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Chapter 35.
Potato Production in Florida

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BOTANY

Nomenclature

Family – Solanaceae

Potato – *Solanum tuberosum* L.

Origin

The potato is native to the Andean highlands of Peru.

Related Species

Tomato, pepper, and eggplant are other important vegetables in the Solanaceae family. Tomatillo and pepino, of much less economic importance in Florida, are also in this family. In addition, many plants in this family are used as ornamentals. Some, like tobacco, contain powerful alkaloids which may be addictive, poisonous, or useful as pharmaceuticals.

VARIETIES

Variety selection, often made several months before planting, is one of the most important management decisions made by the grower. Failure to select the most suitable variety or varieties may lead to loss of yield or market acceptability.

The following characteristics should be considered in selection of potato varieties for use in Florida:

Yield – The selected should have the potential to produce crops at least equivalent to the current market standards. The typical yield for Florida fresh market varieties ranges from 225 – 350 cwt/acre. Production falls on the lower end of the scale in the southern counties and increases as production moves into northern counties.

A typical yield for chip potato production is 275 – 400 cwt/acre. Chip potato production areas are located from mid-state counties on both coasts to northern counties.

Disease, Insect, and Nematode Tolerance – Varieties having disease, insect, and nematode tolerance should be selected when all other factors are equal.

Horticultural Quality – Earliness is an important characteristic for Florida production as the average season length is 100 days. Other important qualities, depending on variety usage, include appropriate skin type, set, and color; taste and mouth feel; uniform tuber shape and size; shallow eyes; and relative specific gravity should all be considered.

Adaptability – Potatoes in Florida are grown as day length increases and temperature change from cool to warm. This is opposite compared to many other production areas in the world. New varieties should be tested on limited acreage and accepted by the public and/or processor before planting on wider acreage. All popular northern varieties *do not* produce well in Florida because of Florida growing conditions.

Market Acceptance – New varieties must have characteristics that are appreciated by consumers. In addition, many other entities in the production chain such as packer, processor, and/or retailer all have demands that the variety must meet.

POTATO VARIETIES FOR COMMERCIAL PRODUCTION

Chipping Varieties

ATLANTIC - With high yield potential, high specific gravity and uniform tuber size and shape, Atlantic is the standard variety for chipping from the field or from very short-term storage. The cultivar is tolerant to scab and Verticillium wilt; resistant to pinkeye; and highly resistant to Race A of golden nematode, virus X and tuber net necrosis. Tubers are susceptible to internal heat necrosis, particularly in sandy soils in warm, dry seasons. Hollow heart in the larger diameter tubers (> 3 in) can be serious in some growing areas when growing conditions over the season fluctuate

HARLEY BLACKWELL –Harley Blackwell is a round, white-, netted-skinned cultivar, resistant to internal heat necrosis, for chipping directly from the field in the mid-Atlantic states. Harley Blackwell is resistant to race a of golden nematode, air pollution susceptible, Verticillium

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wilt, late blight. It is moderately susceptible to early blight with intermediate resistance to common scab and some tolerance to powdery scab.

Fresh Market/Table Varieties

RED LASODA - Red LaSoda is an early to medium season, red-skinned variety that is primarily grown in the southeastern U.S. It is harvested in the winter months as a fresh market variety. Red LaSoda has a high yield potential of tubers with a bright red color. Tubers size early. Tuber eye depth and off-shape tubers are limitations. The cultivar is susceptible to early and late blights, scab, corky ringspot, and bacterial wilt. Red LaSoda is the top planted red-skinned potato variety in Florida.

LAROUGE - LaRouge is a early to medium maturing, red-skinned variety that has a high tuber yield potential with tubers sizing early. Primary growing areas are in the southeastern U.S. The variety is grown for the fresh market and is generally not stored. LaRouge has good scab resistance but is susceptible to early and late blights, corky ringspot, and bacterial wilt. The deep eyes and irregular tuber shape are the major limitations. When harvested in southern states the relatively high yield, bright color, and good boiling qualities make it popular for markets in the late winter.

LACHIPPER - LaChipper is an early to midseason variety with moderate to high tuber yield and moderate specific gravity. It is the top planted fresh market white-skinned variety in Florida. Tubers are more elongated than round, somewhat flattened. Skin is smooth and white with medium to deep, cream colored eyes that are fairly evenly distributed. Tuber flesh is very white. La Chipper possesses some resistance to late blight. It is moderately susceptible to common scab. Exposure to air pollution can result in defoliation and reduction in tuber yield. Deep eyes and irregular shape are disadvantages on the tablestock market.

SEBAGO - Sebago was released by the USDA and the Maine Agricultural Experiment Station in 1938. Tubers are elliptical to round with a smooth, ivory skin. Specific gravity is medium to low. Sebago is recognized statewide as having excellent flavor but it lacks some important horticultural qualities to compete equally with current fresh market standards. When grown in the south, the variety's maturity is considered medium. Tubers grown under ideal conditions are attractive but are susceptible to prominent lenticels under wet conditions. Sebago is resistant to net necrosis and wart and has moderate resistance to early and late blight, southern bacterial wilt, PVX, PVY, PVA and some resistance to scab. The variety is highly susceptible to blackleg.

YUKON GOLD - Yukon Gold has early-medium maturity, moderate yields, moderate specific gravity and relatively attractive tuber type. Tubers slightly oval, may be somewhat flattened with yellow-white skin and light yellow tuber flesh. Its shallow, pink eyes distinguish Yukon Gold from other yellow-skinned, yellow-fleshed cultivars. Yukon Gold is resistant to mild mosaic, moderately resistant to leafroll virus and susceptible to virus Y, common scab and air pollution. In some growing areas, hollow heart and internal heat necrosis may be a problem. Yukon Gold retains the yellow flesh color when baked, boiled or french-fried.

