal law requires that shipping containers carrying potatoes treated with postharvest sprout inhibitors be labeled with the chemical name of the inhibitor. When small bags are shipped in master containers, only the master container needs to be labeled. DO NOT treat seed potatoes.

**Field Application:** Apply 3 lb. a.i. Maleic Hydrazide/A to healthy green nonwater stressed potato vines. Apply when most of the tubers of Russet Burbanks are 4 to 6 oz. in weight and Round White varieties are 1-3/4 to 2" in diameter. Apply at least two weeks before application of any vine killer. If rain comes within 24 hours of application, effectiveness will be reduced. DO NOT apply at temperatures above 85°F. See label for additional information.

**Postharvest Application:** Bulk storage equipped with good ventilation through the pile or pallet box storages can be treated with chloro-IPC by licensed custom applicators, however, only

after harvest cuts and bruises have healed (two to three weeks after harvest). Low doses can increase internal sprouting. Seed potatoes should not be placed in treated storage at any time. Chloro-IPC is sold as an aerosol treatment to be applied in storage or as an emulsifiable concentrate to be added to wash water for prevention of sprouting in marketing channels. DO NOT use the herbicide formulation for sprout control.

### Vine Killing

Vines should be killed two to three weeks before digging to help tubers mature and reduce skinning and bruising during harvest. This also helps to prevent late blight infection of tubers. Vines may be killed by flaming, mowing, beating or with chemical vine killers. CAUTION: Rapid killing with chemicals can result in vascular ring discoloration of tubers.

**ametryn (Evik 80W):** 2-1/2 to 3 lb/A (REI 12h). Apply 14 to 21 days before harvest. Kill is slow during cool weather.

**Diquat:** 1 pt/20 to 100 gal water/A (REI 24h). Apply two to three weeks before harvest. Make second application if necessary to obtain additional desiccation. Allow a minimum of five days between applications. Do not apply to drought-stressed potatoes.

**endothal (Des-i-cate 0.52E):** 1-1/2 to 2 gal/A (REI 48h). Apply 14 to 21 days before harvest.

**paraquat (Gramoxone Extra\*):** 1-1/2 to 2-1/2 pints in 50 to 100 gal water/A (3 dh, REI 48h). Apply 7 to 10 days before harvest. Use clean water. Paraquat should not be used when the potatoes are to be stored or used for seed, as this use may result in tuber decomposition and failure of seed pieces to germinate and grow normally.

### Harvest

Premature harvesting can result in reduced yields and lower specific gravity. On the other hand, if harvesting is delayed too long, field frost and diseases can cause serious losses. Proper operation of the harvesting equipment and careful handling can reduce the amount of damage from bruising. Potatoes should not be allowed to fall more than 4 to 6" and all equipment surfaces should be padded. If potatoes are harvested at temperatures below 55°F, considerable bruising is likely to occur. If tubers are harvested during hot weather (above 80°F) and they cool off slowly, the likelihood of storage rot is increased. The ideal temperature during harvest is 60 to 70°F. Information on bruise testing is available from the University of Maine Cooperative Extension.

### Storage

An important aspect of potato pest control is to provide a pathogen-free storage environment. All storage and potato handling equipment surfaces should be thoroughly cleaned and disinfected prior to handling and placing the crop into storage. Surfaces should be well moistened by the disinfectant spray. Spray bin walls until there is a slight runoff. Recommended disinfectants are quaternary ammonium compounds such as Hyamine 2389. Read label for suitability. Bins or equipment treated with quaternary compounds must be rinsed with clean water before coming into contact with potatoes to be used for human consumption.

### Pre-storage Fungicide Treatment

Treatment of potatoes (seed and tablestock) with thiabendazole (Mertect 340F) as they go into storage has produced excellent control of fusarium tuber rot in storage. The chemical should be applied uniformly in a fine mist or fog as tubers pass over a roller table or bin loader. The rolling motion will facilitate even coverage. To each ton of potatoes, apply 0.42 ounce of Mertect 340F in sufficient water to provide coverage. DO NOT saturate the tubers.

