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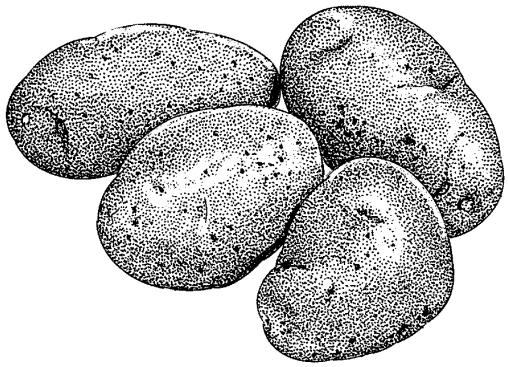
Potato Production

Due to the wide diversity in types and high consumer consumption, potatoes fit well with many growers. They can be marketed direct to consumers at farm stands, farmers markets, and through other local retail outlets. There is also a substantial wholesale market in the Mid-Atlantic based around the increasing demand for locally produced foodstuffs and specialty-type potatoes. Wholesale marketers will want to explore local and regional produce auctions, grocer local-buyer programs, and direct-to-restaurant sales. The diversity of potatoes is just beginning to be realized as more and improved specialty potatoes with different skin, flesh colors, and uses are being grown and marketed. The use of different colors adds to the visual appeal of potatoes on display and can attract attention at a retail outlet.

Potatoes (*Solanum tuberosum*) are the world's most important vegetable crop. They originate in the Andean region of South America and were first brought to Spain, where they were marketed as early as 1576. The potato was then introduced to the rest of Europe, where the Irish were the first to recognize it for its high food value. By the early 1600s potatoes became the staple food of the Irish, with the majority of the people depending on them for their existence. When late blight disease came to Ireland from America, it caused a national famine from 1845 to 1848 that resulted in the death of nearly one million people and the mass overseas migration of one million more. Late blight caused the death of the potato vines and decay of the tubers, resulting in a total loss of the crop. Late blight, although manageable, is still a challenge for growers today.



Potatoes were introduced into the United States in 1719 from stock brought from Ireland and grown in Londonderry, New Hampshire. Today, the United States produces more than 420 million hundredweight (cwt) of potatoes annually on 1.1 million acres with an approximate value of $3 billion. Pennsylvania produces approximately 2.7 million cwt on 11,000 acres each year, generating approximately $27 million in gross receipts. Pennsylvania potatoes supply both the processing (primarily for potato chips) and fresh (or tablestock) markets.

Marketing

Potatoes grown for the fresh market are marketed in Pennsylvania from mid-July through late September if not stored and from mid-September until mid-May if held in storage. Fresh-market potatoes are sold loose, in containers, and in 3-pound to 50-pound paper or poly bags. Another sign of change in the potato industry is in the marketing of "B" size potatoes, which were once discarded as too small or kept for seed and are now packaged in 1.5-pound clamshells or in quart baskets as a ready-to-use product. Potato varieties recommended for Pennsylvania are listed in Table 1.

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Table 1.Recommended potato varieties for Pennsylvania.

Variety	Skin color	Flesh color
Superior	white	white
Eva	white	white
Katahdin	white	white
Dark Red Norland	red	white
Chieftain	red	white
Michigan Purple	purple	white
Norwis	white	light yellow
Kueka Gold	white–buff	pale yellow
Russian Banana	yellow–buff	pale yellow
Yukon Gold	white–buff	yellow
Carola	white–buff	yellow
Desire	rose pink	yellow
Austrian Crescent	white	yellow
Banana	white	yellow
All Blue	blue	blue
Purple Peruvian	dark purple	dark purple
Purple Majesty	purple	purple
Adirondack Blue	purple	purple
Adirondack Red	red	red
Villetta Rose	red	white (mostly B-size potatoes)
All Red	red	light red

Adapted from B. Lamont, *Producing Specialty Potatoes—Preplant Through Harvest*.