GOLDRUSH - Goldrush is a medium maturing russet cultivar grown primarily for the fresh market. Russet-skinned tubers are oblong to long and average approximately 6-10 tubers per plant. Eyes are very shallow and well distributed; under some conditions they may show a reddish blush. Tuber flesh is very white and tuber dormancy is medium in duration. Goldrush has been observed to have moderate resistance to Verticillium wilt, good resistance to scab, moderate resistance to blackspot and some resistance to silver scurf. It is considered susceptible to most common potato viruses and other potato diseases, such as early blight, late blight, soft rot and Fusarium dry rot.

GENERAL INFORMATION – Production, quality, and disease resistance information is not provided for proprietary varieties. Information on proprietary varieties can be obtained by private or licensing company.

For further information on potato varieties for Florida production refer to the following EDIS documents:

Fresh market red and purple-skinned potato varieties for commercial production in northeast Florida. http://edis.ifas.ufl.edu/CV283

Fresh market white-skinned potato varieties for commercial production in northeast Florida. http://edis.ifas.ufl.edu/CV282

Fresh market russet potato varieties for commercial production in northeast Florida. http://edis.ifas.ufl.edu/CV281

Chip potato varieties for commercial production in northeast Florida. http://edis.ifas.ufl.edu/CV280

Potato vine killing or desiccation. http://edis.ifas.ufl.edu/HS181

Growing potatoes in the Florida home garden. http://edis.ifas.ufl.edu/HS183

Potato physiological disorders – growth cracks. http://edis.ifas.ufl.edu/HS182

Potato physiological disorders – brown center and hollow heart. http://edis.ifas.ufl.edu/HS197

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SEEDING AND PLANTING

Planting date and seeding information are given in Table 1.

FERTILIZER AND LIME

For subsurface or sprinkler irrigated crops, band all P_2O_5, micronutrients, K_2O (50%), and nitrogen (50%) in bed at planting. When plants reach a 10-12 inch growth stage (approximately 35-40 days after planting), band or

Table1. General potato planting information.

Planting dates	
North Florida	Jan-Feb
Central Florida	Dec-Feb
South Florida	Oct-Jan[1]
Planting information	
Distance between rows (inch)	36 - 42
Distance between plants (inch)	5 - 10
Planting depth (inch)	3 - 4
Average seed piece size (oz)	2.5 - 3.0
Average seed per planted acre (lb)	2000 - 3000
Days from planting to tuber maturity	85 - 110.

Table 2. Planting information for potato.

Planting dates	
North Florida	Jan-Feb
Central Florida	Dec-Feb
South Florida	Oct-Jan[1]
Planting information	
Distance between rows (in)	36 - 42
Distance between plants (in)	6 - 12
Planting depth (in)	3 - 4
Seed pieces per acre (lb)	2,000 - 3,000
Days to maturity: seed pieces	85 - 110
Plant population[2] (acre)	29,040

[1] February plantings in Glades

[2] Population based on closest between and within row spacing.

Table 3. Soil test and fertilizer recommendations for mineral soils for potato (based on 40 to 42 inch centers).[1]

Target pH	N (lb/A)	K_2O (lb/A)	P_2O_5 (lb/A/crop season)				
			VL	L	M	H	VH
6.0	200	150	120	120	60	0	0

[1] See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.

Table 4. Plant tissue analysis for potato plants 10 inches tall. Dry wt. basis.

Status	N	P	K	Ca	Mg	S	Fe	Mn	Zn	B	Cu	Mo
	Percent						Parts per million					
Deficient	<3.0	0.2	3.5	0.6	0.3	0.25	40	30	30	20	5	0.1
Adequate range	3.0-6.0	0.2-0.8	3.5-6.0	0.6-2.0	0.3-0.6	0.25-0.50	40-150	30-60	30-60	20-60	5-10	0.1-0.2
High	>6.0	0.8	6.0	2.0	0.6	0.50	150	60	60	60	10	0.5

Table 5. Sufficiency ranges for petiole sap testing for potato.

Crop development stage	Fresh petiole sap concentration (ppm)	
	NO_3-N	K
Plants eight-inches tall	1200-1400	4500-5000
First open flowers	1000-1400	4500-5000
50% flowers open	1000-1200	4000-4500
100% flowers open	900-1200	3500-4000
Tops falling over	600-900	2500-3000

inject remaining K_2O and nitrogen into side of bed (Table 3). In seepage irrigated potatoes, banded or infected fertilizer must be placed deep enough in the bed to reach the capillary fringe of the perched water table.

PLANT TISSUE ANALYSIS

Plant tissue analysis for potato is listed in Table 4. This data corresponds to nutrient concentrations in the most recently matured leaf of 10 inch tall plants.

PETIOLE SAP TESTING

Fresh sap can be pressed from leaf petioles and analyzed for nitrogen and potassium concentrations. Results can be used to make fertilizer adjustments within the first 40 days after planting. Application of fertilizer near or after full flower will not result in tuber yield increase. Sufficiency ranges for sap testing for potato are presented in Table 5**.**

IRRIGATION

Potato plant growth is peaks at or soon after full flower. The highest demand for water occurs in the growth stages leading up to full flower. Plant water requirements increase from about 40% of ETo (see Chapter 8, Table 1) during the initial plant growth stages to 110% of ETo at peak foliar growth and tuber development. Tubers bulk rapidly after full flower when the foliage begins to senesce. Plant water use decreases to about 70% ETo. The depth of the perched water table in the seepage irrigated potatoes should be carefully maintained. The perched water table should be dropped before expected periods of heavy rainfall. Over irrigation late in the season can cause lenticels to expand detracting from fresh market tuber quality. In addition, over irrigation late in the season can lower specific gravity in chipping potatoes.

