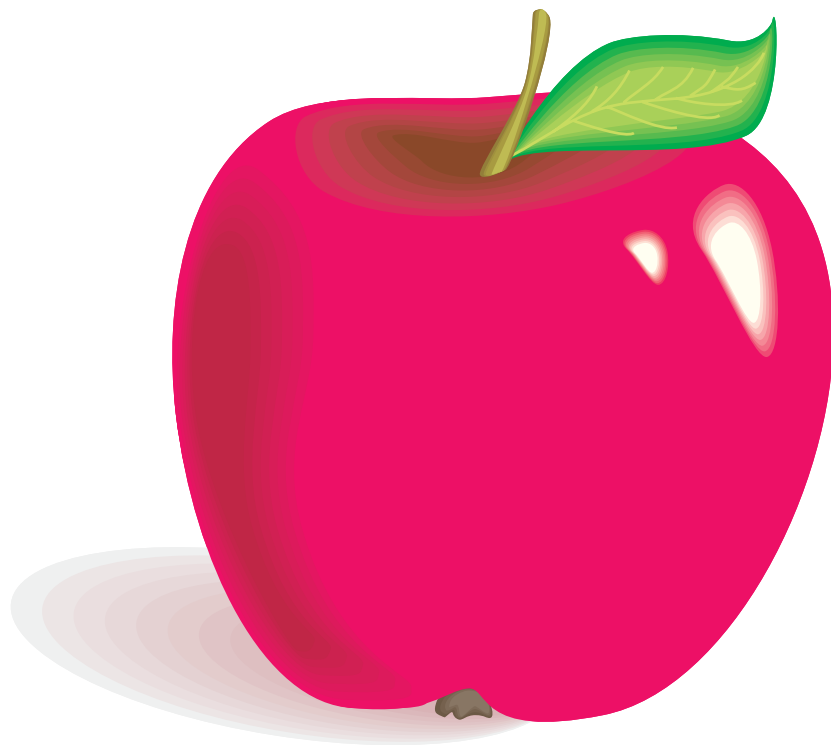


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**Orchard Economics:
Establishing and Producing
Medium-Density Apples
in Hood River County**

Clark F. Seavert, Jenny Freeborn, and Steve Castagnoli



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Introduction

Many factors enter into the decision to renew an existing orchard or develop a new one. Both require the commitment of considerable effort and financial resources. Planting a medium-density orchard can increase production during the establishment years and reduce the time to reach full production compared to a standard-density orchard. While the medium-density orchard has higher economic potential, it also has greater financial risk associated with it.

This analysis is intended for growers and investors who are considering the economic and financial consequences of planting a medium-density apple orchard. It is impossible to cover all apple variety, rootstock, and training system combinations in a publication of this type, so an attempt has been made to reflect the typical production practices performed in the Hood River County apple industry.

Assumptions

In the preparation of this publication, a set of assumptions were made that reflect current trends in orchard design for establishing a medium-density apple orchard. These assumptions are:

1. Typical acreage for a farm in Hood River County is 70 acres of irrigated land. Bearing acres include: 30 acres of winter pears, 8 acres of fresh market Bartlett pears, 4 acres of canning market Bartlett pears, 8 acres of medium-density pears, 5 acres of medium-density apples, 5 acres of high-density sweet cherries or wine grapes, and 10 acres, or approximately

- 15 percent, of the orchard under establishment.
2. Remove 5 acres of existing orchard and plant 558 apple trees per acre (6' x 13' spacing) with a productive life of 25 years, once full production of 50 bins per acre is reached.
3. The medium-density orchard is trained to a central leader on a three-wire vertical support system.
4. Apple prices are \$150 per 850-pound bin.
5. Commercial yields begin in year 3, and full production is reached 6 years after planting with yields of 15, 25, 40, and 50 bins per acre in years 3 through 6, respectively.
6. General labor is hired at a rate of \$11.50 per hour, machine labor at \$13.00 per hour, and harvest labor is \$20.00 per bin to harvest apples, which includes worker's compensation, unemployment insurance, and other labor overhead expenses. All labor is treated as a cash variable expense.
7. The owner provides housing facilities for seasonal labor at a cost of \$40,000 for a 10-person unit. The life of the facility is 30 years and depreciated using the straight-line method of depreciation with a zero salvage value.
8. Foreman housing with all utilities is provided at no cost to the employee,

