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Alternate-Year Production of Thornless Evergreen Blackberries: Technical and Economic Feasibility



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ABSTRACT

Producing fruit in alternate years (A-Y) in Thornless Evergreen blackberries is economically feasible and a horticulturally sound management practice. The cultural advantages are: less labor is required; pesticide and irrigation requirements are reduced; pesticide timing and application are improved; maturity of fruit is hastened; and mechanical damage to new canes is reduced. The A-Y yield per fruit-year acre averaged 170 percent of every-year (E-Y) production. The savings in pre-harvest variable costs per acre for an A-Y compared to an E-Y system were estimated at \$419. Given this yield and cost relationship, the economic feasibility of adopting the A-Y system depends on the grower's E-Y yield and the berry price he expects to receive, less harvest costs.

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ALTERNATE-YEAR PRODUCTION OF THORNLESS EVERGREEN BLACKBERRIES:
TECHNICAL AND ECONOMIC FEASIBILITY

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INTRODUCTION

Many developments have occurred in the caneberry industry of the Willamette Valley during the last few years. The introduction and use of mechanical harvesters have brought new production techniques which have improved the competitive position of the entire industry.

One of the innovations is the alternate-year (A-Y) system - the practice of producing new canes one year and fruit the following year. This is in contrast to the traditional every-year (E-Y) system of producing both fruit and new canes each year. The A-Y system, devised to reduce mechanical damage to new canes, has been under test at the North Willamette Experiment Station since 1967 [1]. Although most of the commonly grown caneberry crops have been included in these tests, emphasis has been on Thornless Evergreen blackberries, the major cultivar in the industry.

This report deals with the experience and data generated from this study. The purposes are two-fold: (1) to describe the cultural advantages and disadvantages of A-Y production, and (2) to analyze the economic feasibility of A-Y production for Thornless Evergreen blackberries.

COMPARATIVE TESTING OF THE E-Y AND A-Y SYSTEMS

A replicated planting was established in Willamette sandy shot loam soil with a row spacing of 10 feet and in-row plant spacing of 5 feet. A solid set overhead sprinkler irrigation system was installed. Plants were trained to a 2-wire trellis, with the top wire 60 inches above the ground and the second wire 15 inches lower. A detailed account of all labor requirements, by operation, was recorded.

In the E-Y system all plants produced both fruit and new canes each year. To begin the A-Y test, all canes from plants on every other row were removed during the winter. The following growing season alternate rows were permitted to produce either fruit or new canes. A N (nitrogen) variable of 50 and 100 pounds per acre, applied each year or only on the fruiting year, was included in this test. Yield between fertilizer treatments was not significant. For 1970 through 1974 the A-Y yield per fruit-year acre averaged 170 percent of the E-Y system's yield (Table 1).

ADVANTAGES OF A-Y PRODUCTION

Testing at the North Willamette Experiment Station has resulted in the following advantages:

1. Reduces cane damage. It is extremely important for maximum fruit production to have healthy, vigorous, fruiting canes. Canes sustaining mechanical damage during the growing season cannot produce fruit to their full potential the following year. Canes are damaged by pickers, both hand and mechanical, sprayers, dusters, tillage tools, etc. When some of these operations are eliminated, a greater number of productive canes are available for trellising.
2. Permits trellis training during the growing season. Training new canes to the trellis as they grow reduces overall training costs because it is easier to train shorter canes before they get intergrown, which happens when they are left on the ground.
3. Less labor required. Tables 2, 3, and 4 indicate that 232 man-hours of hired labor were required for the E-Y system, compared to 87 man-hours per acre for the A-Y system.
4. Spreads the work load. Permits better utilization of the labor force; i.e., laborers, when not doing other tasks during the summer, can be used for trellis training. A few laborers, training throughout the summer, can replace the requirement for a

Table 1. Yield Comparisons of E-Y and A-Y Thornless Evergreen Blackberry Production, North Willamette Experiment Station

