AGRICULTURAL ALTERNATIVES

Strawberry Production

Strawberries are a small-fruit crop that lend themselves well to small-scale and part-time farming operations. Initial investment is high but is primarily related to the cost of land preparation, planting, and installing an irrigation system. Also, equipment needs on a small-acreage farm are not very great. Strawberry plantings should produce commercial-quality fruit for three to five years. Increasing demand for strawberries in recent years has kept fresh-market prices relatively stable. Growing strawberries is not for everyone however, as they have special production requirements, as well as a short shelf life and marketing season.

Small-fruited woodland strawberries were harvested for market in Europe as early as 1600. The introduction of wild varieties from the New World led to the development of new varieties, many of which were later reintroduced into North America. Major commercial strawberry production in California began in the early 1850s but did not expand until around 1900, when refrigerated railroad cars enabled growers to transport the berries over long distances.

Most strawberries consumed in the United States are fresh. As recently as 1980, more than 40 percent of U.S.-produced strawberries were processed, but in recent years this figure has declined to around 30 percent. Strawberries are grown on more than 45,000 acres in the U.S. today.

The leading strawberry-producing states are California, Florida, Oregon, North Carolina, Washington, Michigan, New York, Louisiana, Pennsylvania, Wisconsin, and Ohio.

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Although the United States ranks first in the world in strawberry production, about one-half of all strawberries are grown in Europe. European production is concentrated in Poland, Italy, the former Soviet Union, France, Spain, and the United Kingdom. Other major producers include Japan, Mexico, and Korea.

The most commonly used strawberry production system in Pennsylvania utilizes matted-row culture and June-bearing cultivars. Some growers are also using the plasticulture production system, the ribbon-row system, or day-neutral cultivars; however, the practices, productivity, and economics of these alternatives are very different from that of matted-row production. The information presented in this publication is specific to matted-row culture of June-bearing strawberries. For information on other production systems, consult the *Commercial Berry Production and Pest Management Guide*.

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Marketing

Fresh-market strawberries usually are sold in pint and quart plastic basket containers. Six basic marketing alternatives are available to the strawberry grower: wholesale markets, cooperatives, local retailers (grocery stores), roadside stands, pick-your-own operations, and processing firms. Because they are so perishable, strawberries are well suited to roadside stands and pick-your-own operations.

In wholesale marketing, either you or a shipper can take your crop to the market. Shippers generally sell and transport strawberries for a predetermined price. Wholesale marketing is subject to the most price fluctuations. Marketing cooperatives generally use a daily pooled cost and price, which spreads price fluctuations over all participating producers. Local retailers are another possible market, but you must take the time to contact produce managers and provide good-quality strawberries when stores require them. Roadside stands (either your own or another grower's) and pick-your-own operations provide opportunities to receive higher than wholesale prices for your strawberries, but you may have some additional expenses for advertising, building and maintaining a facility, and providing service to your customers. With pick-your-own operations, you save on harvest costs, but you must also be willing to accept some waste. Depending on your location, processors may or may not be a marketing option. Processors are less likely to contract with small-acreage growers. For more information on marketing, consult *Agricultural Alternatives: Fruit and Vegetable Marketing for Small-scale and Part-time Growers*.

Prices for fresh-market strawberries have been relatively stable in recent years because of increasing demand. Grower prices in the United States for fresh-market strawberries have ranged from $0.65 to $0.75 per pound. Prices in Pennsylvania have been higher, ranging from $1.00 to $2.00 per pound, primarily because of strong local market demand and the high proportion of the crop sold directly to the consumer. Demand for strawberries contracted for processing has been level in recent years, but prices in this market are subject to greater fluctuation because of international supply-and-demand conditions. Processing prices have ranged from around $0.25 to $0.35 per pound in recent years.

Strawberry Cultivars

Strawberries come in three basic types: June-bearing, day-neutral, and everbearing. Only the June-bearing varieties are well adapted to all parts of Pennsylvania. They constitute the overwhelming majority of plants grown on current strawberry acreage. Recommended June-bearing cultivars are listed in Table 1. Day-neutral strawberries can be profitable, since they bear a crop in the fall when prices are fairly high, but they can be grown only in the northern half of Pennsylvania and have some very specific cultural requirements. Everbearing strawberries should not be considered for commercial production, since quality and yield are low.

