EM 8847 • December 2003
$4.50

Economic Evaluation of Lingonberry Production in Oregon

L. Burt and R. Penhallegon

OREGON STATE UNIVERSITY
EXTENSION SERVICE

Contents

Prepared by Larry Burt, Extension economist, and Ross Penhallegon, area horticultural Extension agent; Oregon State University.

Economic Evaluation of Lingonberry Production in Oregon

In the Pacific Northwest, lingonberries (*Vaccinium vitis-idaea* 'Minus' L.) are both an old and a new story. They have been growing as a wild, native plant for a long time and currently are found in coastal areas of Oregon, Washington, British Columbia, and Alaska.

During the last Ice Age, indigenous flora moved south into the temperate areas of North America, Europe, and Scandinavia. Four Vacciniums became dominant: *V. microcarpon* or the small cranberry, *V. myrtillus* or the bilberry, *V. vitis-idaea* or the lingonberry, and *V. oxycoccus* or the European cranberry.

The new story is the introduction of the domesticated European cultivars of lingonberry to Oregon and Washington. The European cultivars have brought about a resurgence of interest in lingonberries as an ornamental crop and potential commercial berry crop in the Pacific Northwest.

European cultivars of lingonberries were introduced into Oregon and Washington around 1995 by Fall Creek Farm and Nursery, Inc. They were introduced to the public in 1997 and were promoted as ornamental plants for edible landscapes. Soon, questions arose about the feasibility of growing lingonberries commercially.

Because lingonberries weren't being grown commercially anywhere in the United States, answers simply weren't available. In response, Oregon State University (OSU) faculty have obtained information from other countries and have established on-farm research plots on 17 farms in Oregon and Washington. In 1998, 16 lingonberry cultivars were planted for commercial evaluation. Currently, 21 cultivars are being evaluated. Research trials have focused on soluble solids (Brix values), individual berry weight, and yields.

Cultivated lingonberry production in the Pacific Northwest is still in the development stage. In 2003, the oldest known planting in the area had been in the ground for 8 years, and the university research program was only 6 years old.

The test plot research addressed the following questions.

- Will European lingonberries grow in the Pacific Northwest?
- Which cultivars are best for growing in this region?
- Which cultivars have the highest yields?
- Is there a difference between the summer crop and the fall crop?

Background

Lingonberry is one of the lesser known small fruits in North America, but it is widely known in Europe. In fact, it is the national fruit of Sweden. Worldwide, most lingonberries are harvested from the wild by hand.

In the late 1980s, Dr. Elden Stang traveled to Finland and brought back lingonberry seedling

stock for a development and breeding program for Wisconsin. At least 17 European-type cultivars of lingonberries are grown in the U.S., and additional cultivars are being developed. Most development work is being done in Germany, Norway, Russia, and Sweden.

Unlike cranberries, lingonberries can be consumed raw. They freeze well and are used in numerous processed products such as jams, jellies, juice concentrates, sauces, wines, and liqueurs.

More than 25 European and North American names are used for this fruit, including airelle d' Ida, berris, alpine cranberry, cowberry, cranberry, dry-ground cranberry, foxberry, graines rouges, linberry, lingberry, lingen, lowbush cranberry, moss cranberry, mountain cranberry, northern mountain cranberry, partridgeberry, red berry, red whortleberry, and rock cranberry. In addition, it is known as kokemomo in Japan, preiselbeeren in Germany, "pomme de terre" in eastern Canada, puolukka in Finland, and by many names in Native American languages, including keepmingyuk (an Inuit word), toomalgleet (from Lower Kuskokwim), and nutlut, which generally was used by Native Americans in the Pacific Northwest. In some growing regions, the term lingonberry is not used at all.

The name lingonberry originated in Sweden. The Swedish words "lingon berry" mean "cow berry" in English. Years ago, English-language writers frequently used the word cowberry; now lingonberry is used routinely. In the United States, the word lingonberry generally is used as the common name.

Lingonberries are perennial, woody, low-growing, evergreen shrubs that produce red, edible berries of varying size. Most cultivars grow to a height of 2–16 inches and spread by underground stems called rhizomes. They are propagated by seed, cuttings, micropropagation, or rhizomes.

Because they are well suited to cooler climates, lingonberries can be expected to do well in regions where blueberries are productive. Thus, they have considerable potential in the Pacific Northwest. Lingonberries are in the Ericaceae family and like acid soils. They are closely related to highbush blueberries, *Vaccinium corymbosum* L., and cranberries, *V. macrocarpon* L. However, each species has unique cultural requirements.

Most cultivars of European lingonberries have two fruiting seasons in the Pacific Northwest. The first crop ripens around early August, and the second from late October to early November. The second harvest tends to be larger and is the one commonly used for commercial production. The "wild" native lingonberry cultivar, *Vaccinium vitis-idaea* 'Minus' L., is unique in that it blooms and fruits only once (ripening in August to September).

Good information is available on lingonberry production and sources of lingonberry plant materials. Also, the Lane County office of the OSU Extension Service has conducted taste testings of several cultivars (both frozen and processed products). For the latest growing guide, list of plant suppliers in the region, and taste test results, contact Ross Penhallegon at the Lane County OSU Extension office (phone: 541-682-4243; e-mail: ross.penhallegon@oregonstate.edu).

Eight researchers worldwide are looking at lingonberries as a viable small fruit crop. Two are in Oregon.

Uses for lingonberries

For those liking a moderately tart fruit, some types of lingonberries can be eaten raw when ripe—either fresh or thawed from frozen packs. However, most fruit is processed for use in juices, preserves, concentrates, candy, jelly, syrup, ice cream, pickles, wine and liqueurs, and some is dried. In Sweden, a large part of the harvest ends up in jams. In Finland, lingonberries are used in jellies, cremes, fruit porridge, mousses, baked cakes, and flans (round pastry tarts that require smaller fruit).

Home uses

Consumption of fresh, smaller sized lingonberries is quite common. They also are used in desserts and baked goods. Prior to the availability of deep-freezing, lingonberries were preserved by pulping or by making jams, purées, and juices. Deep-freezing lingonberries preserves their nutrient content and flavor.

Commercial uses

Lingonberries are used by food processors as a substitute for cranberries. The consistency and acidic flavor of the two are quite similar. A wide variety of products include lingonberries: jams, jellies, sauces, syrups, juices, ice cream, yogurt, chocolates, muffins, pies, cakes, tarts, cookies, pancakes, wine, liqueurs, nectars, raisins, fruit leathers, water-reduced purées, baby foods, instant desserts, and flavor concentrates. Finnish processors have increased their production of juice concentrates and have developed herbal teas and infusions that include both lingonberry fruit and leaves.