Three basic marketing alternatives are available to the potato grower: wholesale markets, retail markets, and processing:

1. In wholesale marketing, producers negotiate price with the retail chain stores. Cooperatives such as the Pennsylvania Potato Growers Cooperative market potatoes to a wide variety of outlets. Produce auctions provide another excellent outlet for new and smaller growers since all product is generally sold, but the price will vary with demand, quantity of other potatoes at the auction, quality, and type of potato.
2. Local retailers (individual grocery stores) are another possibility, but you must take the time to contact produce managers and provide high-quality potatoes when the stores require them. Roadside stands (either your own or another grower's) provide opportunities to receive higher-than-wholesale prices for your potatoes, but you may have some additional expenses for advertising, building and maintaining a facility, and providing service to your customers. CSAs (community-supported agriculture) provide a wide variety of produce to their customers. The most successful CSAs work to provide the greatest variety over the longest season, and potatoes are a good match for other crops such as winter squash and root crops for fall sales. Some growers sell to local restaurants. Because chefs stay up on trends, this may be an important avenue to sell high-end specialty potatoes that may not be recognized at other markets.
3. Pennsylvania is one of the foremost potato processing states in the country. This output is almost entirely in the form of potato chips. Although it is an important part of Pennsylvania's large food processing industry, most of the potatoes used come from outside the state. The acreage of chipping potatoes grown in Pennsylvania is still significant but has been declining for over twenty years. Potato varieties used for chipping have been selected for their frying characteristics and are generally not very good choices for general tablestock use. Most chipping potatoes are grown by larger farming operations on a contract basis. Processors are not likely to contract with small-acreage growers.

Production Considerations

Planting and Fertilization

Potatoes grow best in deep to moderately deep, loose, well-drained soils. The soil should have a pH of 5.5 to 6.5. The best method to determine lime and fertilizer requirements is by soil testing. Some factors to consider in the fertility program are the method of fertilizer application, crop use (fresh or processing), variety, length of the growing season, and manure applications. The fertility value of a legume crop grown the previous season should also be considered. Excess nitrogen fertilization delays maturity, while excess potassium greatly hinders the uptake of magnesium and reduces the firmness of the potato (decreases the specific gravity). Magnesium is recommended when soil levels of magnesium are low or potassium levels are excessively high.

Use only certified seed or seed known to be free of virus diseases. Space seed pieces 7 to 12 inches apart in the row. Spacing varies with potato variety, soil type, amount of moisture available, fertility and the amount of fertilizer applied, and potato size desired at harvest time (closer planting yields smaller potatoes).

In conventionally grown potatoes, the amount of nitrogen applied typically ranges from 160 to 200 pounds per acre depending on the variety. Cultivation is often used to break the soil crust, promote aeration, and kill the first flush of weeds not controlled by herbicides. Later the potatoes have soil ridged over the rows ("hilled") to prevent greening and control weeds in the row. If hilling is delayed, be careful to minimize root damage caused by tillage. Hilling should be completed before the potatoes start to bloom. Potatoes are typically fertilized twice—first at planting when a band of fertilizer is placed alongside the row and later when the plants are side-dressed during cultivation or at hilling.

Potatoes are well suited for production in a plasticulture system (plastic mulches, drip irrigation, fertigation, row covers, and even fumigation, if needed). Although primarily used by smaller growers (less than 5 acres of potatoes) due to the slower planting speed and specialized equipment required, this method produces excellent yields of high-quality potatoes. Plastic mulches warm up the soils faster in the spring and hasten the emergence of the potato plants. The plastic mulch also prevents weeds and eliminates the need to hill and cultivate. Because drip irrigation provides complete control over the amount of moisture applied, it is also an excellent method for applying precise amounts of nutrients. Tissue-culture sampling should be used to measure plant nutrient needs so excessive fertilizer is not applied. The only drawback to plasticulture is in handling the waste plastic at the end of the season. Due largely to eliminating preemergence herbicides, plasticulture greatly simplifies the production of organic potatoes.

Pest Control

Like nearly all vegetable crops, potatoes require weed, disease, and insect management. By practicing IPM (integrated pest management), growers can greatly reduce their reliance on chemicals. IPM includes use of crop rotation, cover crops, nutrient management, predictive computer models for insects and diseases, crop scouting, improved varieties and other related practices and techniques to produce a high-quality crop and keep pesticide use to a minimum. In an IPM protocol the sole difference between an organic grower and a so-called conventional grower is their selection of pesticides and fertilizers. Organic growers are limited to fertilizers and pesticides that are on the Organic Materials Review Institute (OMRI) list, while conventional growers can use both OMRI-approved materials and any other federally approved pesticide.