Healing of cuts and bruises is most rapid at high relative humidity (95 percent) with a tuber temperature of 50 to 60°F and adequate through the pile ventilation. This temperature should be provided for two to three weeks at the beginning of the storage period. This process is called suberization. Effective suberization will reduce evaporative weight loss and prevent rot organisms from entering damaged tubers. After suberization the temperature should be lowered gradually to 40°F for tablestock or seed or maintained at 50°F for chip stock varieties. When a rot potential such as field frost, late blight or ring rot is present, the curing period should be eliminated, the temperature dropped and the ventilation increased. The crop should be utilized as soon as possible.

Temperature control is best achieved with forced air ventilation that is controlled thermostatically by an air proportioning system. Air flows should not exceed 1.0 cu ft/cwt/min. Storage relative humidity should be as high as possible without causing condensation on the storage walls and ceilings. Good insulation properly protected with a vapor barrier reduces danger of condensation.

### WEED CONTROL

Weed maps of field areas are extremely helpful in planning weed control strategies. A weed map can illustrate problem areas so that growers can target specific problems in specific areas. A weed map can also indicate shifts in weed pressure if kept continuously over years and indicate the possible need for a strategy change.

### Preplant and Stale Seedbed Application

**glyphosate (Roundup Ultra 4S):** 1 to 5 qt/A (REI 12h). Apply either before field preparation to control emerged perennial weeds or as a replacement to the drag-off operation as described above. Must be applied either before planting or before potatoes emerge; any crop contact will cause crop death. See also Stale Seedbed Technique on page 29.

**paraquat (Gramoxone Extra\* 2.5S):** 1-1/2 pt/A (REI 12h) in 100 gal water plus 8 oz. of nonionic surfactant. Apply at or before ground crack on round white and before ground crack on Russet Burbanks. Follow all precautions on the label. If the bed is adequately shaped and the potatoes are planted at the proper depth, Gramoxone Extra can be used to replace drag-off as a means of controlling emerged weeds prior to potato emergence. This application, also called the Stale Seedbed Technique, is further described on page 29.

**pelargonic acid (Scythe 4.2):** 3 to 10 gal/A (REI 24h). See Stale Seedbed Technique on page 29.

### Preplant Incorporated and Preemergence Control of Annual Grasses and Certain Broadleaf Weeds

**EPTC (Eptam 7E):** 4-1/2 to 7 pt/A (45 dh, REI 12h). Use the higher rate for control of yellow nutsedge and quackgrass. ‘Superior’ potatoes are sensitive to Eptam and, under stress conditions, early season stunting may occur. Apply to loose mellow-moist or drier soil. Incorporate to a depth of 2" to 3" within 20 minutes after application. Drag-off, if used, must occur prior to application and incorporation. May also be applied and incorporated after a clean cultivation as a directed spray to the base of emerged potato plants.

**EPTC (Eptam 10G):** 40 to 60 lb/A (REI 12h). All of the same precautions listed above for Eptam 7E apply. This formulation has the greatest utility as a layby application for nutsedge control after potatoes are emerged. Do not apply when the soil is wet. If applied over emerged potato plants, apply when vines

**Plant Nutrient Recommendations According to Soil Test Results for Potato**

Potato	Nitrogen (N)* Lbs Per Acre	Soil Phosphorous (P) Pounds P <sub>2</sub> O <sub>5</sub> Per Acre				Soil Potassium (K) Pounds K <sub>2</sub> O Per Acre					
		Very Low	Low	Med	High	Very High	Very Low	Low	Med	High	Very High
<b>Where all Fertilizer is Applied at Planting Time</b>											
Band placement at planting	120-180	250-300	200-250	180-200	150-180	100-150	225-250	200-225	180-200	150-180	120-150
TOTAL RECOMMENDED	120-180	250-300	200-250	180-200	150-180	100-150	225-250	200-225	180-200	150-180	120-150
<b>Where Sidedressing is Used</b>											
Band placement at planting	80-120	250-300	200-250	180-200	150-180	100-150	150-170	135-150	120-135	100-120	80-100
Sidedress	40-60	0	0	0	0	0	75-80	65-75	60-65	50-60	40-50
TOTAL RECOMMENDED	120-180	250-300	200-250	180-200	150-180	100-150	225-250	200-225	180-200	150-180	120-150

\*See pages 7 to 14 for information on nutrient management and application.

are dry and use a cloth drag to knock granules off plants.