Ready-to-mix lingonberry compounds are manufactured for use in dairy products, especially yogurt, sherbets, and ice cream. Scandinavian consumers, quite familiar with lingonberries, have had a high demand for lingonberry yogurt that contains whole fruit. Lingonberry preparations in the form of juices and purées blend well in yogurt because the pips (seeds) are quite small.

Lingonberries contain anthocyanins, which contribute to the red, blue, and purple colors in plant tissue such as flowers and fruit. Thus, there is interest in using these natural, water-soluble plant pigments as food colorants. They can be used as a substitute for artificial food dyes.

Medicinal uses

Lingonberry leaves contain arbutin, which is extracted for use as a medicinal. Also, lingonberries contain flavonoids and other phenolics, which are believed by some researchers to have anticancer properties.

Lingonberry marketing

The information on lingonberry marketing included here is based on publications and interviews with lingonberry growers, processors, and marketers. References listed on page 14 provide additional information. For a general discussion of market development principles, see *Marketing Alternatives for Specialty Produce* (Burt et al.).

Supply

Yields in the wild vary greatly. Perhaps 10 percent of available fruit is harvested. Some districts, however, may harvest as much as 40 percent of the available crop in any given year. The amount of fruit left unharvested in the wild has discouraged European research aimed at finding high-yielding cultivars.

Major wild lingonberry producers include Sweden, Finland, and Russia. Other production areas include Norway, the Baltic countries, Poland, Japan, Germany, Canada, and Alaska. Scandinavia produces only one crop during the summer due to its typically cold spring season.

Both private citizens and commercial companies have common-law rights to harvest lingonberries in the Scandinavian countries. Many other European countries require permits for picking fruit in the wild.

Sweden, the top producer, harvests about 10 percent of its available fruit—all of it wild production. Weather creates quite variable yields. The harvest in Sweden may be over 20,000 tons in some years, but as little as 2,000 tons in other years. Typically, most of the harvest is for domestic consumption. However, Sweden does export more than 3,000 tons per year. From 30 to 80 percent of its commercial harvest may be exported.

Finland harvests less than 2,000 tons in some years and more than 10,000 tons in others. Most of this fruit goes to private domestic use. Some is exported, however; as much as 10 percent of Finland's exports of foodstuffs consist of wild lingonberries.

Germany produces two crops per year and does have a small amount of acreage under cultivation. The second crop matures several weeks later than the Scandinavian crop, and prices for German-produced berries typically drop in heavy-harvest years in Scandinavia. Thus, German producers have an incentive to develop farmable lingonberry cultivars that mature at least a few weeks earlier than the Scandinavian harvest. Doing so should increase grower prices.

The largest producing Canadian province is Newfoundland. However, the harvest averages only about 100 tons per year, ranging from 40 tons to almost 500 tons. Both weather and economics affect the size of the harvest. In recent years, processors have paid wild lingonberry harvesters approximately 60 cents per pound. Most of the harvest is frozen for export to processing operations in Scandinavia. Some is processed locally as jams, jellies, pie fillings, condiments, and wine.

Small quantities of lingonberries are harvested in other Canadian provinces, including British Columbia, New Brunswick, Nova Scotia, and Saskatchewan. Most are used for local processing and consumption. Wild lingonberry pickers in Saskatchewan typically harvest between 1,100 and 5,500 pounds; prices paid by processors usually are around $1.50 per pound. Other Canadian prairie provinces are interested in developing lingonberry industries, but the lack of cultivar development, technology, and investment capital has restrained those efforts.

In the U.S., domesticated European lingonberries are grown in Maine, Minnesota, North Dakota, Oregon, Washington, and Wisconsin. Oregon and Washington currently have at least 16 acres of lingonberries in commercial production. This is the largest commercial cultivation of lingonberries in the world.

Demand

In Scandinavia, much of the interest in lingonberries stems from centuries of tradition. Long ago, lingonberries were a basic food. Later, they were promoted as a good source of vitamins and a general health food.

Swedish lingonberry consumption is just over 2 pounds per capita. Between 5,500 and 6,600 tons of lingonberries are used by Swedish commercial jam producers. Large quantities also are used in beverages. In low-harvest years, Sweden must import lingonberries to meet demand; in some years, Newfoundland exports more than 100 tons to Scandinavian countries to meet their processing needs. As a result, there is interest in Sweden in developing domesticated cultivars that produce high-quality berries.

In Finland, per-capita consumption is 2.6 pounds and increasing. Although Finland is a major producer, it also imports berries from other countries. Imports are used for urban consumption, while rural families usually harvest their own berries. Deregulation of wild lingonberry imports into Finland has created price competition in domestic Finnish lingonberry markets.

Because there isn't enough labor to pick the Black Forest's lingonberry crop, Germany's imports are about four times its domestic harvest. When inclement weather reduces the harvest in Scandinavia, prices increase for imported berries in Germany.

Harvesting considerations

Studies have shown that one person can pick 22–45 pounds of berries per hour using a berry picking rake. Harvest speed may be higher in cultivated rows. Prototype machine harvesters have been built for use with cultivated fruit.

An important element to maintaining a high-quality pack is to pick only mature fruit—fully bright red—to avoid bitterness. Mature lingonberries have soluble solids in the range of 9–16. After observing the first mature fruit, wait 1–2 weeks to ensure that all the fruit is mature and has reached its maximum weight. Harvest carefully so you don't damage the plant stalks for the following year's crop.

Debris can be removed with the use of large sieves, wet belts, sorting tables, and/or blowers. Mature fruit readily falls off the plant. The fruit that drops to the ground is harvestable.

Quality standards

Canadian standards are the same as those for blueberries. They are quite brief and can be found on the Canadian Food Inspection Agency Web site (http://www.inspection.gc.ca/english/reg/rege.shtml).

European standards have been established for field-run fruit (unoverpicked) and sorted fruit (overpicked).

At a minimum, *field-run* requires that the fruit be whole and firm, fresh in appearance, sound (not spoiled or otherwise inedible), and clean (free of foreign matter and external moisture not naturally associated with ripe berries). Good quality must be perceptible to the senses. Thus, the fruit must not have a foreign taste or smell, abnormal leakage, insect damage, more than 8 percent faulty fruit (off-color or damaged by frost or heat), or more than 4 percent harmless foreign matter such as leaves or stems. In this category, I-class consists of predominantly good-quality and well-developed fruit that is uniformly sized and is bright or dark red in color. It must have the typical good taste of a lingonberry. The II-class is described as "developed well enough" and having a typical color and taste of lingonberry.