Year	Yield with E-Y system (tons/acre)	Yield with A-Y system ^{a/} (tons/fruit-year acre)	A-Y yield as percentage of E-Y yield ^{b/} (percent)
1970.....	5.7	10.5	184
1971.....	6.0	8.2	137
1972.....	5.8	12.7	219
1973 ^{c/}	3.0	6.0	200
1974.....	<u>10.2</u>	<u>11.2</u>	<u>110</u>
Average (5 years)..	6.1	9.7	170

^{a/} With half-acre in fruit production and half-acre in cane production, an A-Y yield per fruit-year acre of 8 tons is equivalent to a 4-ton yield per total or planted acre.

^{b/} Where E-Y yield is considered to be 100 percent.

^{c/} Winter injury in 1972 caused the lower yields in 1973.

larger crew during the winter or early spring.

5. Permits more timely application of pesticides. Good pest control is dependent on the application of pesticides at the proper time. For example, control of fruit rot should be initiated in the early bloom stage. This time coincides with new canes extending toward the row middle. With the E-Y system, new canes must be staked or otherwise trained out of the way before spraying or dusting with ground equipment. Under the A-Y system there should be no delay in application, because injury to new canes is not a factor, since they will not be utilized the following year. Fungicides can be easily applied in the fall. If weed control is needed during the fall and winter, canes are out of the way for easy application of a herbicide. Often dormant

sprays of lime sulfur are omitted because canes on E-Y systems are not trained until late March or April. Summer training can help prevent this problem.

6. Reduces or eliminates need for irrigation during the cane year. One of the primary reasons for irrigating is to increase fruit size. When supplemental water is used on the E-Y system, there is no way to keep new canes from getting more than they require, so excessively long canes result. Cane length to reach the adjacent plant is usually all that is necessary and, under normal A-Y growing conditions, this is obtained by mid-summer when soil moisture is still adequate. If a hand-move system is used, considerably less labor is required if only half the acreage is irrigated.
7. Reduces or eliminates fertilizer requirements during the cane year. It has been customary, on the E-Y system, to fertilize heavily to increase fruit size. This permits new canes to grow in a so-called "luxury" range, where they reach lengths in excess of that necessary for optimum fruit production. Testing with a N variable indicates little, if any, benefit from 50 or 100 pounds per acre each year [2]. The highest yield (5-year average) was produced on plots receiving no N on the cane year and 100 pounds per acre on the fruit year.
8. Reduces pesticide use. The pesticide requirement is cut nearly in half because plants on the cane year need nothing for fruit rot, mildew, or fruit worm (the larvae of orange tortrix and/or leaf rollers). A copper spray, recommended to be applied about October 1, would be required only on the cane year. Crown borer control (not affected) would be the same for both systems.
9. Prevents natural tipping of new canes. When canes remain on the ground for most of the winter, a tip plant forms on the terminal end. These are a real nuisance to growers not in the plant propagation business. Also, canes tipped down are more vulnerable to breaking during trellising, and volunteer plants have to be eliminated by some mechanical means. Canes summer-trained need the

laterals trimmed in October to prevent their tipping down. This also reduces wind resistance, which can cause trellis damage during the wet winter months.

10. Permits mechanical detrainning. During the dormant season following harvest, all cane growth is cut off at ground level. Since there is no need to selectively cut out only one kind of cane, the operation can be totally mechanized using chain saws, rotary cutters, or similar devices.
11. Earlier harvest season. Fields summer-trained on the A-Y system ripen fruit earlier. Most years the difference is 7 to 10 days. With hand harvest this usually means one more picking before Labor Day, which signals the end of a sizeable portion of the labor force.
12. Increased winter hardiness. Canes trained to the trellis during the summer, while not producing fruit, have been quite winter-hardy. Even the 1973 harvest, following temperatures of 5°F in December 1972 and January 1973, resulted in a 100 percent yield increase favoring the A-Y system (Table 1). Observations at the North Willamette Experiment Station since 1967 support the fact that blackberry canes trellis-trained during the summer are generally more winter-hardy than canes lying on the ground. The one exception is when snow is deep enough to completely cover canes on the ground during severe cold weather. Canes of mature blackberry plants, due to their stiffness, do not lie flat to the ground along their entire length. Seldom in the Willamette Valley does snow reach such depths to cover the basal 2 to 3 feet of canes. If snow does occur, there is no assurance it will coincide with extremely low temperatures.