**metolachlor (Dual Magnum):** 1 to 2 pt/A (REI 12h). Use the lower rate on light soils. If cool, wet soil conditions occur after application, Dual may delay maturity and/or reduce yield of 'Superior' and other early-maturing potato varieties. Dual, alone or in combination with metribuzin, is especially helpful in controlling both yellow nutsedge and black nightshade. May be applied preplant and incorporated to a depth of 3". May also be applied after planting as a preemergence or delayed preemergence treatment to clean soil before potato plants emerge. Drag-off, if used, must occur prior to application. May be tank mixed with metribuzin (Sencor or Lexone) or with linuron (Lorox) to improve broadleaf weed activity. DO NOT incorporate these tank mixes. A prepackaged tank mix of metolachlor plus metribuzin is available as **Turbo 8EC**. The use rate is 2 to 4 pt/A. Please follow all precautions for both metolachlor and metribuzin.

**pendimethalin (Prowl 4E):** 1-1/2 to 3 pt/A (REI 12h). Apply as a broadcast spray after planting or drag-off but before potatoes emerge. If rainfall does not occur within seven days after application, shallow cultivation to a depth of 1" to 2" will improve control. May be tank mixed with metribuzin (Sencor or Lexone) or linuron (Lorox) to improve broadleaf weed activity. May be tank mixed with Eptam 7E before planting to obtain control of yellow nutsedge or quackgrass.

NOTE: A common strategy of potato growers is to combine one of the "grass" herbicides listed above (EPTC, metolachlor or pendimethalin) with one of the "broadleaf" herbicides listed below (linuron or metribuzin). In more northern areas of New England, grasses are much less of a problem due to cooler soil temperatures, and there are many cases where only a broadleaf herbicide is necessary. If only a broadleaf herbicide is used, sethoxydim (Poast), described below, could be used during the growing season to provide emergency or spot treatment of any emerged annual or perennial grasses that were not anticipated.

### Preemergence and Early Postemergence Control of Many Broadleaf Weeds

**linuron (Lorox DF):** 1-1/2 to 4 lb/A (REI 24h) in 40 to 100 gal water. Make a single application as a broadcast spray after planting but before crop emerges. Drag-off, if used, must occur prior to application. DO NOT spray over top of emerged potatoes. Plant seed at least 2" deep. Constant tank agitation is required. See label to select proper rate for your soil type. Heavy rain after application may cause injury to potatoes. DO NOT repeat application or plant other crops within four months of treatment. DO NOT overlap spray. Needs moist soil to activate. Will also control small emerged annual weeds if present at the time of application. One pt nonionic surfactant/25 gals spray mixture may be added to improve activity on emerged weeds (see label). May be tank mixed with metolachlor (Dual) or pendimethalin (Prowl) to improve activity on annual grasses.

**metribuzin (Sencor or Lexone DF):** 2/3 to 1-1/3 lb/A (REI 12h) in 20 to 40 gal water. Apply as a broadcast spray after planting or drag-off but before crop emerges. Drag-off, if used, must occur prior to application. DO NOT incorporate into the soil. Constant tank agitation is required. See label to select proper rate for your soil type. DO NOT overlap spray. Will also control small emerged annual weeds present at the time of application. May be tank mixed with metolachlor (Dual) or pendimethalin (Prowl) to improve activity on annual grasses.

Sencor or Lexone may also be applied as a postemergence spray in certain situations (see postemergence section below). A prepackaged tank mix of metribuzin plus metolachlor is available as **Turbo 8EC** (2 to 4 pt/A). Follow all precautions for both metribuzin and metolachlor.

**rimsulfuron (Matrix 25 DF):** 1 to 1-1/2 oz/A (60 dh, REI 4h). Apply after hilling or drag-off, but before potatoes emerge. Activation by rainfall or irrigation (1/4 to 3/4") is needed within 1 week of application. If weeds are present at application, add a nonionic surfactant at 1 to 2 pt/100 gal water. May be tank mixed with other soil applied herbicides; see the label for advice. Weak on lambsquarters.