The minimum standards for *sorted* fruit are essentially the same as those for field-run. The exception is that berry clusters are not allowed. Also, the limit for faulty berries is reduced to 5 percent and no more than an average of just under 14 pieces of foreign matter per pound of sorted fruit. I-class and II-class are essentially the same as for field-run. In addition, a higher class, Extra-class, is established for fruit that meets I-class, but is judged by the senses to be of superior quality and having an excellent taste above that typically considered good.

With respect to sorted fruit, the quality tolerance for Extra-class allows for up to 5 percent I-class,

but the pack must be practically free of faulty berries and foreign matter. I-class allows for 10 percent II-class berries; however, only 2 percent by weight is allowed for faulty berries, and just under five pieces of foreign matter per pound are allowed. For II-class, as much as 10 percent of the fruit by weight may simply meet minimum requirements, as long as the proportion of faulty fruit doesn't exceed 5 percent nor foreign matter exceed just under 14 pieces per pound.

Packaging of sorted fruit must be uniform, and all the fruit must be from the same district. The visible fruit in the package must represent the quality throughout the package. The materials used in packaging must protect the fruit from injury and must be new and clean. All inks and glues must be nontoxic. Also, each package must be marked clearly with the name of the produce (if not visible from the outside), the quality class, name and address of the packer/manufacturer/seller, the origin of the product (usually the regional or local area where harvested), and the net weight.

Market potential

Fresh packs, frozen berries, and finished products containing lingonberries all have potential market outlets. Pacific Northwest markets have potential, but it will take time to develop them. Initial markets likely will be small and require high-quality fruit. Marketing can be increased as consumer awareness builds.

It is clear that existing markets require top-quality fruit. Markets likely will be receptive to the more steady supply of fruit that cultivated operations could provide.

Marketing concerns

As indicated earlier, lingonberries are sold under a wide variety of names, which creates a potential marketing problem. For example, Oregon filbert growers eventually learned that they needed to market their product under the name hazelnuts. Consumers on the east coast of the U.S. and in Europe readily recognized a hazelnut, but had no idea what a filbert was. The industry gradually converted the product name entirely to hazelnuts. The problem of multiple names is even greater in the case of lingonberries.

Marketing examples

A few specific marketing cases have been reported from other countries. The government of Newfoundland developed effective lingonberry promotional materials in the mid-1990s, which included printed posters, recipe brochures, and table tents for use with restaurants, hotels, institutional buyers, and the retail food trade. Processed products have been specifically marketed to Newfoundlander communities across Canada. The Toronto market accepted fresh lingonberries sold in clamshell containers under the local name of mountain cranberries. Most lingonberries marketed in Germany are sold fresh in 5.5-pound baskets.

Production cost–returns format

Enterprise budgeting principles

The format used here for lingonberry cost and return calculations incorporates standard terminology used in enterprise budgets. For a more detailed discussion of enterprise budgeting principles, see *Understanding and Using Enterprise Budgets* (Cross and Eleveld). If you would like an electronic copy of the EXCEL spreadsheets used in this study, please contact Larry Burt (phone: 541-737-1436; e-mail: larry.burt@oregonstate.edu).

An *Operation* refers to a procedure or step in the establishment or production process. If the operation is performed by an off-farm business for a fee, it is referred to as a *Custom Operation*. The term *Machinery* includes "enterprise-owned" tractors, implements pulled by a tractor, trucks, and self-propelled vehicles such as pickers. *Equipment* is machinery not requiring a tractor or self-propelled power.

Operations are listed chronologically from first step to last step. Each operation is in turn broken down into labor, machinery (and equipment), and materials charges. Labor is assumed to be purchased at a set hourly rate, plus benefits and taxes. Machinery includes fuel, maintenance parts and labor, and taxes. Materials include fertilizers and pesticides, mulches, plant stock, irrigation water, other utilities, and miscellaneous items. Custom operation costs are classified as materials, but there may be specific labor charges in addition. In that case, no machinery charges are shown, nor are they included in the machinery complement.

Standard cost categories are used. *Variable* costs, such as soil tests, pesticides, or fertilizer, are associated with establishment operations or intended crop production. *Fixed* costs, such as base utility charges, are those that occur regardless of the level of crop production. Sometimes, these costs are prorated among enterprises. *Cash* costs are out-of-pocket expenses—for example, hired planting labor. Costs that don't require out-of-pocket cash flow (e.g., the use of a farm building) are referred to as *non-cash* expenses. Typical cost categories in an enterprise budget would be variable cash (e.g., fungicide spraying), fixed cash (e.g., machinery insurance), or fixed non-cash (e.g., amortization of establishment costs).

Gross returns is the sum of the value of product sold in one or more markets. For each market, total revenue is calculated as price-per-unit times number of units sold. The total of all costs—variable and fixed, whether cash or non-cash—is subtracted. The result is *net returns*.

The important question at this point is "Net returns to what?" Assuming returns are not included in the cost structure of the enterprise, there is a division of returns to owner's capital investment, owner's labor, owner's management, and owner's risk. If capital charges are included in total costs, the returns are to the remaining elements: owner's labor, management, and risk. In turn, if capital and owner's labor are included in total costs, the return is to owner's management and risk. Return to owner's risk is an appropriate term when owner's capital, labor, and management are all included in total costs.

The concept of *break-even* is very useful in analyzing returns. An enterprise is at break-even when total revenue equals total expenses—net return equals zero. If there is a positive net return, we can refer to the return as a *profit* (return to risk). The adequacy of the net return requires one to make a subjective judgment as to whether the return is high enough to justify the risk of loss in operating the enterprise. This judgment typically is made by comparing returns and associated risks of alternative enterprises.

Two directly related concepts to break-even may prove useful. The *break-even quantity* is equal to the total fixed cost of the enterprise divided by the difference between the price per unit and the

variable cost per unit. The *break-even price* is the sum of total fixed cost and total variable cost, divided by quantity sold.

Budgeting assumptions

In developing this lingonberry enterprise budget template, we assumed the following scenario. (If you wish to change these assumptions, you must make the corresponding changes to the cost–returns format included here.)