DISADVANTAGES OF A-Y PRODUCTION

Testing at the North Willamette Experiment Station has revealed the following disadvantages:

1. Physical damage to trellis. The A-Y system requires a heavier trellis to withstand the added weight of canes and fruit. When canes are trellis-trained in the summer, a heavy foliage canopy develops by the end of the growing season. Trellises can be damaged during the winter months if heavy end posts are not used and/or if trellis posts are too far apart. Generally, conversion of an old field to the A-Y system requires strengthening of the trellis system.
2. Excessive lateral growth. Lateral growth on the basal area of canes is a nuisance, and can be a problem. Some growers have successfully controlled low lateral growth with multiple summer applications of dinoseb^{1/} and summer oil, which also controls any annual broadleaf weeds present. Mechanical control, such as hand clipping with shears or hedge trimmers, has also been used, but is more expensive. Such clipping should be done in the fall to prevent "tipping" of terminal ends.
3. Increased volume of pesticide carrier required. Because of the increased amount of foliage, it is necessary to apply the recommended rate of pesticide in larger volumes of carrier (water for sprays and talc for dusts). If 100 gallons per acre of spray have been effective with plants on the E-Y system, the A-Y system generally will require more (perhaps 200 gallons per acre). Increasing the volume of pesticides may necessitate the need for improved and/or additional application equipment.

ECONOMIC ANALYSIS OF A-Y VERSUS E-Y PRODUCTION

The technical feasibility of A-Y Thornless Evergreen blackberry production has been demonstrated. For 1970-74, yield per fruit-year acre of the A-Y system averaged 170 percent of the E-Y system (Table 1). However, because the A-Y

^{1/} Dinoseb (free phenol formulation); Dow General or Sinox General.

system produces fruit on only one acre out of two in berry production, the A-Y yield would have to be 200 percent of E-Y for the two systems to produce the same quantity of berries. Based on research to date, total production will be less with the A-Y than the E-Y system. In assessing the economic feasibility of A-Y production, the question is whether the cost savings associated with the A-Y system more than offsets the decrease in production.

To answer this question, a hypothetical Thornless Evergreen blackberry production unit is analyzed. The returns and variable costs are compared on this unit for an A-Y versus an E-Y system. Prices for the production inputs are based on those quoted during May 1974.

Pre-Harvest Variable Costs: E-Y System

Table 2 presents the variable costs per acre, excluding harvest costs, for a typical E-Y system. Variable costs considered are those which would be affected by the choice of system. Fixed costs such as depreciation, taxes, interest on land and machinery, and establishment costs per acre are assumed to remain the same, regardless of whether berries are produced with the A-Y or E-Y system. Harvest costs will depend on yield per acre, and are considered later in the analysis.

Labor, machinery, and material costs are detailed for each of the operations which comprise the E-Y system. The total pre-harvest variable costs amount to \$758 per acre; \$609 is labor, \$23 machinery, and \$126 in other costs.

Pre-Harvest Variable Costs: A-Y System

In adopting the A-Y system, the grower would most likely divide his berry acreage so that half would be in fruit and half in canes during any one year. This would provide a more even flow of income among years and reduce the risks of price, weather, and disease.

To realize the full potential of the A-Y system, sections or entire fields should be alternated rather than alternating rows within a field, and trellis training during the summer of the cane year should be practiced.