### Postemergence Weed Control

**metribuzin (Sencor or Lexone 75DF):** 1/3 to 2/3 lb/A (60 dh, REI 12h) in 20 to 40 gal water. Apply only after three days of sunny weather. DO NOT use on BelRus, red-skinned or early maturing, white-skinned varieties. Treat before weeds are 1" tall. Treatment may cause chlorosis or necrosis of potato vines. DO NOT reapply. If Sencor or Lexone 75DF is used before crop emergence, do not apply more than 1-1/2 lb/A per year.

**metribuzin (Sencor or Lexone 75DF):** 1/3 to 2/3 lb/A (60 dh, REI 12h) plus **sethoxydim (Poast 1.53EC):** 1 to 1-1/2 pt/A (30 dh, REI 12h). Add 2 pt/A of crop oil concentrate. Observe all precautions listed above for both products.

**pelargonic acid (Scythe 4.2):** 3% to 10% (REI 24h). Use a 3-5% solution for annual weeds (4-6 oz/gal water), a 5-7% solution for biennial and perennial weeds (6-9 oz/gal water), and 7-10% solution for maximum burndown (9-13 oz/gal water). Delivery rate for boom applications should be 75 to 200 gallons of spray solution per acre; complete coverage of weed foliage is essential. Use a DIRECTED/SHIELDED SPRAY; Contact with crop will cause injury. For hand-held equipment, spray to completely wet all weed foliage but not to the point of runoff. Repeat applications as necessary. Tank mixes are allowed with this product. These include tank mixes with glyphosate (Roundup), sulfosate (Touchdown), and residual herbicides. See label for complete details.

**rimsulfuron (Matrix 25 DF):** 1 to 1-1/2 oz/A (60 dh, REI 4h). Apply to young, actively growing weeds before crop exceeds 14" in height. Small weeds (less than 1" in height or diameter) are easiest to kill; however, quackgrass is more easily controlled when it is 4 to 6" high and actively growing. Add a nonionic surfactant at 1 to 2 pt/100 gal water. Application to moist soil is best. Rainfall or irrigation (1/4 to 3/4") within 1 week of application will activate Matrix in the soil. May be tank mixed with metribuzin (Lexone); see the label for advice. Weak on lambsquarters. More weed species are controlled postemergence than preemergence. Do not apply after June 30. Apply only after at least three days of sunny weather. See label for other postemergence precautions.

**sethoxydim (Poast 1.5EC):** 1 to 1-1/2 pt/A (30 dh, REI 12h). Apply with crop oil concentrate at 2 pt/A. Apply to actively growing grasses (see product label for susceptible stage of growth). DO NOT cultivate for five days prior or seven days after Poast application.

### Problem Weeds

See the relative susceptibility chart of weeds to herbicides at

the end of this manual to better assess the performance of an individual herbicide on each weed species.

**Yellow Nutsedge:** The herbicides listed above, which will provide the best control of yellow nutsedge, include a soil incorporated treatment of EPTC (Eptam), a preemergence application of metolachlor (Dual) or a postemergence application of metribuzin (Sencor or Lexone). The best strategy is to map the problem spots in a field and make an application of either Eptam or Dual before the nutsedge emerges. A postemergence application of Sencor or Lexone can be used to clean any areas that escape the Eptam or Dual treatment. The best time to apply a postemergence treatment of Sencor or Lexone is when the yellow nutsedge is 4" to 6" tall. Remember that nutsedge is not a grass and will not be controlled by sethoxydim (Poast).

**Quackgrass:** By far the best strategy for control of quackgrass is with an application of glyphosate (Roundup) to actively growing quackgrass the fall prior to planting. An application of Roundup in the spring at least three days prior to soil preparation will suppress quackgrass but will not kill it. EPTC (Eptam) and sethoxydim (Poast) can also be used to suppress quackgrass during the growing season. Both of these herbicides will provide greater activity if the quackgrass rhizomes (underground storage roots) are cut thoroughly with a disc prior to planting the potatoes. Also, Poast will provide better suppression of quackgrass if the lower rate is used and repeated when the quackgrass regrows (about two weeks after the first application). Be sure to observe the preharvest interval for both Eptam and Poast.