- The enterprise is 5 acres.
- All budgeting formats are shown on a per-acre basis.
- General labor is calculated at $10.00 per hour, including benefits and taxes, regardless of whether the labor is hired or owner provided. Harvest labor is calculated at $15.00 per hour on the same basis.
- Recognizing that hand-harvest costs increase as yields increase, we assumed 5 hours of harvest labor for low- and medium-yielding varieties and 6 hours for high-yielding varieties. (When machine harvesting is available, harvest costs should be less yield-sensitive. Dryland cranberry and lowbush blueberry pickers can be used on lingonberries.)
- All capital investment earns an 8.5 percent rate of return per year regardless of the investment time period.
- Year 1 is an establishment year primarily devoted to land preparation.
- Year 2 is an establishment year primarily devoted to planting.
- Years 3 through 9 are production years; there may be more than a 7-year productive life for a well-managed lingonberry field.

Miscellaneous expenses are shown in Table 1 and the machinery complement is shown in Table 2.

The tables on pages 15–24 identify a format for estimating establishment year 1 and 2 costs, operating costs for years 3 through 9, and returns for wholesale, retail, and processed markets at a range of prices and yields.

Amortizing establishment costs

Table 6 on page 17, "Amortization of lingonberry establishment costs over 7 years," shows the calculation process for obtaining the annualized establishment cost. It uses a standard approach, which involves compounding the year 1 (Table 4, page 15) and year 2 (Table 5, page 16) establishment costs to the end of year 2. It is assumed that year 1 costs are moved at 8.5 percent

Table 1.—General overhead/miscellaneous.

Office supplies	$120.00	
Office equipment	220.00	
Utilities	1,440.00	(120.00/month)
Hand tools	300.00	
Total	2,080.00	

Table 2.—Machinery complement.

Item	Cost	Straight-line annual depreciation	Annual (average value) interest
Used tractor, medium, 50–100 horse (10-year life)	$15,000	$1,500	$ 638
Pickup truck (10-year life)	17,000	1,700	722
Flail mower, used (5-year life)	7,000	1,400	298
2 solo backpack sprayers (5-year life)	250	50	11
Irrigation pipe/solid set (15-year life)	10,000	667	425
1 row picker (10-year life)	20,000	2,000	850
Total	69,250	7,317	2,944

per year from the end of year 1 to the end of year 2. The resulting value, almost $6,200, is added directly to the year 2 establishment cost because the year 2 value is assumed to already be at the end of year 2. The total of all establishment costs at the end of year 2 is almost $30,000.

The establishment costs must be spread (costed-out) over the 7-year operating life of the enterprise at 8.5 percent on the declining balance over that time period. Annualized establishment costs are calculated using a standard amortization table. The interest factor is 5.199. That value is divided into the total establishment costs to determine that an annualized establishment cost of just under $5,800 per acre for each production year will cover the accumulated establishment costs over the 2-year period prior to production. This annualized establishment cost is included in the fixed non-cash operating costs section of annual operating costs, Table 7 on page 18.

An alternative way of thinking about amortization is to say that the "present value, end of year 2" of an annualized payment of about $5,800 (the annual payment over 7 subsequent years multiplied by the interest factor) is equal to the total establishment costs of about $30,000.

Table 3.—Yield of lingonberry cultivars.

Year	Low-yielding cultivars (lb/acre)	Medium-yielding cultivars (lb/acre)	High-yielding cultivars (lb/acre)
1	0	0	0
2	0	0	560
3	466	997	1,994
4	877	1,789	3,668
5	2,318	2,389	7,337
6	4,735	5,078	14,675
7	7,073	8,554	32,350
8	11,101	17,001	49,900
9	20,146	33,942	66,700

Break-even analysis

Small-plot production trial data collected by Ross Penhallegon were the source for the yield numbers presented in Tables 3, 8, 9, and 13 (below and pages 19, 20, 24). The data indicate per-acre yields *when optimal production practices are employed*. These yields are not guaranteed in a commercial production setting.

We did a budget run for each yield level. For high-yielding cultivars, the revenue generated in year 2, less harvest costs, was treated as an offset to establishment costs in that year. In addition, we did a medium-yielding cultivar run under the assumption that micropropagation technology would decrease the cost of plants (year 2) by 50 percent.

At this time, the longevity of a lingonberry planting is unknown. While the test plot yields indicate that production increases through year 9, we would expect yields to decline at some point. To forestall this eventuality, it is expected that mechanically pruning the lingonberry plants somewhere between every 5–9 years will reinvigorate the plants to continue yielding at optimal levels. Time is needed for test plots to reveal a desirable pruning schedule.

Because of the limited marketing of fruit from this region to date, definitive prices aren't yet established. For illustration purposes, based in part on the ranges of prices commercial growers were getting at the time of this study, we used the following assumptions.

- *Fresh wholesale* prices might be in the range of $1.50–$3.50 per pound, so we assigned a price of $2.50 per pound.
- *Fresh retail* prices might be in the range of $3.00–$7.00 per pound. We used a value of $5.00 per pound.
- *Processed* prices were assumed to be $1.10–$2.00 per pound. Our calculations assume the $1.10 price per pound.

Several caveats need to be mentioned. As the harvested acreage of commercial lingonberries increases, the price of lingonberries is expected to decline. On the other hand, shortages in established markets would be expected to encourage price increases. This effect has occurred in Scandinavian and German markets for wild lingonberries.

As with other raw agricultural commodities, the relationship between price and quantity available is expected to be inelastic. In other words, the percentage change in price is likely to be somewhat greater than a percentage change in production. One factor that likely would come into play is the relationship, as yet undetermined, between lingonberry markets and those for substitute commodities—perhaps cranberries, blueberries, or some caneberries.

Low-yielding cultivars

Table 8 on page 19, a break-even table, assumes yields that have been demonstrated for low-yielding cultivars. Thus, no fruit is available during the initial 2-year establishment period. The budget assumes that year 9 is the final year of production.

The estimated annual gross returns per acre for each market were calculated as the assumed price multiplied by the estimated production for each year. Based on the yield data obtained from Ross Penhallegon's plot trials, just over 46,700 pounds of lingonberries per acre would be produced over the useful life of the enterprise. The nominal gross returns over that period would range from about $51,400 for processed fruit to $233,600 if the fruit were sold at retail.

The break-even price per pound for each operating year was calculated using the formula described earlier: total cost divided by total production for a given year. The break-even price is quite high for the first 2 years of production, about $23.60 per pound in the first year (year 3 of the budget) and just over $12.50 in the second year (year 4). As production increases, the break-even price drops significantly, e.g., to about $0.55 per pound in year 9.