WEED MANAGEMENT

Weed control early in the season is important to maximize tuber yield and quality. A combination of herbicide application and working potato acreage will reduce weed pressure. Care should be taken to implement a weed control program that reduces weed pressure late in the season after foliage begins senesces. Failure of a weed control program late in the season will impact tuber bulking and the ease at which potatoes can be harvested. Water furrows should be maintained weed free as they can serve as a weed seed bank to re-infest the planted acreage. Herbicides labeled for weed control in potatoes are listed in Table 6.

POTATO VINE DESICCANTS

Potatoes grown in Florida fit into two marketing niches. A few potato varieties are grown for the processing market (chip or diced). For the processing market, it is often not necessary to produce a fully mature tuber with excellent skin quality as the potato will be processed shortly after harvest. However, many tubers in Florida enter the fresh market. Fresh market tubers are sold on appearance and taste. It is important for these tubers to have excellent skin quality and the ability to maintain quality for a short period of time.

Non-mature tubers will “skin” when harvested. Skinned tubers appear untidy due to bits of protruding skin. Skinned areas will also discolor turning from tan to dark brown. Non-mature tubers also lose significantly more weight than unskinned tubers in storage and transit. Skinned areas are sites of soft rot infection resulting in rejected loads.

Tubers can be induced to mature in the field by killing the potato vines either mechanically, with herbicides, or a combination of both. Rapid killing of vines under stressful (water or heat) conditions can result in discoloration of the tuber vascular tissue. Discoloration does not increase in storage or affect storage quality.

Killing the potato vines induces tubers to mature rapidly and causes the periderm to set. Tubers should remain in the field at least 14 to 21 days after vine kill and dependent on herbicide label information. The longer the period between vine kill and harvest, the less chance tubers will skin at harvest. The time it takes for tubers to mature after vine kill is variety dependent. A small plot of tubers should be dug periodically by hand and rubbed to test for skin slippage. It is difficult to get the skin to slip on mature tubers. It will take tubers longer to mature when plants are killed under active growing conditions (vines green and vigorous) compared to tubers under senescing vines.

When vines are killed, sunburning and/or greening can affect tubers not sufficiently covered with soil. Hilling soil around the plant to keep tubers covered is important. Vine desiccants are listed in Table 7.

DISEASE MANAGEMENT

Chemicals approved for disease management of potato are listed in Table 8.

INSECT MANAGEMENT

Table 9 outlines the insecticides approved for use on insects attacking potato.

PRODUCTION COSTS

Production costs for chip and table potatoes in major Florida potato growing areas are given in Table 10 (Hastings-chip) and Table 11 (Hastings-table).

Table 6. Chemical weed controls: potatoes.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre) Mineral	Muck
Carfentrazone (Aim)	Potatoes	Directed-hooded row-middles	0.008-0.025	0.008-0.025
Remarks: Aim may be applied as a post-directed hooded burn-down application to emerged broadleaf weeds in row middles. Aim is not labeled for grassy weeds. May be tank mixed with other herbicides registerred for this treatment pattern. May be applied at 0.33 oz (0.008 lb ai) to 1 oz (0.025 lb ai). Use a quality spray adjuvant such as crop oil concentrate (coc) or non-ionic surfactant (nis) at recommended rates.				
Carfentrazone (Aim)	Potatoes	Preplant Directed-hooded Row-middles	0.031	0.031
Remarks: Aim may be applied as a preplant burndown treatment and/or as a post-directed hooded application to row middles for the burn-down of emerged broadleaf weeds. May be tank mixed with other registered herbicides. May be applied at up to 2 oz (0.031 lb ai). Use a quality spray adjuvant such as crop oil concentrate (coc) or non-ionic surfactant at recommended rates.				
Clethodim (Select)	Potatoes	Postemergence	0.1-0.25	0.1-0.25
Remarks: Control of emerged grasses. Always use a crop oil concentrate at 1% v/v in the finished spray volume unless tank mix instructions indicate otherwise. Do not apply within 30 days of harvest. Use 6 oz. to 16 oz. product to control actively growing grasses at recommended heights. For control of annual grasses, use 6 to 16 fl. oz/A, for perennial grasses, use 8 to 16 fl oz/A.				
DCPA (Dacthal W-75)	Potato	Preemergence or early layby	6.0-8.0	---
Remarks: Controls germinating annuals. Apply to moist soil. Note label precautions of replanting non-registered crops within 8 months.				
EPTC (Eptam 7E) (Eptam 10G)	Potato	Postemergence or early layby; Preplant, Dragoff, Layby	3.0 3.0	--- ---
Remarks: Granular formulation may be applied Preplant incorporated, at Dragoff and incorporated or at Layby and incorporated into clean cultivated soil. Emulsifiable formulation should not be applied on winter and early spring potatoes. Apply only after potatoes have emerged and true leaves have formed or at layby. There is a 45-day preharvest interval for application.				
S-Metolachlor (Dual Magnum)	Potato	Preemergence; Preplant incorporated; Postplant incorporated	.95 - 1.9	---
Remarks: Applications must be made before crop emergence. Preemergence and postplant incorporated should be made after drag off but before potato or weed emergence. May be tank mixed with Sencore/Prowe as preemergence treatment. When used alone, label states control of many grasses and broadleaf weeds including crabgrass, fall panicum, goosegrass, signalgrass, yellow nutsedge, galensoga, pigweed and Florida pusley. Note: Under prolonged cool, wet conditions, minor foliage injury has been seen.				
Metribuzin (Sencor DF) (Sencor 4)	Potato	Preemergence	0.5 - 1.0	---
Remarks: Apply to soil surface after drag-off but before crop emergence. Do not incorporate. Use lower rate on sandy soil.				
Metribuzin (Lexone DF) (Sencor DF) (Sencor 4)	Potato	Postemergence	0.25 - 0.5	---
Remarks: Not to be used on early maturing white or red skinned varieties. Apply only if there have been 3 consecutive days of sunny weather. Treat before weeds are 1" tall. Do not apply within 60 days of harvest. Split applications of pre plus postemergence may be made. Do not use more than 1 lb. per season.				