**INSECT CONTROL**

Regular field scouting is one of the most important aspects of effective insect control. See Reference No. 10 on page 103.

**Aphids**

Aphids spread viruses to seed and tablestock potatoes, which can reduce yields. High populations of aphids can cause foliage to decline. Fields should be scouted for aphids starting in late June. Examine 50 compound leaves from the top, middle and bottom of the potato canopy. In fresh market and processing potatoes, insecticides should be applied when an average of five aphids per leaf are present. In Maine, the economic threshold for tablestock and processing fields is when aphids are found on 50 percent of the plants or one winged green peach aphid is found within the field.

**azadirachtin (Neemix 4.5):** 1/8 to 1 pt/A (0 dh, REI 12h).

**imidacloprid (Provado 1.6F):** 3-3/4 oz/A (7 dh, REI 12h). DO NOT use if Admire was used at planting. Control melon aphid and other potato infesting aphids. See plant back restrictions.

**insecticidal soap (M-Pede):** 2-1/2 oz/gal water (0 dh). Spray to wet all infested plant surfaces. Repeated applications may be required.

**methamidophos (Monitor\* 4):** 1-1/2 to 2 pt/A (14 dh, REI 48h). Does not control melon aphid (MA).

**methomyl (Lannate\* LV):** 1-1/2 to 3 pt/A (6 dh, REI 48h). Only effective against melon aphid (MA). May not be compatible with tin-based fungicides on some varieties.

**oxamyl (Vydate L):** 1 to 2 qt/A (7 dh, REI 48h).

**phorate (Thimet\* 20G):** 11-1/3 oz/1,000 feet of row for sandy soils and 17-1/3 oz/A for heavy or clay soils (90 dh, REI 48h). Distribute granules in the furrow or band on each side of the row.

**Colorado Potato Beetle (CPB)**

The CPB survives on a number of different host plants in the Northeast. These include horsetail, nightshade, tomato, eggplant and potato. Because a large part of the overwintering population remains in the field of its origin or surrounding uncultivated area, it is best not to plant a susceptible crop into fields planted to a host plant the previous year.

Colorado potato beetles rapidly develop resistance to insecticides. This can happen in as short a time as one year. The following recommendations may slow the development of resistance.

**Rotate to nonhost crops.** Crop rotation is the most important practice in managing the CPB. It is best to rotate fields away from last year's fields and overwintering sites that bordered last year's fields. This single practice can delay colonization and reduce population densities.

**Alternate** different groups of insecticides throughout the season; e.g., alternate applications of Asana or Pounce or Ambush with Provado. Use the bioinsecticides M-Trak, Novodor or Raven when possible.

**DO NOT try to kill every beetle** in the field. Potato crops can withstand 15 percent defoliation without affecting yields.

**Avoid** spraying the beetle in late season, as food reserves in the foliage two weeks prior to senescence add little to final tuber bulking.

**Determine** whether or not a damaging population is present. As CPB eggs hatch, adults and larvae should be counted to determine the need to apply insecticides. Walk the field in a V-shaped pattern and select 50 potato stalks at intervals. e.g., every 10 to 20 paces, depending on field size. Count adults, large larvae (greater than half-grown), small larvae (less than half-grown) separately. Compare the counts to the following table. If the number of CPB is high, an insecticide should be applied; if the number is low, no insecticide is required for that week. If the number of CPB is between high and low, no insecticide should be applied; but the field should be checked in three to five days. Otherwise, the field should be checked weekly. These thresholds are for midseason. Late in the season, potato plants can tolerate more defoliation without affecting yields. These thresholds DO NOT apply to *B.t.* products.

**Action Thresholds**

Life Stage	No. of CPB per 50 stalks	
	Low	High
Adults	15 or fewer	25 or more
Small Larvae	75 or fewer	200 or more
Large Larvae	30 or fewer	75 or more

**NewLeaf Potatoes:** Use NewLeaf varieties in areas where CPB has been a major problem and plant 20% of field to the same cultivar as the NewLeaf to prevent resistance development. The NewLeaf varieties produce the same *B.t.* toxin as that used in Raven, Novodor, and M-Trak.