Weed management can be achieved with herbicides, cultivation, plastic mulch, and crop rotation. Several preplant and postemergence herbicides are available for potatoes depending on the specific weed problem and potato growth stage. Careful preparation of a long-term crop-rotation scheme can greatly reduce populations of difficult-to-control weeds as a grower can vary cultivation and rotate herbicides. Early cultivation can be used in conventionally planted systems when weeds are young and before the potato canopy has closed.

Several insects can cause severe problems in potatoes, including Colorado potato beetles, flea beetles, aphids, leafhoppers, wireworms, and corn borers. Monitoring insect populations by scouting is critical in determining when you should use insecticides and which materials you should spray. Some of the newer insecticides are applied in the furrow at planting. Local and regional corn borer trapping programs focused on sweet corn provide important local information to time spray applications. Wireworms are a particularly tough pest that can be monitored using field corn monitoring stations.

Several potato diseases can cause severe crop losses if not properly managed. These include early blight, late blight, common and powdery scab, blackleg, leaf roll and mosaic viruses, rhizoctonia, verticillum wilt, fusarium dry rot, and bacterial soft rot. Although the list of diseases seems overwhelming, most diseases can be managed with disease-resistant varieties, crop rotation, and proper use and timing of fungicides. It is also important to be aware of favorable weather conditions for the spread of certain diseases such as late blight. Growers can also access computer models based on local and regional weather patterns to obtain important data to help in managing diseases.

Harvest and Storage

Depending on the variety grown, potatoes are generally harvested from mid-July through October in Pennsylvania. Care should be taken to prevent bruising potatoes during harvesting, storing, grading, and marketing. Potatoes are harvested when they are mature or when the skins are set. In any case, harvest when the air and soil temperatures are above 45°F. Newly harvested potatoes can be sold immediately after harvest. Consumers and restaurants often seek out these “fresh” or “new” potatoes, which often bring a premium price. Because the skins are very tender, handle them carefully, wash them only as much as necessary, allow them to dry, and get them to market quickly.

When storing potatoes ventilation, storage temperatures, and relative humidity are important factors to consider. Storage conditions during the first 10 to 14 days are critical to heal cuts and bruises in newly harvested potatoes and have a high-quality crop to market. Make sure there is good air movement, a temperature about 65°F, and high relative humidity (85 to 90 percent) in the potato storage facility during this period. Temperature should then be reduced very slowly (one degree per day) to the final storage temperature. Potatoes stored longer than three months for the fresh or tablestock market should be held at 38–40°F. Maintain relative humidity at 85 percent or higher to help prevent shrinkage and pressure bruising and to keep the potatoes firm. Consult an agricultural engineer who is familiar with the construction of potato storages when building a new potato storage facility or renovating an older facility. Use plastic bulk containers for storing larger quantities of potatoes. Plastic containers are preferred to wooden ones because they are much easier to clean.

Regulations

All agricultural operations in Pennsylvania, including small-scale and part-time farming operations, operate under the PA Clean Streams Law. A specific part of this law is the Nutrient Management Act (Act 38). There are portions of the Nutrient Management Act that may or may not pertain to your operation due to the number and/or size of animals you have. However, all operations may be a source of surface water or groundwater pollution. Because of this possibility, contact your local Soil and Water Conservation District to determine what regulations may pertain to your operation.

Risk Management

There are several risk management strategies you may employ for your operation. You should insure your facilities, and you also may want to insure your crops as well. Insuring your farm may be accomplished by consulting your insurance agent or broker. You may also insure your crops through a traditional yield-based crop insurance policy or your income through a crop insurance program called AGR-Lite. To use AGR-Lite you must have five years of Internal Revenue Service (IRS), Schedule F forms. If your business structure is either a C or S corporation, the necessary information can be entered into a Schedule F form for crop insurance purposes. You can then contact an agent who sells crop insurance and insure the income of your operation. For more on agricultural business insurance, see *Agricultural Alternatives: Agricultural Business Insurance*. For more information concerning crop insurance, contact a crop insurance agent or check **cropins.aers.psu.edu** on the Web.

When using any pesticides in your enterprise, remember to follow all label recommendations regarding application rates and personal protection equipment (PPE) requirements. Also remember that any Worker Protection Standards (WPS) apply to the owner as well as employees.

Budgeting

The sample budgets included in this publication summarize the costs and returns for tablestock potatoes grown both conventionally and in a plasticulture system. These budgets should help ensure that you include all costs and receipts in your calculations. Costs and returns are often difficult to estimate in budget preparation because they are numerous and variable. Think of these budgets as an approximation and make appropriate adjustments using the "your estimate" column to reflect your specific production conditions. More information on using crop budgets can be found in *Agricultural Alternatives: Enterprise Budget Analysis*.