Net returns (gross returns less total cost) were calculated for each operating year. We did one set of calculations using the assumed wholesale price and another set using the assumed retail price. Because initial yields were relatively low, the first few production years showed losses. However, increasing yields in future years showed increasingly positive net returns beginning in the third or fourth production year—depending on the assumed price per pound.

At a price of $2.50 per pound, the negative net returns in the early years were not recovered until the ninth production year. In nominal dollars, the gain in net returns over the 7 years of production was about $39,800. At the higher retail price of $5.00 per pound, losses in the first few years were more than recovered by positive net returns in the later years. The nominal net returns accumulated over 7 production years were just over $156,600 per acre.

Nominal dollar amounts don't take the time value of money into consideration. In our study, money was assumed to be worth (or earn) 8.5 percent per year. Thus, all net returns, whether positive or negative, should earn 8.5 percent from the time they occur (assumed to be the end of each year) until the end of the ninth year. Each marketing assumption then can be compared by examining the relative end-of-year-9 value.

In our examples, the wholesale market at $2.50 per pound generated a total return of just over $30,000 per acre by the end of the ninth year. The corresponding return with the assumed retail price of $5.00 per pound is almost $159,700 per acre. In that case, the higher price better offsets the lower yields in the earlier production years.

Medium-yielding cultivars

We did a budget template run for costs and returns when the lingonberry acreage was established with medium-yielding cultivars. All of the establishment and production costs were assumed to remain the same as those for low-yielding cultivars. Results can be seen in the

break-even table for medium-yielding cultivars, Table 9 on page 20. Again, no fruit is available during the initial 2-year establishment period. The budget assumes that year 9 is the final year of production.

The estimated annual gross returns per acre for each market were calculated as the assumed price multiplied by the estimated production for each year. Based on the yield data obtained from Ross Penhallegon's medium-yield plot trials, almost 70,000 pounds of lingonberries per acre would be produced over the useful life of the enterprise, 50 percent more than the production of low-yielding cultivars. Nominal gross returns would range from about $76,700 for processed fruit to $349,000 if the fruit were sold at retail—50 percent more revenue than that generated by low-yielding cultivars.

The break-even price per pound for each operating year was calculated. Despite the higher yields of these cultivars, the break-even price remains high for the first 2 years of production, although it is considerably reduced. For the first production year, the break-even price is just over $11.00 per pound, and it is just over $6.00 in year 2. These prices are more than 50 percent lower than those for low-yielding cultivars. As production increases, the break-even price drops significantly. In the ninth year, it is just over $0.30 per pound for the medium-yielding cultivars, compared to just under $0.60 per pound for low-yielding cultivars.

Net returns were calculated for each operating year. As with the low-yielding cultivars, we did one set of calculations using the assumed wholesale price and another set using the assumed retail price. Because initial yields were relatively low, the first few production years showed losses. However, losses were somewhat reduced compared to those sustained with low-yielding cultivars. Increasing yields in future years showed the same increasingly positive net returns beginning in the third or fourth production year, but at higher levels than the low-yielding cultivars. Again, returns depended on the assumed price per pound.

At a price of $2.50 per pound, the negative nominal dollar net returns in the early years were recovered by positive returns in the eighth year of production, 1 year earlier than with the low-yielding cultivars. Net returns over the 7 years of production were just over $97,000, or almost 150 percent more than for low-yielding cultivars. A major factor behind the large increase was greatly improved yields in the final 2 years of production. At the higher retail price of $5.00 per pound, losses in the first few years were more than recovered by positive net returns in later years. Thus, the nominal dollar net returns accumulated over 7 production years were just under $272,000 per acre, about 75 percent higher than those generated by low-yielding cultivars.

To include the time value of money in our analysis (at 8.5 percent per year), we moved all dollar amounts to the end of the ninth year. In our examples, the wholesale price of $2.50 per pound generates a total return of almost $92,000 per acre by the end of the ninth year, just over 200 percent more than generated by the low-yielding cultivars. With the assumed retail price of $5.00 per pound, the return is just over $283,000 per acre, almost 80 percent greater than that generated by low-yielding cultivars. As in the low-yielding scenario, the higher price better offsets the lower yield in the earlier production years.

Reduced plant costs. A number of nurseries have the capability to propagate lingonberry plants using tissue culture, a technique known as *micropropagation*. Growth regulators are used to create rapid proliferation of shoots, which then are rooted. These miniature plantlets can be grown quickly in a greenhouse. There is a high degree of survival for the plantlets as they mature into full-size plants.

Industry experiments with tissue culture indicate it can reduce the wholesale cost of lingonberry plants by about half. Thus, the cost per plant would be reduced to $1.50. At 5,438 plants per acre, the per-acre cost of plants would be just over $8,200—a major reduction in the year 2 establishment cost (Table 10, page 21).

We did a budget run with the cost of plants set at one-half the typical cost of conventionally grown lingonberry plants. Table 11 on page 22 shows that total establishment costs in the second year are just over $14,600, a reduction of about 38 percent compared to the total second-year establishment costs when conventionally grown plants are purchased. We also did this run with medium-yielding cultivars.

Compared to the medium-yielding cultivars established with conventionally grown plants, Table 12 (page 23) shows lower break-even prices and higher net returns each production year. As an example, the break-even price during the first production year is about $9.30 per pound, approximately 14 percent less than with conventionally grown plants. In the ninth year, the break-even price drops 5 cents from that for conventionally grown plants, to just under $0.30 per pound.

When a time value analysis is done at the assumed wholesale price of $2.50 per pound, the total return at the end of the ninth year is more than $107,000 per acre, about 17 percent higher than when conventionally grown plants are used to establish the field. At the assumed retail price of $5.00 per pound, almost $299,000 in per-acre returns accumulates at the end of the ninth year, about 6 percent more than when utilizing conventionally grown plants.

High-yielding cultivars

Finally, we did a budget run on costs and returns when the lingonberry acreage was established with high-yielding cultivars. With one exception, all of the establishment and production costs were assumed to remain the same as those for low- and medium-yielding cultivars. Results can be seen in Table 13 on page 24. The exception is that test plots managed by Ross Penhallegon indicate that about 560 pounds of fruit typically are available in establishment year 2. The revenue generated, less harvesting costs, is treated as an offset to establishment costs in that year. The budget continues to assume that year 9 is the final year of production.