Production Considerations

The strawberry plant is a herbaceous perennial that produces an abundance of runner plants, which are used to fully establish a bed. The strawberry plant has an extremely shallow root system. (The roots extend only about 6 inches deep in clay loam soils). Because of this shallow root system and since the flower blossoms can be killed by spring frosts, irrigation is a requirement, not an option, for commercial strawberry production. Overhead irrigation is most com-

Table 1. June-bearing strawberry cultivars suitable for Pennsylvania.

CULTIVAR	SEASON	DESCRIPTION
Earliglow	Early	Excellent flavor and quality, but size runs down. Moderate productivity.
Northeaster	Early	Large, firm, aromatic fruit. Moderate productivity. Tolerates heavier soils. For trial only.
Cavendish	Early-mid	Large fruit, good flavor, productive. Uneven ripening in some years. Good for pick-your-own.
Honeoye	Early-mid	Large fruit, high yields, "perfumy" flavor. Better in cooler climates. Avoid heavy soils.
Allstar	Mid	Productive. Berries light in color, good size and shape. Resistant to many diseases.
Primetime	Mid	Medium-firm, large fruit with mild flavor. Productive. Resistant to many diseases. For trial only.
Jewel	Mid-late	Productive. Large, firm fruit with good color.

monly used, since it is necessary for frost protection. For more information on crop irrigation, consult *Agricultural Alternatives: Irrigation for Fruit and Vegetable Production.*

Strawberries can be grown on a variety of soils. Growers should choose a well-drained site that receives plenty of sun and is close to an irrigation source. The slope of the site should be no greater than 12 percent to ease the multiple cultivations that strawberries require. The term "well-drained" refers to internal soil drainage. A sloping site is not necessarily well-drained internally. Soil should have a pH of 5.5 and 6.5 and should be tested the fall before planting is intended. Do not use a site that was previously in sod, because it can harbor root-feeding grubs that can damage the strawberry roots. Also, strawberry plantings should not follow verticillium-susceptible crops, such as peppers, eggplant, potatoes, or tomatoes. Soil that has been used to grow these crops should be either planted with a non-verticillium susceptible cover crop for five to eight years or fumigated before planting. Cover cropping for at least a year with a crop such as rye or sudangrass is a highly recommended practice that will help control weeds before planting the strawberry beds. Also, cover crops can be plowed under to add organic matter to the heavy soils prevalent in Pennsylvania.

Planting

Strawberries usually are planted 18 to 24 inches apart in rows 36 to 48 inches apart. Spacing decisions depend upon the size of your equipment. Growers should purchase cultivars resistant to red stele and verticillum wilt from a reputable nursery. These plants should be set in April as soon as the soil can be worked. Flower blossoms should be removed during the first season so that plants can establish a full bed. This practice sacrifices the first year's crop, but enables growers to establish a bed of vigorous plants that can be renovated and maintained for up to five years. It is especially important to closely monitor and control pests in the first year.

Mulching

Four inches of clean straw mulch (about 2 tons of straw per acre) should be applied when the plants are dormant, usually between late November and late December. This practice protects the strawberry plants from sudden fluctuations in temperature and helps prevent frost heaving. The straw should be removed the following March. Plants should flower in early May (timing generally depends on geographic location) and fruit about 30 days after flowering.

Harvesting and Renovation

In Pennsylvania, a well-maintained strawberry planting will produce an average of 7,000 pounds per acre. Fruit size decreases with the age of the bed, and overall yield declines after about three to five years. Strawberries must be picked and handled very carefully. The fruit must be firm, well colored, and free from rot. When harvested at the right time and handled properly, strawberries will remain in good condition for a few days. After fruiting is complete, the beds are renovated (mowed, narrowed, fertilized, and treated with herbicides), and the fruiting cycle begins again.

Proper postharvest handling of strawberries is essential if you are to be a successful marketer. Cooling the berries will remove field heat, which improves their shelf life. Harvesting early in the day while temperatures are cool and then precooling the fruit before shipping it extends shelf life significantly.

Pest Control

Several insect pests and diseases can cause crop losses. Therefore, monitoring and controlling pests is important. Some pests affect the flowers and fruit, while others attack the foliage, stems, crowns, and roots of the plant. Pest management involves many aspects of production, with pesticide application being only one. Try to use all available practices to reduce the potential for disease and insect damage. Many of these types of problems can be reduced with proper site selection, crop rotation, cultivator selection, and soil treatment and by planting disease-free plants.