For More Information

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Associations

Pennsylvania Cooperative Potato Growers, Inc.
3107 North Front Street
Harrisburg, PA 17110-1310
717-232-5200.

Pennsylvania Vegetable Growers Association
RR 1, Box 947
Richfield, PA 17086-9626
717-473-8468.

Web Sites

Global Potato News
www.potatonews.com

Idaho Center for Potato Research and Education
www.ag.uidaho.edu/potato/resources/links.htm

International Potato Center
www.cipotato.org

Maine Potato Board
www.mainepotatoes.com

National Potato Council
www.nationalpotatocouncil.org

Nebraska Potato Eyes
www.panhandle.unl.edu/peyes.htm

Oregon State University Potato Research and Extension
oregonstate.edu/potatoes

Potato Association of America
www.umaine.edu/PAA

Potato Research Online
www.potatoresearch.com

University of Idaho Potato Disease Problems
www.uidaho.edu/ag/plantdisease/potato.htm

University of Nebraska-Lincoln's Potato Education Guide
www.panhandle.unl.edu/potato

Initial Resource Requirements: Conventional Production

- Land: 1 acre
- Labor: $450.00 to $550.00
- Capital: $2,700.00 to $3,100.00
- Equipment: Tractor—50 to 75 hp
- Boom sprayer
- Potato harvester

Initial Resource Requirements: Plasticulture Production

- Land: 1 acre
- Labor: $850.00 to $1,000.00
- Capital: $4,300.00 to $4,600.00
- Equipment: Tractor—50 to 75 hp
- Boom sprayer
- Plastic mulch layer
- Mulch lifter
- Irrigation system
- Rotary mower

Sample Tablestock Potato Budget for Conventional Production

Summary of estimated costs per acre, Pennsylvania 2008

Items	Quantity	Unit	Price	Amount	Your Estimate
Variable costs					
Custom					
Soil test	1	kit	$10.00	$10.00	_____
Applying calcium lime	0.5	ton	$12.40	$6.20	_____
Plowing	1	acre	$18.00	$18.00	_____
Disk and harrow	1	acre	$16.10	$16.10	_____
Tissue sampling	1	kit	$31.00	$31.00	_____
Fertilizer					
Nitrogen	160	pound	$0.62	$99.20	_____
Phosphorus	150	pound	$0.94	$141.00	_____
Potassium	150	pound	$0.50	$75.00	_____
Fungicides					
Tops MZ Gaucho	1.5	pound	$5.60	$8.40	_____
Bravo Weather Stick	0.75	gallon	$62.20	$46.65	_____
Thimet 20G	15	ounce	$0.18	$2.70	_____
Headline	0.1875	gallon	$396.00	$74.25	_____
Penncozeb DF	7.5	pound	$5.50	$41.25	_____
Herbicides					
Dual II Magnum EC	0.25	gallon	$104.30	$26.08	_____
Lexone/Sencor 75DF	0.66	pound	$15.90	$10.49	_____
Matrix	1	ounce	$12.75	$12.75	_____
Reglone	96	ounce	$0.84	$80.64	_____
Insecticides					
Admire 2F	32	ounce	$9.79	$313.28	_____
Spintor 2SC	4	ounce	$5.18	$20.72	_____
Surfactant	12	ounce	$0.15	$1.80	_____
Potato seed	20	cwt	$11.50	$230.00	_____
Labor					
Machinery operation	3.5	hour	$12.50	$43.75	_____
Hired labor	12	hour	$10.00	$120.00	_____
Harvest					
Harvest labor	43	hour	$10.00	$430.00	_____
Potato bags (5 lb)	3000	bags	$0.06	$180.00	_____
Fuel	11.45	gallon	$3.25	$37.21	_____
Repair and maintenance					
Tractors	1	acre	$14.52	$14.52	_____
Implements	1	acre	$50.10	$50.10	_____
Interest charge	1	acre	$52.82	$52.82	_____
Total variable costs				*$2,193.91*	_____
Fixed Costs					
Tractors	1	acre	$35.89	$35.89	_____
Implements	1	acre	$79.56	$79.56	_____
Land charge	1	acre	$200.00	$200.00	_____
Potato storage	1	acre	$100.00	$100.00	_____
Grader/washer	1	acre	$110.00	$110.00	_____
Total fixed costs				*$525.45*	_____
Total costs				**$2,719.36**	_____