Table 6. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre) Mineral	Muck
Paraquat (Gramoxone Inteon) (Firestorm)	Potato	Preemergence	0.47	0.47
Remarks: Controls emerged weed seedlings. Apply after planting, but before potatoes emerge. Use a non-ionic spreader.				
Pelargonic Acid (Scythe)	Potato	Preplant Preemergence Directed-Shielded	3-10% v/v	3-10% v/v
Remarks: Product is a contact, nonselective, foliar herbicide. There is no residual activity. May be tank mixed with soil residual herbicides. Consult label for rates and timings of applications.				
Pendimethalin (Prowl)	Potato	Preemergence; Preemergence Incorporated	0.75	---
Remarks: May be applied after planting but before potatoes and weeds emerge or after drag-off. Most effective when incorporated by rainfall or mechanically into top 1 to 20 of soil within 7 days after application. Will not control established weeds. May also be applied early postemergence (from emergence to 6-inch stage of growth). Use this application on trial basis only. May be tank mixed with Sencore/Lexone, Eptam. Label states not for use on peat or muck soils.				
Rimsulfuron (Matrix)	Potato	Preplant Preemergence Directed-Shielded	0.25-0.38 oz	0.25-0.38 oz
Remarks: Apply at a rate of 1 to 2oz of product to clean soil following hilling or drag-off. Product must be activated by irrigation or rainfall with 5 days. Apply postemergence to actively growing small weeds after crop emergence. Add as non-ionic surfactant to postemergence applications. Do not apply within 60 days of harvest. Do not exceed 2.0 oz product per acre/growing season. Preemergence tank mixes of Matrix with Lexone, Eptam, Prowl, Lorox or Dual are labeled. Postemergence tank mixes of Matrix plus Lexone an Eptam are labeled. Note and follow rotational crop guidelines.				
Sethoxydim (Poast)	Potato	Postemergence	0.188 - 0.28	0.188 - 0.28
Remarks: Controls actively growing grass weeds. A total of 5 pts. product per acre may be applied in one season. Do not apply within 30 days of harvest. Apply in 5 to 20 gals. of water adding 2 pts. of crop oil concentrate per acre. Unsatisfactory results may occur if applied to grasses under stress. Use 0.188 lb ai (1 pt.) to seedling grasses and up to 0.28 lb ai (1.5 pts.) to perennial grasses emerging from rhizomes, etc. Consult label for grass species and growth stage for best control.				

Table 7. Chemical desiccants for potato production.

Active Ingredient	Common Name	Manufacturer	Product Rate	PH Interval[1]	Relative Desc. Rate[2]
Carfentrazone	AIM	FMC	3.2-5.8 fl oz/A	7 days	Fast
Diquat	Reglone	Syngenta	1-2 pt/A	7 days	Fast
Endothal	Desicate II	Cerexagri	1.5-2 qt/A	10 days	Slow
Pelargonic Acid	Scythe	Dow	7-10% sol.	1 day	Fast
Pyraflufen	ET	Nichino	2.75-5.5 fl oz/A	14 days	Slow

[1] Preharvest interval is the minimum time between application and harvest. It is not necessarily the time required to achieve tuber maturity and good skin-set.

[2] Relative desiccation rate for each herbicide.

Table 8. Disease management for potato.