Repeat applications of the following insecticides may be necessary; alternation of chemicals is advised.

**abamectin (AgriMek 0.15EC):** 8 to 16 oz/A (14 dh, REI 12h). DO NOT apply more than 32 oz/A per season.

**azadirachtin (Neemix 4.5):** 1/8 to 1 pt/A (O dh, REI 12h), use higher rate.

**azinphosmethyl (Guthion\* 2L):** 1-1/2 pt/A (7 dh, REI 48h). Apply once per season.

***Bacillus thuringiensis kurstaki/tenebrionis* (Raven) or subsp. *tenebrionis* (M-Trak, Novodor):** Rate will vary depending upon product. These materials are most effective against small larvae. For this reason, they should be applied soon after first egg hatch. Apply first spray one to three days after there is one or more egg masses per plant and 30 percent of these have hatched. If fields are densely populated and eggs are hatching continuously, reapply after five to seven days. Apply mid-morning, or when temperatures are above 70°F, for best results. Another approach is to wait until the first 1/8"-long batch of large larvae are observed and use a single application of Provado to kill large and small larvae. Then start your applications of *B.t.* a week later. This tactic allows for more uniform egg hatch, so that sprays can be better timed. **This material will not control adult CPB, aphids or leafhoppers.** The bacterial toxin acts as a stomach poison causing gut paralysis. Death may take as long as four to five days. However, the larvae stop feeding within one hour of ingestion. Therefore, look for feeding damage, not presence of larvae to evaluate effectiveness. Use high rates if fields are densely populated. See page 32 for additional information.

**cryolite (Kryocide):** 10 to 12 lb/A (0 dh, REI 12h). Not effective against the adult beetle. DO NOT apply more than 96 lb/A per season. Application to exposed tubers may result in excess residues. Use of any Kryocide product obtained before 1994 will require the possession of a supplemental label that can be obtained from your supplier. This material can cause extensive wear of nozzles.

**endosulfan (Thiodan\* 50WP):** 1 to 2 lb/A (1 dh, REI 24h).

**esfenvalerate (Asana\* XL):** 5-4/5 to 9-3/5 oz/A (7 dh, REI 12h) plus **piperonyl butoxide (Butacide 8EC):** 8 oz/A. Apply when temperature is less than 80°F and when foliage is free from dew or other moisture.

**imidacloprid (Admire 2F):** 9/10 to 1-1/3 oz/1,000 row feet (REI 12h). This material is highly effective in controlling the beetle, and to prevent resistance development, it should be restricted to lands where the beetle has routinely been a major problem. DO NOT use two years in a row on the same lands. See plant back restrictions on label. Does not control European corn borer.

**imidacloprid (Provado 1.6F):** 3-3/4 oz/A (7 dh, REI 12). DO NOT use if Admire was used at planting. Use once for each generation and integrate with *B.t.s* or other insecticide to delay insecticide resistance development. Moderately effective against aphids and leafhopper. See plant back restrictions on label.

**oxamyl (Vydate\* L):** 1 to 2 qt/A (7 dh, REI 48h). Use when air temperature is greater than 80°F.

**permethrin (Pounce\* 3.2EC):** 4 to 8 oz/A (7 dh, REI 12h) plus **piperonyl butoxide (Butacide 8EC):** 8 oz/A. Apply when temperature is less than 80°F and when foliage is free from dew or other moisture.

**spinosad (SpinTor 2SC):** 3 to 6 oz/A (7 dh, REI 4h). DO NOT apply to consecutive generations, or make more than 2 applications per generation.

## Potato Leafhopper and Flea Beetles

Potato leafhoppers overwinter in Louisiana and vicinity and move north on storm fronts into the central states and then into New England on winds from the west. Very low numbers (0.1 per compound leaf) can cause significant crop damage. Monitor as for aphids. All insecticides registered for Colorado potato beetle, except *Bacillus thuringiensis*, control flea beetles and leafhoppers.

## European Corn Borer

Although the borer can infest potatoes, there are no data available to show it to cause economic losses.