Table 2. Estimated Pre-Harvest Variable Costs Per Acre for E-Y
Production of Thornless Evergreen Blackberries ^{a/}

Operation	Month	Labor ^{b/}		Machinery cost ^{c/}	Other cost	Total cost
		Hours	Cost			
dollars						
Dormant spray.....	March	0.5	1.75	1.45	12.00	15.20
Cane borer drench ^{d/}	March	0.5	1.75	1.45	4.15	7.35
Herbicide (in row).....	March	0.5	1.75	1.45	1.95	5.15
Fertilizer (borated)....	March	0.5	1.75	1.15	37.50	40.40
Paint white marks.....	March	4.0	10.00*		5.00	15.00
Shred old canes.....	March	0.5	1.75	1.15		2.90
Chemical pruning.....	April	0.5	1.75	1.45	2.50	5.70
Disc.....	April	0.5	1.75	1.15		2.90
Rototill.....	May	1.5	5.25	4.50		9.75
Herbicide (between rows)	May	0.5	1.75	1.45	3.90	7.10
Pre-bloom spray.....	May	0.5	1.75	1.45	5.50	8.70
First staking.....	June	19.0	47.50*			47.50
Second staking.....	July	26.0	65.00*			65.00
Cut thorny canes.....	July	10.0	25.00*			25.00
Full-bloom spray.....	July	0.5	1.75	1.45	2.50	5.70
Green-fruit spray.....	August	0.5	1.75	1.45	2.50	5.70
Sticker spreader ^{e/}					4.00	4.00
Final staking.....	August	4.0	10.00*			10.00
Copper application.....	September	0.5	1.75	1.45	5.60	8.80
Remove stakes.....	September	4.0	10.00*			10.00
Cut off old canes.....	September	23.0	57.50*			57.50
Take down canes.....	September	28.0	70.00*			70.00
Trellis new canes.....	October	114.0	285.00*			285.00
Irrigation ^{f/}		0.8	2.65	2.50	4.00	9.15
Operating capital interest (10%).....					34.50	34.50
Pre-harvest variable costs.....		240.3	608.90	23.50	125.60	758.00

^{a/} Established field with plant spacing of 5 x 10 feet.

^{b/} Hired labor (denoted by *) at \$2.50 per hour. Operator labor at \$3.50 per hour.

^{c/} Machinery operating costs for fuel, lubricants, and repairs (see Table A-1).

^{d/} Cane borer drench applied every other year.

^{e/} Total for all spray operations.

^{f/} Overhead solid set irrigation system, irrigated three times, with 6 acre-inches applied.

Tables 3 and 4 present the pre-harvest variable costs per acre for the fruit year and cane year, respectively. Again, the labor, machinery, and material costs are presented by operation. In comparing the costs of the two systems, the cost per acre for the fruit year and cane year must be added together and the total divided by two to determine the total pre-harvest cost for one A-Y acre. This equals \$339 per acre (the sum of \$412 plus \$266 divided by two).

Comparing the Net Returns

There is a substantial cost savings, amounting to \$419 per acre (\$758 minus \$339) for the A-Y system, compared to the E-Y system. However, to determine which system of production is more profitable requires comparison of the net returns above variable costs.^{2/}

Table 5 illustrates an example computation of net returns for the two systems, assuming a price of 20¢ per pound of berries. Yield under the E-Y system is assumed to be 5 tons per acre, with the A-Y system yielding 4 tons per acre (equivalent to an 8-ton yield on fruit-year acres).

Subtracting the cost of harvesting (figured at 12¢ per pound) and the pre-harvest variable costs leaves a \$42 net return for the E-Y system, compared to \$301 per acre for the A-Y system. For this particular example the A-Y system has a net return per acre more than seven times that of the E-Y system. As prices and yields vary, however, the relative profitability of the two systems changes.

Break-Even Analysis

To decide between the A-Y and E-Y systems, the grower must answer the question of whether the yield of berries obtained under the A-Y system will make the net return higher than the E-Y system. The answer depends on expected berry price, cost of harvesting, E-Y berry yield, and cost savings from the A-Y system.

^{2/} Note that the economic comparisons between A-Y and E-Y production made in this report assume that one acre in the A-Y system would be half in fruit and half in canes. Thus, the fixed costs per acre are the same for the two systems, and comparisons are based on returns above variable costs.