The estimated annual gross returns per acre for each market are calculated using the same price multipliers. The test plot yield data show that more than 177,000 pounds of lingonberries per acre will be produced over the useful life of the enterprise, exceeding production by medium-yielding cultivars by more than 150 percent. The nominal gross returns over that period would range from about $195,000 for processed fruit to $886,000 for fruit sold at retail. Revenue generated would exceed that

from medium-yielding cultivars by more than 150 percent.

Compared with the low- and medium-yielding cultivars, the break-even price for high-yielding plants is lower each operating year. Instead of just over $11.00 per pound for medium-yielding cultivars, it was about $5.40 per pound for the first year of production, dropping to $3.00 in year 2. Thus, the break-even price for high-yielding cultivars is 50 percent less than that for medium-yielding cultivars. As production increases, the break-even price drops quite significantly. In the ninth year, it is $0.16 per pound for the high-yielding cultivars compared to just over $0.30 per pound for medium-yielding cultivars.

At a price of $2.50 per pound, the negative nominal dollar net returns in the early years are recovered by positive returns in the sixth year of production, 2 years earlier than with medium-yielding cultivars. Net returns over the 7 years of production are about $366,000, almost 280 percent greater than the medium-yielding cultivars. A major factor behind the large increase is the much higher yield in the final 2 years of production compared to medium-yielding cultivars. At the retail price of $5.00 per pound, losses in the first year of production are more than recovered by positive net returns in the next year. Thus, the nominal dollar net returns accumulated over 7 production years are just under $808,000 per acre, almost 200 percent above those generated by medium-yielding cultivars.

We moved all net returns to the end of the ninth year to take into account the time value of money. In our example, the wholesale price of $2.50 per pound generated a total return of just over $394,000 per acre, about 330 percent more than that generated by medium-yielding cultivars. The corresponding return with the assumed retail price of $5.00 per pound was almost $886,000 per acre, nearly 215 percent higher than revenue generated by medium-yielding cultivars.

As in the medium-yielding scenario, the higher price better offsets the lower yield for lingonberries in the earlier production years.

Playing what-if games

The real usefulness of the lingonberry budgeting template is its ability to help you analyze alternative scenarios quickly. It is helpful to get a sense of change that occurs when a range of feasible options or possibilities is tested. You might wish to analyze the implications of market price or cost changes on the returns expected from a prospective lingonberry operation. Or, you might want to know the impact on net returns of updated yield data. Perhaps a range of rates of return needs to be considered. The list goes on, depending on the scenarios that you can imagine.

Selected references

Ailor, K. and R. Penhallegon. "Growing Lingonberries: A Survey of Literature" (1999). 27 pp.

Ailor, K. and R. Penhallegon. "Lingonberry Harvest and Marketing: A Survey of Literature" (1999). 17 pp. (An extensive list of research articles is available from these authors upon request. Contact Ross Penhallegon at 541-682-4243 or ross.penhallegon@oregonstate.edu).

*Burt, L., J. Kropf, and C. Moulton. *Marketing Alternatives for Specialty Produce*, PNW 241 (Oregon State University, Corvallis, revised April 2000).

*Cross, T. and B. Eleveld. *Understanding and Using Enterprise Budgets*, EM 8354 (Oregon State University, Corvallis, revised January 1994).

Dierking, W., Jr. and S. Dierking. "European Vaccinium species." *Acta Horticulturae* 346:299–304 (1993).

Gustavsson, B.A. "Lingonberry breeding and cultivation." *Acta Horticulturae* 346:311–313 (1993).

Holloway, P.S., C. Stushnoff, and D.K. Wildung. "Chilling and bud break in lingonberries…from Fairbanks, Oulu, Finland, and the Pasrik Valley, Norway." *Journal of Horticultural Science* 108(1): 88–90 (1983).

Lineberger, R.D. "Tissue Culture of Woody Plants." This article is available on the Web (http://aggie-horticulture.tamu.edu/tisscult/microprop/woodypl.html). It is part of a general Web site at Texas A&M on plant tissue culture (http://aggie-horticulture.tamu.edu/tisscult/microprop/microprop.html).

Penhallegon, R.H. "Lingonberries—A Production Guide." (Publication in progress; contact Ross Penhallegon for a copy, 541-682-4243 or ross.penhallegon@oregonstate.edu.)

Stang, E.J. "Lingonberry cultivars: building blocks for an industry?" *Fruit Varieties Journal* 48(1): 3–6 (1994).

Stang, E.J., G.G. Weis, and J. Klueh, "Lingonberry: potential new fruit for the northern United States." In *Advances in New Crops, Proceedings of the First National Symposium, New Crops: Research, Development, Economics,* J. Janick and J.E. Simon, eds. (Timber Press, Portland, Oregon, 1990), pp. 321–323.

*Ordering information

Many OSU Extension Service publications may be viewed or downloaded from the Web. Visit the online Publications and Videos catalog at **http://eesc.oregonstate.edu.**

Copies of our publications and videos also are available from OSU Extension and Experiment Station Communications. For prices and ordering information, visit our online catalog or contact us by fax (541-737-0817), e-mail (puborders@ oregonstate.edu), or phone (541-737-2513).

Table 4. Establishment costs (per acre)—Year 1.

Operation/item	Description	Labor ($)	Machinery ($)	Materials ($)	Total ($)
Variable cash costs					
Herbicide (Roundup)	0.25 gallons @ $125/gallon	3.50	1.75	31.25	36.50
Custom operations					
Rip field		—	—	15.00	15.00
Plow		—	—	15.00	15.00
Drag and roll (3 times)		—	—	21.00	21.00
Soil test	Analysis fee @ $35/acre	10.00	1.25	35.00	46.25
Incorporate sulfur	200 pounds/acre granulated sulfur @ $64 plus $20 custom application	7.00	—	84.00	91.00
Shape beds		9.00	—	15.00	24.00
Irrigation (1 time)		20.00	—	25.00	45.00
Strip fumigate	Fumigant	—	—	500.00	500.00
	Custom application	—	—	60.00	60.00
Spread mulch	3 units @ $70/unit	38.00	—	210.00	248.00
	Spreader rental	—	—	60.00	60.00
General overhead		—	—	416.00	416.00
Total variable cash costs		87.50	3.00	1,487.25	1,577.75
Fixed cash costs					
Machinery insurance	1% of total value	—	—	692.00	692.00
Land rent		—	—	160.00	160.00
Total fixed cash costs		—	—	852.00	852.00
Fixed non-cash costs					
Operating capital (total cash cost) interest		—	—	206.53	206.53
Building rent		—	—	1,000.00	1,000.00
Machinery interest and depreciation		—	—	2,052.20	2,052.20
Total fixed non-cash costs		**—**	**—**	**3,258.73**	**3,258.73**
Total year 1 establishment costs		**87.50**	**3.00**	**5,597.98**	**5,688.48**

Table 5. Establishment costs (per acre)—Year 2.