**azinphosmethyl (Guthion\* 2L):** 2 to 3 pt/A (7 dh, REI 48h).

**esfenvalerate (Asana\* XL):** 5-4/5 to 9-3/5 oz/A (7 dh). DO NOT exceed 67.9 oz/A per season. Apply when temperature is less than 80°F and when foliage is free from dew or other moisture.

**permethrin (Pounce\* 3.2EC):** 4 to 8 oz/A (7 dh, REI 12h).

**spinosad (SpinTor 2 SC):** 3 to 6 oz/A (7 dh, REI 4h).

## Wireworms

To avoid wireworm problems, potatoes should not be grown in rotation with sod or grass crops. Delay planting susceptible crops, such as potatoes or corn, on such land for at least two years after the sod has been broken. If wireworms are present, broadcast insecticide and incorporate into soil, preferably when soil temperature is above 60°F.

**ethoprop (Mocap 10G):** 2.1 lbs/1,000 feet of row in 12" band at planting. Mix with top 2 to 4" of soil (REI 48h).

**phorate (Thimet\* 20G):** see description on page 84 under aphids for rates.

## DISEASE CONTROL

Virus control will be enhanced by buying certified seed. Consult seed producers to determine what the certification covers. Destroy cull piles and volunteer plants. DO NOT keep potatoes for seed.

### Seed Piece Treatment (Fungi)

Potato seed treatment is one of the more overlooked portions of a whole-season disease control program. Properly suberized and properly treated seed will provide a better, more uniform stand of plants. Proper application of the appropriate material is necessary. Too much chemical may prove phytotoxic. Inadequate coverage may not totally protect the seed piece. Dust formulations are preferable for cut seed. CAUTION: Dip treatments may spread bacteria to seed pieces which were previously not affected. NOTE: Many of these seed treatments are now formulated with Douglas fir or alder bark as a carrier. Improved healing of the cut surface has been reported with these products.

**captan (Captan 5%):** 1 to 2 lbs/bushel of seed. Treat seed within six hours of cutting. For control of *Fusarium* tuber rot.

**maneb/mancozeb (Maneb, Penncozeb, Manzate, Dithane):** rates vary depending on formulation; see Table 14, page 35. (3 dh, REI 24h).

**pentachloronitrobenzene (Terraclor):** See label for specific instructions. For control of *Rhizoctonia*; complete coverage is needed for satisfactory control.

**thiophanate-methyl (Tops 2.5D):** 1 lb/100 lbs. Treat cut seed for control of *Rhizoctonia* and *Fusarium* tuber rot.

### Early Blight (*Alternaria*)

Apply any of the following fungicides when plants are 4" to 6" tall. Begin applications earlier if late blight is found in your area, or if disease forecast systems recommend beginning a protection program. Repeat at five- to seven-day intervals, depending on amount of moist weather or dew. Use shorter interval under cool, (60 to 70°F) moist conditions. Proper fertilization and mineral balance will reduce susceptibility of plants to Early Blight.

### Late Blight (*Phytophthora*)

Late blight can occur from infected seed potatoes, or infected potato debris overwintered in the field. New late blight strains introduced into the region are resistant to metalaxyl. Do not leave cull piles of potatoes in the field. The fungicides used for early blight have some protective ability against *Phytophthora* but cannot be relied on to provide significant control. If late blight is reported within one half mile, begin applications of Acrobat or Curzate. Curzate should be combined with mancozeb, chlorothalonil or metiram to give additional protection against early blight, and to prevent resistance development to Curzate. Acrobat is premixed with mancozeb. Plants with significant disease should be plowed under. Check with your local extension specialist for the availability of special-exemption fungicides.

**chlorothalonil (Bravo Ultrex 82 WDG):** 7/10 lb before vines close between rows; 9/10 to 1-2/5 lb/A after vines close between rows or when disease severity values are reached (7 dh, REI 48h). Apply lower rates at 7 to 10 day intervals and apply at 5 to 7 day intervals when plants are growing rapidly or disease conditions are severe.

**cupric hydroxide (Champ II):** 2/3 to 1 pt/A. Apply on 3- to 10-day intervals. When disease pressure is high, apply 2 to 2-2/3 pt/A. (0 dh, REI 24h).