Table 3. Estimated Variable Cost Per Acre for A-Y Production of Thornless Evergreen Blackberries, Cane Year a/

Operation	Month	Labor ^{b/}		Machinery cost <u>c/</u>	Other cost	Total cost
		Hours	Cost			
----- dollars -----						
Cane borer drench.....	March	1.0	3.50	2.90	8.30	14.70
Herbicide (in row).....	March	0.5	1.75	1.45	1.95	5.15
Disc.....	April	0.5	1.75	1.15		2.90
Rototill.....	May	1.5	5.25	4.50		9.75
Herbicide (between rows).	May	0.5	1.75	1.45	3.90	7.10
Secure new canes.....	May	82.0	205.00*			205.00
Train new canes.....	July	18.0	45.00*			45.00
Remove thorny canes.....	August	19.0	47.50*			47.50
Copper application.....	September	0.5	1.75	1.45	5.60	8.80
Trim laterals.....	September	19.0	47.50*			47.50
Irrigation ^{d/}		0.3	.90	2.50	2.00	5.40
Operating capital interest (10%).....					13.00	13.00
Pre-harvest variable costs.....		142.8	361.65	15.40	34.75	411.80

a/ Established field with plant spacing of 5 x 10 feet.

b/ Hired labor (denoted by *) at \$2.50 per hour. Operator labor at \$3.50 per hour.

c/ Machinery operating costs for fuel, lubricants, and repairs (see Table A-1).

d/ Overhead solid set irrigation system, irrigated one time with 3 acre-inches applied.

Table 4. Estimated Pre-Harvest Variable Cost Per Acre for A-Y Production of Thornless Evergreen Blackberries, Fruit Year a/

Operation	Month	Labor ^{b/}		Machinery cost <u>c/</u>	Other cost	Total cost
		Hours	Cost			
----- dollars -----						
Dormant spray.....	March	0.5	1.75	1.45	12.00	15.20
Herbicide (in row).....	March	0.5	1.75	1.45	1.95	5.15
Fertilizer (borated).....	March	0.5	1.75	1.15	75.00	77.90
Chemical pruning.....	April	0.5	1.75	1.45	2.50	5.70
Disc.....	April	0.5	1.75	1.15		2.90
Rototill.....	May	1.5	5.25	4.50		9.75
Herbicide (between rows)..	May	0.5	1.75	1.45	3.90	7.10
Pre-bloom spray.....	May	0.5	1.75	1.45	5.50	8.70
Remove thorny canes.....	May	5.0	12.50*			12.50
Full-bloom spray.....	July	0.5	1.75	1.45	2.50	5.70
Green-fruit spray.....	August	0.5	1.75	1.45	2.50	5.70
Sticker spreader ^{d/}					4.00	4.00
Cut off canes.....	November	3.0	7.50*	1.20		8.70
Cut canes between trellis.	November	5.0	12.50*	2.00		14.50
Take down canes.....	November	22.0	55.00*			55.00
Shred canes.....	November	1.0	3.50	2.10		5.60
Irrigation ^{e/}		1.0	3.50	2.50	8.00	14.00
Operating capital interest (10%).....					8.30	8.30
Pre-harvest variable costs.....		43.0	115.50	24.75	126.15	266.40

a/ Established field with plant spacing of 5 x 10 feet.

b/ Hired labor (denoted by *) at \$2.50 per hour. Operator labor at \$3.50 per hour.

c/ Machinery operating costs for fuel, lubricants, and repairs (see Table A-1).

d/ Total for all spray operations.

e/ Overhead solid set irrigation system, irrigated four times with 12 acre-inches applied.