Chemical	Fungicide Group	Maximum Rate/Acre/ Application	Maximum Rate/Acre/ Season	Min. Days to Harvest	Pertinent Diseases or Pathogens	Remarks
Dithane M45, Penncozeb 80WP (Mancozeb)	M3	2 lb	14 lb	3	Early Blight Late Blight	1.25 lb/50 gal. water for seed piece treatment. Allow to dry and do not use as livestock feed.
Dithane F45 Rainshield or Manzate Flowable (Mancozeb)	M3	1.6 qt	11.2 qt	3	Early blight Late blight	1 qt/50 gal. water for seed piece treatment. Allow to dry and do not use as livestock feed.
Penncozeb 75DF, Manzate 75DF, Manzate Pro-Stick (Mancozeb)		2 lb	15 lb	3	Early blight Late blight	1.25 lbs/50 gal water for seed piece treatment. Allow to dry and do not use as livestock feed.
Manex (Maneb)	M3	1.6 qt	11.2 qt	3	Early blight Late blight	0.8 qt./10 gal of water for seed piece treatment. Allow to dry and do not use as livestock feed.
Maneb 80WP (Maneb)	M3	2 lb	14 lb	3	Early blight Late blight	1 lb/10 gal. water for seed piece treatment. Allow to dry and do not use as livestock feed.
Ridomil Gold Copper 64.8 W (Copper hydroxide; Mefenoxam)	4	2 lb	7.5 lb	14	Late blight	Limit is 3 appl./crop of this product & other Ridomil products Add protectant fungicide, see label.
Maneb 75DF (Maneb)	M3	2 lb	14.9 lb	3	Late blight Early blight	Same as for Maneb 80 WP
Rovral 4F and Iprodione 4L (Iprodione)	2	2 pt	8 pt	14	Early blight Sclerotinia	Limit is 4 appl./crop Limit is 4 appl./crop
Ridomil Gold Bravo 76.4W	M5 and 4	2 lb	8 lb	14	Late blight Early blight	
Bravo Ultrex (Chlorothalonil)	M5	1.36 lb	13.6 lb	7	Late blight Early blight	Up to 0.7. lb is allowed before vines close or before 18 severity values occur
Equus 720SST (Cholorthalonil)	M5	1.5 pt	15 pt	7	Late blight Early blight	Same as Bravo Weather Stik
Polyram 80DF (Metiram)	M3	2 lb	14 lb	3	Late blight Early blight	Limit is 7 appl./season
Quadris 2.08FL (Azoxystrobin)	11	15.4 fl oz	3.75 qt	14	Late blight Early blight Various, see label	Limit is 6 appl./crop/acre & alternate chemistry
Amistar 80DF (Azoxystrobin)	11	5 oz	2.5 lb	14	Same as Quadris	Same as Quadris
ManKocide 61.1DF (Copper hydroxide; Mancozeb)	M1 & M3	5.3 lb	74.66 lb	3	Early blight Late blight	
Super-Tin 80WP1 (Triphenyltin hydroxide)	30	3.75 oz	15 oz	7	Early blight Late blight	For use with closed tractor cabs only.
Bravo Weather Stik 6L (Chlorothalonil)	M5	1.5 pt	15 pt	7	Early blight Late blight	Up to 3/4 pt. allowed before vines close between rows or before 18 disease severity values occur.

Table 8. Continued.

Chemical	Fungicide Group	Maximum Rate/Acre/ Application	Season	Min. Days to Harvest	Pertinent Diseases or Pathogens	Remarks
Curzate 70DF (Cymoxanil)	27	3.2 oz	22.4 oz	14	Late blight	Limit is 7 apps/crop. Use in combination with a protectant fungicide. It is best to alternate Curzate with other fungicides such as mancozeb or chlorothalonil. Do not replant area to other crops within 30 days of treatment.
Topsin M 70WP (Thiophanate-methyl)	1	1-1 ½ lb/A	4 lb	21 3	White Mold (Sclerotinia)	May be tank mixed with other fungicides labeled for early and late blight control. Aerial application is not recommended.
Gavel 75DF (Mancozeb; Zoxamide)	M3 & 22	2.0 lb	12 lb		Early blight Late blight	This product contains 66.7% mancozeb so do not exceed maximum allowed for mancozeb considering this and other mancozeb-containing products. A 30 day rotational limit for non-labelled crops exists for this product
Headline 2.09F (Pyraclostrobin)	11	12 fl oz	72 fl oz	3	Early blight Late blight	6 appl. Maximum. Alternate with other fungicide type between appls.
Heritage (Axoxystrobin)	11	9.6 oz	4.0 lb	14	Early blight Late Blight	6 appl. Maximum. Alternate with other fungicide type between appls.
Gem 500SC (Trifoxystrobin)	11	3.8 fl oz	23 fl. oz	7	Early blight Late Blight	Limit is 6 appl./crop and alternate chemistry
Endura 70WP (Boscalid)	7	10 oz	20.5 oz	30	Early blight	Limit is 4 appl./crop & alternate chemistry
Acrobat (Dimethomorph)	40	6.4 oz	32 oz	4	Late blight Tuber blight	
Agri-tin (Triphenyltin hydroxide)	30	3.75 oz	11.25	7	Early blight Late blight	
Agri-Mycin and Streptrol (Streptomycin)	25	100 ppm				Seed treatment
Blocker 4F (Pentachloronitro - benzene (PCNB)	14	10 pt/A	20 pt		Stem canker Black scurf Late blight	Apply at planting
Echo 720 (Chlorothalonil)	M5	1.5 pt	11.25 lb ai/A	7	Early blight	
Echo 90DF (Chlorothalonil)	M5	1.25 lb			Late blight	
Equus DF (Chlorothalonil)	M5	1.36 lb	13.6 lb	7	Early blight Late blight Botrytis	
Maxim 4FS (Fludioxonil)	12	0.16 oz/100 lb seed				Seed treatment. Must be made using specific equipment. See label.
Maxim Potato Seed Protectant (Fludioxonil)	12	0.5 lb/100 lb seed			Fusarium Stem Canker	Seed treatment
Moncut 70DF (Flutolanil)	7	1.1 lb	3.5 pt	14	Rhizoctonia	In-furrow use only

Table 8. Continued.