**cymoxanil (Curzate 60 DF):** 3-1/3 oz/A (14 dh, REI 12h). Do not use Curzate alone. Combine with a full rate of manzate, chlorothalonil or metiram. Do not make more than 7 applications per season.

**dimethomorph plus mancozeb (Acrobat MZ):** 2-1/4 lb/A (14 dh, REI 24h). Do not make more than 5 applications in any one season.

**maneb/mancozeb (Maneb, Penncozeb, Manzate, Dithane):** rates vary depending on the formulation. See Table 14, Page 35 (3 dh, REI 24h).

**mefenoxam plus manzate (Ridomil Gold MZ):** 2.5 lb/A. Apply when conditions are favorable for disease and repeat at 14-day intervals (3 dh, REI 48h). Do not plant any crop which is not registered for use with Ridomil Gold active ingredient in Ridomil Gold active ingredient-treated soil for a period of 12 months.

### Common Scab (*Streptomyces*)

Scab is caused by the soilborne bacterium *Streptomyces scabies*. The disease tends to be prevalent when soil is dry during tuber initiation, soil pH is above 5.2, and non-decomposed manure is used as fertilizer. Continuous cropping of potato will also increase the disease. When planting susceptible varieties, avoid fields with a history of scab. When scab is present, rotate out of potatoes for at least two years. Beets, carrots, radish and some weeds can also be hosts. Maintain soil at 5.0 to 5.2. Mancozeb may be useful in controlling seed-borne scab. The varieties Norchip, Norland, Pike,

Salem and Superior are resistant to scab. Allengany, Andover, Atlantic, Chieftain, Elba, Genesee, Monoma, Reba and Redsen are moderately resistant. Katahdin, Kennebec and Snowden are moderately susceptible. Chippewa, Kanona, Norwis and Yukon Gold are very susceptible.

### *Pythium* Leak

Leak can be a problem in stored potatoes, especially bruised, immature potatoes harvested in hot weather.

**mefenoxam plus manzate (Ridomil Gold MZ):** 2.5 lb/A (3 dh, REI 48h). Make the first application at flowering and another 14 days later. If the field has a history of storage rot problems, make another application 14 days after the second. Do not plant any crop which is not registered for use with Ridomil Gold active ingredient in Ridomil Gold active ingredient-treated soil for a period of 12 months.

**mefenoxam plus chlorothalonil (Ridomil Gold EC/Bravo WP):** 2 lb/A (3 dh, REI 48h). Make the first application at flowering and another 14 days later. If the field has a history of storage rot problems, make another application 14 days after the second. Do not plant any crop which is not registered for use with Ridomil Gold EC active ingredient in Ridomil Gold active ingredient-treated soil for a period of 12 months.

### *Verticillium* and *Fusarium* Wilt

*Verticillium* and *Fusarium* are soil-borne fungi that cause vascular wilts of potato. They can be introduced into fields by contaminated seed or soil. Continual potato production tends to result in an increase in wilt disease. A combination of lesion nematodes and *Verticillium* results in early dying. Rotation with nonsusceptible crops such as grasses will reduce disease. At this time, there are no varieties resistant to *Fusarium* Wilt.

### Potato Leaf Roll Virus (PLRV)

Potato Leaf Roll Virus is the most serious virus disease of potatoes in New England and can result in significant yield reductions. The virus is transmitted by aphids in a persistent manner. The virus can overwinter in unharvested tubers which may develop into virus-infected volunteer plants. Plant virus-free, certified seed. Remove volunteer plants. Rogue plants with virus symptoms. When populations of aphids reach economic thresholds, treatment is warranted. DO NOT use any of last year's potato harvest for seed.

### Potato Virus S (PVS), Potato Virus A (PVA), Potato Virus X (PVX), Potato Virus Y (PVY, Rugose Mosaic)

These viruses may occur singly or in combination. PVY, PVS and PVA are spread by aphids in a nonpersistent manner. PVX is not known to be spread by aphids but is easily spread by plant-to-plant contact, farm machinery or cultural practices. Plant virus-free certified seed. Plant early, use resistant varieties, and control aphid populations.