Table 5. Example Calculation of Net Returns over Variable Costs for A-Y Versus E-Y Production of Thornless Evergreen Blackberries

	Per acre	
	E-Y system	A-Y system ^{a/}
Assumed yield.....	5 tons	4 tons
Gross returns @ 20¢ per pound.....	\$2,000.00	\$1,600.00
Harvest cost @ 12¢ per pound.....	<u>1,200.00</u>	<u>960.00</u>
Returns above harvest cost.....	\$ 800.00	\$ 640.00
Pre-harvest variable cost.....	<u>758.00^{b/}</u>	<u>339.10^{c/}</u>
Net returns above total variable costs.....	\$ 42.00	\$ 300.90

^{a/} Represents half-acre in fruit production and half-acre in cane production, i.e., if the yield is 8 tons per fruit-year acre, then the yield per total acre is 4 tons.

^{b/} Variable costs before harvest (see Table 2).

^{c/} Tables 3 and 4 present the variable costs before harvest for A-Y production of one acre in cane year and one acre in fruit year. To reduce this total for two acres to one acre, simply divide the total by 2. $(411.80 + 266.40)/2 = 339.10$

To determine the yield required from the A-Y system to make it a profitable alternative to E-Y production, break-even analysis was employed. The break-even yields for the A-Y systems are presented in Table 6, assuming a cost savings of \$419 per acre for A-Y versus E-Y production. Break-even yields (Table 6) are measured in two ways: (1) yield per acre in the A-Y system (one-half acre in cane year and one-half acre in fruit year); and (2) yield per acre for those acres in the fruit year.

Table 6. Yield Required by A-Y System for Net Returns to Break-Even
with E-Y System of Thornless Evergreen Blackberry Production

Berry price less harvest costs <u>a/</u> (\$/lb.)	E-Y yield per acre	Break-even A-Y yield		Break-even A-Y fruit- year yield as percentage of E-Y yield <u>d/</u> (percent)
		Per total A-Y acre <u>b/</u> pounds	Per fruit- year acre <u>c/</u>	
0.08	6,000	764	1,528	25.5
	8,000	2,764	5,528	69.1
	10,000	4,764	9,528	95.3
	12,000	6,764	13,528	112.7
	14,000	8,764	17,528	125.2
	16,000	10,764	21,528	134.6
	18,000	12,764	25,528	141.8
	20,000	14,764	29,528	147.6
0.13	6,000	2,778	5,555	92.6
	8,000	4,778	9,555	119.4
	10,000	6,778	13,555	135.6
	12,000	8,778	17,555	146.3
	14,000	10,778	21,555	154.0
	16,000	12,778	25,555	159.7
	18,000	14,778	29,555	164.2
	20,000	16,778	33,555	167.8
0.18	6,000	3,673	7,346	122.4
	8,000	5,673	11,346	141.8
	10,000	7,673	15,346	153.5
	12,000	9,673	19,346	161.2
	14,000	11,673	23,346	166.8
	16,000	13,673	27,346	170.9
	18,000	15,673	31,346	174.1
	20,000	17,673	35,346	176.7
0.23	6,000	4,179	8,357	139.3
	8,000	6,179	12,357	154.5
	10,000	8,179	16,357	163.6
	12,000	10,179	20,357	169.6
	14,000	12,179	24,357	174.0
	16,000	14,179	28,357	177.2
	18,000	16,179	32,357	179.8
	20,000	18,179	36,357	181.8

a/ For example, a 20¢ per pound price and a 12¢ per pound harvest cost would give an 8¢ berry price less harvest cost.

b/ Yield from one acre, where half is in cane year and half is in fruit year.

c/ Yield per acre in the fruit year of the A-Y system.

d/ Percent the A-Y yield per fruit-year acre would have to be of E-Y yield for net returns to break-even. E-Y yield equals 100 percent.

At the break-even yield, the net return (i.e., the return above variable and harvest costs) would be the same for the E-Y system and the A-Y system. If A-Y yields are expected to be greater than the break-even level, then the A-Y system would be more profitable than the E-Y system. If expected A-Y yields are less than break-even, then the E-Y system is more profitable. The last column of Table 6 indicates the break-even A-Y yield per fruit-year acre as a percentage of the E-Y yield.