Chemical	Fungicide Group	Maximum Rate/Acre/ Application	Season	Min. Days to Harvest	Pertinent Diseases or Pathogens	Remarks
Omega 500F (Fluazinam)	29	8 oz			Late blight White mold	
Potato Seed Treater 6% and Potato Seed Treater PS (Mancozeb)	M3	1 lb/100 lb seed			Fusarium	Seed treatment
Ranman (Cyazofamid)	21	2.75 fl oz/A	27.5 fl oz	7	Late blight	Alternate sprays with a fungicide with a different mode of action. Follow label directions
Reason 500SC (Fenamidone)	11	8.2 fl oz	24.6 fl oz	14	Late blight Early blight	Alternate sprays with a fungicide with a different mode of action. Follow label directions
Previcur Flex (Promocarb hydrochloride)	U	1.2 pt	6.0 pt	14	Late blight Early blight	Use with a tank mix. See label for seed piece treatment.
Ridomil Gold EC (Mefenoxam)	4	Apply 0.42 oz/1000 linear ft			Pythium and Phytophthora damping-off	Apply at planting
Ridomil Gold MZ (Mancozeb; Mefenoxam)	M3 & 4	2.5 lb	7.5 lb	3	Early blight Late blight	
Scala SC (Pyrimethanil)	9	7 oz	35 oz	7	Early blight	
Serenade ASO (Bacillus subtilis strain QST 713)		6 qt		0	Early blight Late blight	
Serenade Max (Bacillus subtilis strain QST 713)		3 lb		0	Early blight Late blight	
Sonata (Bacillus pumilus strain QST 2808)		4 qt		0	Early blight Late blight	
Sulfur (Various brands) (Sulfur)	M2					Do not apply in warm weather. Do not apply within 2 weeks of an oil spray.
Tanos	27 & 11	8 oz	48 oz	14	Early blight Late blight	Do not make consecutive applications. Rotate to material with different mode of action
(Cymoxanil; Famoxadone)					Late blight	
Terraclor 75WP (Pentachloronitrobenzene (PCNB))	14	6.66 lb			Rhizoctonia	At planting
Terraclor F (Pentachloronitrobenzene (PCNB))	14	10.4 oz 1000 linear ft			Rhizoctonia	At planting
Thiophanate Methyl 85WDG (Thiophanate-methyl)	1	1.2 lb	3.2 lb	21	White mold	

Table 8. Continued.

Chemical	Fungicide Group	Maximum Rate/Acre/ Application	Season	Min. Days to Harvest	Pertinent Diseases or Pathogens	Remarks
Topsin M WSB (Thiophanate-methyl)	1	1.5 lb	4 lb	21	White mold	
Topsin 4.5FL (Thiophanate-methyl)	1	30 fl oz	80 fl oz	21	White mold	
Ultra Flourish (Mefenoxam)	4	0.84 oz/1000 linear ft			Pythium and Phytophthora-caused seed decays	At planting
Tops 2.5D (Thiophanate-methyl)	1	1 lb/100 lb seed			Fusarium and Rhizoctonia-caused seed decays	
Various copper compounds[3]	M1				Early blight Late blight	See individual labels

[1] Super Tin should be tank-mixed with a mancozeb fungicide (e.g. Manex, Dithane, Manex, Manzate or Penncozeb)

[2] Dusting sulfur, Kumulus DF, Micro Sulf, Micronized Gold, Microthiol Disperss, Sulfur 9, Thiosperse 80%, Wettable Sulfur, Yellow Jacket Wettable Sulfur.

[2] Badge SC, Basic Copper 53, COC DF, COC WP, Champ DP Dry Prill, Champ 2 FL, Champion, Copper-Count-N, Cuprofix Disperss, Cuprofix MZ Disperss, Copper Sulfate Instant Powder, Kocide 101, Kocide 2000, Kocide 4.5LF, Kocide DF, Nordox, Nu Cop 50WP, Nu-Cop 3L, Nu-Cop 50DF, Tenn-Cop 5E, Stretch.

Table 9. Insecticides approved for use on insects attacking potatoes.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Actara (thiamethoxam)	1.5-3.0 oz	12	14	aphids (higher rate), Colorado potato beetle, potato leafhopper	4A	Toxic to bees. Do not use following soil application of Platinum. Maximum 6 oz/acre per season.
Admire 2F (imidacloprid)	13-20 fl oz/acre; seed-piece treatment: 8-16 oz/acre	12	at planting, see label for options	aphids, Colorado potato beetle, flea beetles, potato leafhopper, wireworms (seed-piece only)	4A	Do not apply more than, 0.31 lb ai per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre.
Admire Pro	5.7-8.7 fl oz seed piece: 3.5-7.0 fl oz					
Agree WG (Bacillus thuringiensis subspecies aizawai)	1.0-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11B1	Apply when larvae are small for best control. OMRI-listed[2].
***Agri-Mek 0.15 EC** (abamectin)	8-16 fl oz	12	14	Colorado potato beetle, Liriomyza leafminers, spider mites	6	No more than 2 sequential applications. See label for resistance management.