Operation/item	Description	Labor ($)	Machinery ($)	Materials ($)	Total ($)
Variable cash costs					
Set planting flags	10 bundles @ 10 per bundle	10.00	—	100.00	110.00
Spot-treat weeds	0.1 gallon @ $125/gallon	10.00	—	12.50	22.50
Plant lingonberries	5,438 plants @ $3.00	120.00	—	16,314.00	16,434.00
Plant grass between rows		15.00	—	—	15.00
	Grass seed	—	—	15.00	15.00
	Planter rental	—	—	8.00	8.00
Irrigate (6 times)		120.00	—	158.25	278.25
Apply ammonium sulfate	100 pounds @ $187.60/ton	7.00	—	9.38	16.38
Spread mulch		38.00	—	—	38.00
	3 units @ $70/unit	—	—	210.00	210.00
	Spreader rental	—	—	60.00	60.00
Grass strip mowing		5.80	4.10	—	9.90
Spraying					
Fungicide	Foliar sulfur	7.00	—	30.00	37.00
Fungicide	Phytophthora root rot	23.00	—	135.00	158.00
Fuel		—	143.00	—	143.00
General overhead		—	—	416.00	416.00
Total variable cash costs		355.80	147.10	17,468.13	17,971.03
Fixed cash costs					
Machinery insurance	1% of total value	—	—	692.00	692.00
Land rent		—	—	160.00	160.00
Total fixed cash costs		—	—	852.00	852.00
Fixed non-cash costs					
Operating capital (total cash cost) interest		—	—	1,599.99	1,599.96
Building rent		—	—	1,000.00	1,000.00
Machinery interest and depreciation		—	—	2,052.20	2,052.00
Total fixed non-cash costs		—	—	4,652.16	4,652.16
Total year 2 establishment costs		**355.80**	**147.10**	**22,972.29**	**23,475.19**

Table 6. Amortization of lingonberry establishment costs over 7 years (per acre).

Year	Amount ($)	Interest factor	Value at end of year 2 ($)
1	5,688	1.085	6,172
2	23,475	1.000	23,475
Total			**29,647**

Annual production cost to recover establishment costs at 8.5% per year

Year	Amount ($)	Interest factor	Annualized establishment cost ($)
3–9	29,647	5.119	5,792

Table 7. Annual operating costs for years 3–9 (per acre).

Operation/item	Description	Labor ($)	Machinery ($)	Materials ($)	Total ($)
Variable cash costs					
Herbicide spot-treat (Roundup)	0.1 gallons @ $125/gallon	10.00	—	12.50	22.50
Irrigate (4 times)		80.00	—	105.50	185.50
Apply ammonium sulfate	100 pounds @ $187.60/ton	7.00	—	9.38	16.38
Spread mulch	Every 3 years; prorated/year	12.67	—	—	12.67
	1 unit @ $70/unit	—	—	70.00	70.00
	Spreader rental	—	—	20.00	20.00
Grass strip mowing		5.80	4.10	—	9.90
Fungicide spraying	Primarily root rot	23.00	—	135.00	158.00
Fuel		—	143.00	—	143.00
General overhead		—	—	416.00	416.00
Harvest (5 hours)		75.00	—	—	75.00
Total variable cash costs		213.47	147.10	768.38	1,128.95
Fixed cash costs					
Machinery insurance	1% of total value	—	—	692.00	692.00
Land rent		—	—	160.00	160.00
Total fixed cash costs		—	—	852.00	852.00
Fixed non-cash costs					
Operating capital (total cash cost) interest		—	—	168.38	168.38
Building rent		—	—	1,000.00	1,000.00
Machinery interest and depreciation		—	—	2,052.20	2,052.00
Amortization of establishment costs		—	—	5,791.60	5,791.60
Total fixed non-cash costs		—	—	9,012.18	9,012.18
Total costs		**213.47**	**147.10**	**10,632.56**	**10,993.12**

Table 8. Low yield: break-even analysis for years 1–9 (per acre).

Year of operation	Pounds harvested	Wholesale gross return ($)	Retail gross return ($)	Processed gross return ($)
1	0	0	0	0
2	0	0	0	0
3	466	1,165	2,330	513
4	877	2,193	4,385	965
5	2,318	5,795	11,590	2,550
6	4,735	11,838	23,675	5,209
7	7,073	17,683	35,365	7,780
8	11,101	27,753	55,505	12,211
9	20,146	50,365	100,730	22,161
Total for 7 years	**46,716**	**116,790**	**233,580**	**51,388**

Break-even price for years 3–9 when sold wholesale

Year of operation	Break-even price per pound ($)	Net return at $2.50 wholesale price ($)	End of year 9 value at 8.5% per year ($)
3	23.59	(9,828)	(16,034)
4	12.53	(8,801)	(13,233)
5	4.74	(5,198)	(7,204)
6	2.32	844	1,079
7	1.55	6,689	7,875
8	0.99	16,759	18,184
9	0.55	39,372	39,372
Total for 7 years		**39,838**	**30,038**

Break-even price for years 3–9 when sold retail

Year of operation	Break-even price per pound ($)	Net return at $5.00 retail price ($)	End of year 9 value at 8.5% per year ($)
3	23.59	(8,663)	(14,134)
4	12.53	(6,608)	(9,936)
5	4.74	597	827
6	2.32	12,682	16,198
7	1.55	24,372	28,691
8	0.99	44,512	48,295
9	0.55	89,737	89,737
Total for 7 years		**156,628**	**159,679**

Table 9. Medium yield: break-even analysis for years 1–9 (per acre).