To illustrate the use of Table 6, suppose a grower is contemplating converting to the A-Y system. Assume his E-Y fields average 10,000 pounds per acre, the expected price for berries is 25¢ per pound, and his harvest costs are 12¢ per pound (i.e., a berry price less harvest cost of 13¢ per pound). For the A-Y system to be economically feasible, his A-Y yields would have to be 13,555 pounds per fruit-year acre, or 6,778 pounds over all acres (half in cane year and half in fruit year). This represents a 35.6 percent increase in fruit-year yield (see Table 6).

If his expected price is 30¢ per pound, with harvest costs at 12¢, the break-even yield for the A-Y system would be 15,346 pounds per fruit-year acre, or an increase of 53.5 percent over the E-Y yield. Note in Table 6 that as the price increases or the E-Y yield increases, the A-Y yields must be higher, percentage-wise, to break even.

SUMMARY AND CONCLUSION

Assume the A-Y system would result in a cost saving of \$419 per acre of land in blackberries (Tables 2, 3, and 4). Also assume, based on research at the North Willamette Experiment Station, that A-Y yields per fruit-year acre will average 170 percent of E-Y yields. Stating this yield relationship another way, the A-Y yield per total acre (one-half acre in cane year and one-half acre in fruit year) will average 85 percent (170 divided by 2) of E-Y yields (Table 1). Given these assumptions, A-Y production will be economically feasible for any grower with an E-Y value of production less harvest cost below \$2,793 per acre. This is calculated as follows:

$$\$419 / (1 - .85) = \$2,793.$$

For example, a combination of a 6-ton yield, 35¢ price, and 12¢ per pound harvest cost would approximate this \$2,793 value of production less harvest cost.

Each blackberry grower should make this analysis for his operation. In deciding whether to adopt an A-Y system, he will need to estimate cost savings and yield under A-Y production, present yield under E-Y production, and the price he expects to receive less harvest costs.

There are other management considerations regarding A-Y production which were not taken into account in this study. Under the A-Y system there is more flexibility in adapting to market conditions. If the outlook for next year's price appears to be particularly pessimistic, the grower may decide to switch more acres into the A-Y system. On the other hand, if the price outlook is optimistic, he may decide to go with more acres of E-Y production.

There are labor considerations. The A-Y system requires less labor, and work is less arduous. This is an advantage, since hired labor is becoming more difficult to recruit and more expensive to employ.

An unanswered question is what, if any, is the long-term physiological effect on blackberry plants? To date no adverse effects have been observed.

Will a field of caneberreries in the A-Y system have as long a stand-life as a field under the E-Y system? If fields have to be established more frequently under the A-Y system, this will mean an increase in establishment costs. The establishment costs were assumed equal for the two systems in this study. If A-Y fields do have shorter lives, this would diminish the A-Y system's economic advantage.

The A-Y system of producing blackberries is a radical departure from conventional methods; however, from both cultural and economic standpoints, the merits of A-Y production are worthy of consideration.

REFERENCES

- [1] -Bullock, R. M. and W. A. Sheets. "Control of Caneberry Growth for Mechanical Harvest." Proc. West. Wash. Hort. Ass'n., 59:78-80, 1969.
- [2] Sheets, W. A. and K. F. Kangas. "Progress Report on A-Y Production of Caneberries." Ore. Hort. Soc., 61:91-92, 1970.

APPENDIX

Table A-1. Assumed Operating Costs of Machinery Used for Thornless Evergreen Blackberry Production

Description	Initial investment	Operating cost per hour <u>a/</u>
35 HP tractor.....	\$6,000	\$1.80
200-gallon sprayer.....	1,000	1.10
Rotary fertilizer spreader.....	500	.50
6-foot rotary mower.....	800	.30
6-foot rototiller.....	1,200	1.20
6-foot tandem disc harrow.....	650	.50
Chainsaw (or brush cutter).....	200	.40

a/ Costs for fuel, lubrication, and repairs.