Table 9. Insecticides approved for use on insects attacking potatoes.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Ambush 25W** (permethin)	3.2-12.8 oz	12	14	cabbage looper, Colorado potato beetle, potato aphid, potato flea beetle, potato leafhopper, potato tuberworm	3	Do not apply more than 1.6 lb active ingredient per season (102.4 oz).
***Asana XL (0.66 EC)** (esfenvalerate)	2.9-9.6 fl oz	12	7	beet armyworm (aids in control), cabbage looper, Colorado potato beetle, cucumber beetles (adults), cutworms, flea beetles, grasshoppers, potato aphid, potato leafhopper, potato tuberworm, tarnished plant bug	3	Do not apply more than 0.35 lb ai/acre per season (7 applications at highest rate).
Assail 70WP (acetomiprid) Assail 30 SG	0.6-1.7 oz 1.5-4.0 oz	12	7	aphids, Colorado potato beetle, leafhoppers, flea beetle	4A	Do not make more than 4 applications per season. Do no exceed a total of 0.3 lb ai per acre per season.
Avaunt (indoxacarb)	2.5-6.0 oz	12	7	cabbage looper, Colorado potato beetle	22	Do not apply more than 24 oz/acre per crop.
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	26	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	26	Antifeedant, repellant, insect growth regulator.
***Baythroid 2** (cyfluthrin)	0.8-2.8 fl oz	12	0	cabbage looper, Colorado potato beetle, cutworms, flea beetles, potato leafhopper, potato tuberworm, tarnished plant bug	3	Allow at least 5 days between applications. A total of 6 applications and a maximum of 16 oz may be applied per acre per season.
Biobit HP (Bacillus thuringiensis subspecies kurstaki)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11B2	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed[2].
BotaniGard 22 WP, ES (Beauveria bassiana)	**WP:** 0.5-2 lb/100 gal **ES:** 0.5-2 qts/100 gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
Clinch (Abamectin)	1 lb	12	0	fire ants	6	Apply when ants are actively foraging. Apply after dew or rainfall has dried for maximum effectiveness. Do not apply if rainfall is anticipated within 4-6 hours.
Crymax WDG (Bacillus thuringiensis subspecies kurstaki)	0.5-2.0 lb	4	0	caterpillars	11B2	Use high rate for armyworms. Treat when larvae are young.

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Deliver (Bacillus thuringiensis subspecies kurstaki)	0.25-1.5 lb	4	0	caterpillars	11B2	Use higher rates for armyworms. OMRI-listed[2].
Dimethoate 4 EC, 2.67 EC (dimethoate)	**4EC:** 0.5-1 pt **2.67:** 0.75-1.5 pt	48	0 - 2.67 2 - 4E	aphids, grasshoppers, leafhoppers, leafminers	1B	Highly toxic to bees.
DiPel DF (Bacillus thuringiensis subspecies kurstaki)	0.5-2.0 lb	4	0	caterpillars	11B2	Treat when larvae are young. Good coverage is essential. OMRI-listed[2].
***Di-Syston 15 G** (soil only) (disulfoton)	13.5-20.5 lb	48	75, soil	aphids, Colorado potato beetle, flea beetles, leafhoppers, wireworms	1B	Do not make more than 2 soil applications. See label for details.
***8 EC** (soil or foliar)	2-3 pt		30, foliar 75, soil	green peach aphid (east of Rocky Mountains)	1B	No more than 3 foliar applications.
Endosulfan 3 EC (endosulfan)	0.66-1.33 qts	24	1	aphids, armyworms, Colorado potato beetle, false chinchbugs, flea beetles, leafhoppers, plant bugs, potato tuberworm, stink bugs, three-lined potato beetle, whiteflies	2	No more than 6 applications per year.
Entrust (spinosad)	1-3 oz	4	7	armyworms, Colorado potato beetle, loopers, thrips	5	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more than 4 times/crop.
Extinguish ((S)-methoprene)	1.0-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75 oz	12	14	green peach aphid, potato aphid	9B	Apply when aphids first appear.
***Furadan 4F** (carbofuran)	1-2 pts	48	14	Colorado potato beetle, flea beetles, leafhoppers	1A	See label for restrictions based on soil type and water table.
Gaucho (imidacloprid + mancozeb)	0.75 lb/100 lb cut seed-pieces	24	seed-piece treatment	aids in control of aphids, Colorado potato beetle, flea beetles, wireworms	4A	See label for restrictions.
Imidan 70 W (phosmet)	1.3 lb	24	7	Colorado potato beetle, flea beetles, potato leafhoppers	1B	Use only on potatoes to be harvested by machine.
Javelin WG (Bacillus thuringiensis subspecies kurstaki)	0.12-1.5 lb	4	0	most caterpillars, but not Spodoptera species (armyworms)	11B2	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
Kryocide (cryolite)	10-12 lb	12	0	Colorado potato beetle	9A	Application to exposed tubers may result in excess residues.
***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt **SP:** 0.5-1.0 lb	48	6	aphids, beet armyworm, fall armyworm, flea beetles, leafhoppers, loopers, potato tuberworm, variegated cutworm	1A	

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Lepinox WDG (Bacillus thuringiensis subspecies kurstaki)	1.0-2.0 lb	12	0	for most caterpillars, including beet armyworm (see label)	11B2	Treat when larvae are small. Thorough coverage is essential.
Malathion 8F (malathion)	1-3 pt	12	0	aphids, false chinchbugs, grasshoppers, mealybugs, leafhoppers	1B	
***Mocap 15 G, *EC** (ethoprop)	See labels	48	preplant or at planting	symphylans, wireworms	1B	
***Monitor 4 EC** (methamidophos)	1.5-2 pts	48	14	aphids, armyworms, cabbage looper, Colorado potato beetle, cutworms, flea beetles, Lygus bug, potato leafhopper, potato tuberworm	1B	
M-Pede 49% EC Soap, insecticidal	1-2% V/V	12	0	aphids, Colorado potato beetle, leafhoppers, plant bugs, thrips, whiteflies, mites	--	OMRI-listed[2].
Oberon 2SC (spiromesifen)	8-16 fl oz	12	7	potato psyllid, twospotted spider mite, whiteflies	23	Maximum amount per crop: 32.0 fl oz/acre. Maximum applications: 2.
***Penncap-M** (methyl parathion)	2-6 pt	4 days - See label	5	Colorado potato beetle, cutworms, flea beetles, grasshoppers, potato leafhopper, tarnished plant bug	1B	Do not apply more than 24 pt per acre per year.
Platinum (thiamethoxam)	5-8 fl oz	12	applied at planting or at plant emergence	aphids, Colorado potato beetles, flea beetles, potato leafhoppers	4A	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Actara or Provado in conjunction with Platinum.
***Pounce 3.2 EC** (permethrin)	4-8 oz	12	14	aphids, aster leafhopper, beet armyworm, cabbage looper, Colorado potato beetle, cutworms, flea beetles, leafhoppers, potato tuberworm, tarnished plant bug	3	
Provado 1.6 F (imidacloprid)	3.8 oz	12	7	aphids, Colorado potato beetle, flea beetles, leafhoppers	4A	Do not use if other 4A insecticides have been used at planting.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, Colorado potato beetle, cucumber beetles, flea beetles, leafhoppers, leafminers, loopers, Lygus bugs, mites, plant bugs, stink bugs, thrips, vegetable weevil, whiteflies	3, 21	
Rimon 0.83EC (novaluron)	9-12 fl oz	12	14	armyworms, Colorado potato beetle, loopers, other foliage feeding caterpillars, potato tubermoth, whiteflies	15	Do not apply more than 24 oz per acre per season. Limited to 2 applications.