Birds can be a serious problem on many strawberry farms. Netting, chemical repellents, scare tactics, and noise devices may be required to protect the crop. Deer also can cause extensive damage to the plants by trampling and eating the plants and ripening berries. Hunting, fencing, and repellents all can reduce deer damage.

Weeds also must be controlled in a strawberry planting. Strawberries have shallow root systems, which puts them at a disadvantage when competing for water and nutrients. Many weed problems can be greatly reduced by avoiding sites with persistent weed problems and eliminating weeds before planting. Shallow cultivation and herbicide application can control weeds after establishment. The most common cause of a failed strawberry enterprise is failure to control weeds. Few herbicides are available for strawberries, but if they are applied appropriately and if hand and machine cultivation is employed when chemical controls can not be used or fail, a strawberry planting can be very profitable.

Sample Budgets

Included in this publication are three strawberry production budgets. The first two summarize the costs of land preparation and establishment of the strawberry planting. The third summarizes the costs and returns to a mature (years one to five) strawberry planting. These sample budgets should help ensure that all costs and receipts are included in your

calculations. Costs and returns are often difficult to estimate in budget preparation because they are numerous and variable. Therefore, you should think of these budgets as an approximation and then make appropriate adjustments in the "Your Estimate" column to reflect your specific growing and resource situation. Additional strawberry budgets can be found in the *Penn State Commercial Berry Production and Pest Management Guide*. More information on the use of crop budgeting in farm management decision making can be found in *Agricultural Alternatives: Enterprise Budget Analysis.*

Prepared by Kathleen Demchak, extension associate in horticulture, Jayson K. Harper, associate professor of agricultural economics, and George L. Greaser, senior research associate in agricultural economics.

Initial resource requirements

- Land: 1 acre
- Labor
  - Land preparation: 4 hours
  - Establishment: 64 hours
  - Production: 58 hours
  - Custom harvest labor (mature): $5,000
- Capital
  - Land preparation: $250
  - Strawberry plants: $553
  - Mulch: $225 per year
  - Fuel, repairs, maintenance, and depreciation of machinary: $100 per year

For More Information

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Associations

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Fresh-market Strawberry Production Budget

Per acre costs for land preparation, establishment, and mature production (harvest costs based on 10,000 lbs.)

	Land prepartion (Year -1)	Planting establishment (Year 0)	Mature planting (Year 1+)
Variable costs			
Custom hire	$36.80	$33.80	$12.00
Fertilizer and lime	$50.00	$11.00	$13.20
Herbicides	$19.25	$74.00	$158.75
Insecticides	$0.00	$0.00	$65.28
Fungicides	$0.00	$0.00	$113.49
Seed	$25.00	$0.00	$0.00
Plants	$0.00	$552.50	$0.00
Irrigation	$0.00	$60.00	$100.00
Mulch	$0.00	$225.00	$225.00
Labor	$8.29	$531.89	$5,494.42
Fuel	$1.39	$8.60	$15.77
Repairs and maintenance	$1.91	$9.29	$26.67
Interest	$4.17	$86.94	$10.31
Total variable costs	$146.81	$1,593.02	$6,234.89
Fixed costs			
Equipment	$3.02	$17.34	$52.54
Land	$100.00	$100.00	$100.00
Total fixed costs	$103.02	$117.34	$152.54
Total costs	**$249.83**	**$1,710.36**	**$6,387.43**

Returns above total costs for various price and yield combinations (harvest cost adjusted for yield)

Profitability	**Yield (lbs/A)**					
Price received ($/lb.)	**5000**	**6000**	**7000**	**8000**	**9000**	**10000**
$0.80	$113	$413	$713	$1,013	$1,313	$1,613
$1.00	$1,113	$1,613	$2,113	$2,613	$3,113	$3,613
$1.20	$2,113	$2,813	$3,513	$4,213	$4,913	$5,613
$1.40	$3,113	$4,013	$4,913	$5,813	$6,713	$7,613
$1.60	$4,113	$5,213	$6,313	$7,413	$8,513	$9,613
$1.80	$5,113	$6,413	$7,713	$9,013	$10,313	$11,613
$2.00	$6,113	$7,613	$9,113	$10,613	$12,113	$13,613

Minimum price needed to cover total costs adjusted for various yields

breakeven price	**$0.78**	**$0.73**	**$0.70**	**$0.67**	**$0.65**	**$0.64**

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