Year of operation	Pounds harvested	Wholesale gross return ($)	Retail gross return ($)	Processed gross return ($)
1	0	0	0	0
2	0	0	0	0
3	997	2,493	4,985	1,097
4	1,789	4,473	8,945	1,968
5	2,389	5,973	11,945	2,628
6	5,078	12,695	25,390	5,586
7	8,554	21,385	42,770	9,409
8	17,001	42,503	85,005	18,701
9	33,942	84,855	169,710	37,336
Total for 7 years	**69,750**	**174,375**	**348,750**	**76,725**

Break-even price for years 3–9 when sold wholesale

Year of operation	Break-even price per pound ($)	Net return at $2.50 wholesale price ($)	End of year 9 value at 8.5% per year ($)
3	11.03	(8,501)	(13,868)
4	6.14	(6,521)	(9,805)
5	4.60	(5,021)	(6.958)
6	2.16	1,702	2,174
7	1.29	10,392	12,234
8	0.65	31,509	34,188
9	0.32	73,862	73,862
Total for 7 years		**97,423**	**91,826**

Break-even price for years 3–9 when sold retail

Year of operation	Break-even price per pound ($)	Net return at $5.00 retail price ($)	End of year 9 value at 8.5% per year ($)
3	11.03	(6,008)	(9,802)
4	6.14	(2,048)	(3,080)
5	4.60	952	1,319
6	2.16	14,397	18,389
7	1.29	31,777	37,409
8	0.65	74,012	80,303
9	0.32	158,717	158,717
Total for 7 years		**271,798**	**283,255**

Table 10. Establishment costs with micropropagation—Year 2 (per acre).

	Description	Labor ($)	Machinery ($)	Materials ($)	Total ($)
Variable cash costs					
Set planting flags	10 bundles @ 10 per bundle	10.00	—	100.00	110.00
Spot-treat weeds	0.1 gallon @ $125/gallon	10.00		12.50	22.50
Plant lingonberries	5,438 plants @ $1.50	120.00	—	8,157.00	8,277.00
Plant grass between rows		15.00	—	—	15.00
	Grass seed	—	—	15.00	15.00
	Planter rental	—	—	8.00	8.00
Irrigate (6 times)		120.00	—	158.25	278.25
Apply ammonium sulfate	100 pounds @ $187.60/ton	7.00	—	9.38	16.38
Spread mulch		38.00	—	—	38.00
	3 units @ $70/unit	—	—	210.00	210.00
	Spreader rental	—	—	60.00	60.00
Grass strip mowing		5.80	4.10	—	9.90
Spraying					
Fungicide	Foliar sulfur	7.00	—	30.00	37.00
Fungicide	Phytophthora root rot	23.00	—	135.00	158.00
Fuel		—	143.00	—	143.00
General overhead		—	—	416.00	416.00
Total variable cash costs		355.80	147.10	9,311.13	9,814.03
Fixed cash costs					
Machinery insurance	1% of total value	—	—	692.00	692.00
Land rent		—	—	160.00	160.00
Total fixed cash costs		—	—	852.00	852.00
Fixed non-cash costs					
Operating capital (total cash cost) interest		—	—	906.61	906.61
Building rent		—	—	1,000.00	1,000.00
Machinery interest and depreciation		—	—	2,052.20	2,052.00
Total fixed non-cash costs		—	—	3,958.81	3,958.81
Total year 2 establishment costs		**355.80**	**147.10**	**14,121.94**	**14,624.84**

Table 11. Amortization of lingonberry establishment costs over 7 years with micropropagation (per acre).

Year	Amount ($)	Interest factor	Value at end of year 2 ($)
1	5,688	1.085	6,172
2	14,625	1.000	14,625
Total			**20,797**

Annual production cost to recover establishment costs at 8.5% per year

Year	Amount ($)	Interest factor	Annualized establishment cost ($)
3–9	20,797	5.119	4,063

Table 12. Medium-yield, micropropagation: break-even analysis for years 1–9 (per acre).

Year of operation	Pounds harvested	Wholesale gross return ($)	Retail gross return ($)	Processed gross return ($)
1	0	0	0	0
2	0	0	0	0
3	997	2,493	4,985	1,097
4	1,789	4,473	8,945	1,968
5	2,389	5,973	11,945	2,628
6	5,078	12,695	25,390	5,586
7	8,554	21,385	42,770	9,409
8	17,001	42,503	85,005	18,701
9	33,942	84,855	169,710	37,336
Total for 7 years	**69,750**	**174,375**	**348,750**	**76,725**

Break-even price for years 3–9 when sold wholesale

Year of operation	Break-even price per pound ($)	Net return at $2.50 wholesale price ($)	End of year 9 value at 8.5% per year ($)
3	9.29	(6,772)	(11,048)
4	5.18	(4,792)	(7,205)
5	3.88	(3,292)	(4,562)
6	1.82	3,431	4,382
7	1.08	12,121	14,269
8	0.54	33,238	36,064
9	0.27	75,591	75,591
Total for 7 years		**109,526**	**107,491**

Break-even price for years 3–9 when sold retail

Year of operation	Break-even price per pound ($)	Net return at $5.00 retail price ($)	End of year 9 value at 8.5% per year ($)
3	9.29	(4,279)	(6,981)
4	5.18	(319)	(480)
5	3.88	2,681	3,715
6	1.82	16,126	20,597
7	1.08	33,506	39,444
8	0.54	75,741	82,179
9	0.27	160,446	160,446
Total for 7 years		**283,901**	**298,920**

Table 13. High yield: break-even analysis for years 1–9 (per acre).

Year of operation	Pounds harvested	Wholesale gross return ($)	Retail gross return ($)	Processed gross return ($)
1	0	0	0	0
2	560	1,400	2,800	616
3	1,994	4,985	9,970	2,193
4	3,668	9,170	18,340	4,035
5	7,337	18,343	36,685	8,071
6	14,675	36,688	73,375	16,143
7	32,350	80,875	161,750	35,585
8	49,900	124,750	249,500	54,890
9	66,700	166,750	333,500	73,370
Total for 7 years	**177,184**	**442,960**	**885,920**	**194,902**

Break-even price for years 3–9 when sold wholesale

Year of operation	Break-even price per pound ($)	Net return at $2.50 wholesale price ($)	End of year 9 value at 8.5% per year ($)
3	5.39	(5,768)	(9,411)
4	2.93	(1,583)	(2,381)
5	1.47	7,589	10,517
6	0.73	25,934	33,125
7	0.33	70,122	82,549
8	0.22	113,997	123,686
9	0.16	155,997	155,997
Total for 7 years		**366,286**	**394,082**

Break-even price for years 3–9 when sold retail

Year of operation	Break-even price per pound ($)	Net return at $5.00 retail price ($)	End of year 9 value at 8.5% per year ($)
3	5.39	(783)	(1,278)
4	2.93	7,587	11,408
5	1.47	25,932	35,937
6	0.73	62,622	79,986
7	0.33	150,997	177,757
8	0.22	238,747	259,040
9	0.16	322,747	322,747
Total for 7 years		**807,846**	**885,596**

This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties.

Published December 2003.