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Sevin XLR, 4 F; 80 S (carbaryl)	**XLR, 4F:** 0.5-2.0 qt **80S:** 0.63-2.5 lb	12	7	Colorado potato beetle, corn earworm, cutworms, fall armyworm, flea beetles, hornworms, leafhoppers, stink bugs, tarnished plant bug, tomato fruitworm, tomato hornworm	1A	Do not apply more than a total of 6 qt or 7.5 lb.
SpinTor 2 SC (spinosad)	3-6 fl oz	4	7	armyworms, Colorado potato beetle, leafminers (Liriomyza spp.), loopers, thrips	5	Do not apply to consecutive generations of Colorado potato beetle, or make more than 2 applications per single generation.
Sun Spray 98.8%, JMS Stylet-Oil, others (oil, insecticidal)	3-6 qt/100 gal (JMS)	4	0	leafhoppers, leafminers, thrips, whiteflies, mites	--	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
***Telone C-35** (dichloropropene + chloropicrin) ***Telone II** (dichloropropene)	See label	5 days - See label	preplant	symphylans, wireworms	--	See supplemental label for additional use restrictions for certain counties.
***Temik 15 G** (aldicarb)	14-20 lb	48	At planting	aphids, Colorado potato beetle, flea beetles, leafhoppers	1A	Do not apply after planting. See label for other restrictions.
***Thimet 20 G** (phorate)	See label - varies with soil type and time of application.	48	90	aphids, Colorado potato beetle, flea beetles (larvae), leafhoppers, leafminers, wireworms	1B	One application per season.
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	26	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
Venom (dinotefuran)	**foliar:** 1-1.5 oz **soil:** 6.5-7.5 oz	12	**foliar -** 7 **soil -** at planting	Colorado potato beetle, flea beetle, green peach aphid, potato leafhopper, psyllid	4A	Soil application one time either at preplant, preemergence, or at ground crack.
***Vydate L** (oxamyl)	**foliar:** 2-4 pt	48	7	aphids, Colorado potato beetle, flea beetles, leafhoppers, tarnished plant bug	1A	No more than 6 foliar applications per crop.
Xentari DF (Bacillus thuringiensis subspecies aizawai)	0.5-2.0 lb	4	0	caterpillars	11B1	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

The pesticide information presented in this table was current with federal and state regulations at the time of revision. The user is responsible for determining the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label instructions.

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes

[1] Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v.3.3 October 2003. 1A. Acetylcholine esterase inhibitors, Carbamates 1B. Acetylcholine esterase inhibitors, Organophosphates
2A. GABA-gated chloride channel antagonists
3. Sodium channel modulators
4A. Nicotinic Acetylcholine receptor agonists/antagonists, Neonicotinoids
5. Nicotinic Acetylcholine receptor agonists (not group 4)
6. Chloride channel activators
7A. Juvenile hormone mimics, Juvenile hormone analogues
7D. Juvenile hormone mimics, Pyriproxifen
9A. Compounds of unknown or non-specific mode of action (selective feeding blockers), Cryolite
9B. Compounds of unknown or non-specific mode of action (selective feeding blockers), Pymetrozine
11B1. Microbial disruptors of insect midgut membranes, B.t. var aizawai
11B2. Microbial disruptors of insect midgut membranes, B.t. var kurstaki
12B. Inhibitors of oxidative phosphorylation, disruptors of ATP formation, Organotin miticide
15. Inhibitors of chitin biosynthesis, type 0, Lepidopteran
16. Inhibitors of chitin biosynthesis, type 1, Homopteran
17. Inhibitors of chitin biosynthesis, type 2, Dipteran
18. Ecdysone agonist/disruptor
20. Site II electron transport inhibitors
21. Site I electron transport inhibitors
22. Voltage-dependent sodium channel blocker
23. Inhibitors of lipid biosynthesis
25. Neuroactive (unknown mode of action)
26. Unknown mode of action, Azadirachtin

[2] OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

* Restricted Use Only.

Table 10. Breakeven production costs of chip potatoes at various yield levels in the Hastings area, 2004-2005.

		Yield (cwt/acre)				
	Cost per acre	**175**	**200**	**225**	**250**	**275**
Variable Costs	$1,541.19	$8.81	$7.71	$6.85	$6.16	$5.60
Fixed Costs	$593.38	$3.39	$2.97	$2.64	$2.37	$2.16
Harvest Cost/unit		$1.00	$1.00	$1.00	$1.00	$1.00
Total Cost/unit		$13.20	$11.67	$10.49	$9.54	$8.76