Sample Tablestock Potato Budget for Plasticulture Production

Summary of estimated costs per acre, Pennsylvania 2008

Items	Quantity	Unit	Price	Amount	Your Estimate
Variable costs					
Custom					
Soil test	1	kit	$10.00	$10.00	_____
Applying calcium lime	0.5	ton	$12.40	$6.20	_____
Plowing	1	acre	$18.00	$18.00	_____
Disk and harrow	1	acre	$16.10	$16.10	_____
Laying plastic mulch	1	acre	$50.00	$50.00	_____
Spreading fertilizer	1	acre	$9.15	$9.15	_____
Tissue sampling	1	kit	$31.00	$31.00	_____
Fertilizer					
Nitrogen	160	pound	$0.62	$99.20	_____
Phosphorus	150	pound	$0.94	$141.00	_____
Potassium	150	pound	$0.50	$75.00	_____
Fungicides					
Tops MZ Gaucho	1.5	pound	$5.60	$8.40	_____
Bravo Weather Stick	0.375	gallon	$62.20	$23.33	_____
Thimet 20G	15	ounce	$0.18	$2.70	_____
Headline	0.1875	gallon	$396.00	$74.25	_____
Penncozeb DF	4.5	pound	$5.50	$24.75	_____
Herbicides					
Reglone	64	ounce	$0.84	$53.76	_____
Insecticides					
Admire 2F	32	ounce	$9.79	$313.28	_____
Spintor 2SC	4	ounce	$5.18	$20.72	_____
Surfactant	8	ounce	$0.15	$1.20	_____
Potato seed	20	cwt	$11.50	$230.00	_____
Plasticulture					
Drip tape	4	rolls	$21.00	$84.00	_____
Black plastic mulch	2.67	rolls	$100.00	$267.00	_____
Irrigation installation	1	acre	$800.00	$800.00	_____
Irrigation operating	8	inches	$20.00	$160.00	_____
Labor					
Machinery operation	13.86	hour	$12.50	$173.25	_____
Hired labor	16.66	hour	$10.00	$166.60	_____
Harvest					
Harvest labor	46.5	hour	$10.00	$465.00	_____
Potato bags (5 lb)	3000	bags	$0.06	$180.00	_____
Fuel	10.6	gallon	$3.25	$34.45	_____
Repair and maintenance					
Tractors	1	acre	$11.91	$11.91	_____
Implements	1	acre	$10.24	$10.24	_____
Interest charge	1	acre	$116.11	$116.11	_____
Total variable costs				*$3,676.60*	_____
Fixed Costs					
Tractors	1	acre	$24.67	$24.67	_____
Implements	1	acre	$25.30	$25.30	_____
Land charge	1	acre	$200.00	$200.00	_____
Potato storage	1	acre	$100.00	$100.00	_____
Grader/washer	1	acre	$110.00	$110.00	_____
Total fixed costs				*$459.97*	_____
Total costs				**$4,136.57**	_____

Net returns for five different yields and prices using conventional production

	Potato yield (5-lb bags/A)				
Potato prices/5-lb bag	**2,000**	**2,500**	**3,000**	**3,300**	**4,000**
$1.00	($274)	$185	$281	$679	$1,077
$2.00	$1,726	$2,685	$3,281	$4,179	$5,077
$3.00	$3,726	$5,185	$6,281	$7,679	$9,077
$4.00	$5,726	$7,685	$9,281	$11,179	$13,077
$5.00	$7,726	$10,185	$12,281	$14,679	$17,077

3,000 5-lb bags = 150 cwt per acre

Net returns for six different yields and prices using plasticulture production

	Potato yield (5-lb bags/A)				
Potato prices/5-lb bag	**2,300**	**3,000**	**3,300**	**4,000**	**4,300**
$1.00	$(1,641)	$(1,078)	$(837)	$(273)	$(32)
$2.00	$659	$1,922	$2,463	$3,727	$4,268
$3.00	$2,959	$4,922	$5,763	$7,727	$8,568
$4.00	$5,259	$7,922	$9,063	$11,727	$12,868
$5.00	$7,559	$10,922	$12,363	$15,727	$17,168

3,300 5-lb bags = 165 cwt per acre

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