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- valued at \$600 per month, or \$103 per acre, and is a fixed non-cash opportunity cost to the operator. This is the estimated market rental rate for a three-bedroom, two-bathroom house in the area.
8. The machinery and equipment used in the budget reflects the typical machinery complement of a farm in Hood River County. A detailed breakdown of machinery values is shown in Table 1. Estimated machinery costs from the American Society of Agricultural Engineers are shown in Table 2. The 70-hp tractor is used for flailing, shredding brush, pulling an air-blast sprayer, and during harvest. The 50-hp tractor is used to auger holes for new trees, spread fertilizer, pull an older air blast sprayer, apply gopher bait, and used at harvest. The 35-hp tractor is used to spray weeds, assist in harvest, and as a general utility tractor. Table 3 lists the estimated cost of each operation with 13' tree row spacing. Gasoline and diesel costs per gallon are \$3.00 and \$3.30, respectively.
 9. The interest rate on operating funds is 8.5 percent, which is treated as a cash expense. One-half of the cash expenses are borrowed for a six-month period.
 10. Machinery and land are owned by the operator and assessed 8.5 and 8 percent rates of interest, respectively, as opportunity costs. Land is valued at \$6,000 per acre.
 11. Previous years' establishment costs are funded by the operator at a charge of 10 percent interest and are considered an opportunity cost.
 12. Herbicides used for strip maintenance are applied to 30 percent of each acre.
 13. A micro-sprinkler irrigation system with poly-tube is used at an estimated cost of \$1,200 per acre. The life of the system is 25 years and depreciated using the straight-line method of depreciation with a zero salvage value. Interest is calculated using the average value of the system multiplied by an 8.5 percent interest rate $((\text{cost} + \text{salvage value}) \div 2 \times .085)$. Repairs and maintenance for the system costs one percent of the purchase price per year.
 14. The trellis system is installed at a cost of \$1,800 per acre, not including stringing the wire. The life of the system is 25 years, and it is depreciated using the straight-line method of depreciation with a zero salvage value. Interest is calculated using the average value of the system multiplied by a 8.5 percent interest rate $((\text{cost} + \text{salvage value}) \div 2 \times .085)$. Repairs and maintenance for the system costs 1 percent of the purchase price per year.
 15. Two wind machines are used for frost control along with three smudge pots per acre. The wind machines are valued at \$17,000 each, and smudge pots cost \$10 each. Depreciation periods are 25 years for the wind machines and 10 years for the smudge pots using the straight-line method of depreciation.
 16. Additional assumptions for variable, cash fixed, and non-cash fixed cost are listed in Table 4.
 17. Price inflation for the duration of this study was ignored.
 18. Income tax consequences are also ignored for this study.

Table 1. Machinery Cost Assumptions.

Machine	Size or description	Market value	Hours or miles of annual use	Expected life (years)	Salvage Value
Tractor	4 wheel dr 70hp, new	\$ 33,000	523	10	\$ 9,748
Tractor	2 wheel dr 50hp, old	18,000	179	20	2,311
Tractor	2 wheel dr 35 hp, old	7,500	163	20	962
Air-blast sprayer	400 gallon unit, PTO, new	17,500	156	10	3,095
Air-blast sprayer	400 gallon unit, PTO, older	5,000	104	10	884
Flail chopper	8' unit	6,000	138	7	1,531
Weed sprayer	100 gallon unit	2,000	38	15	192
Fertilizer spreader		2,300	12	20	120
Brush windrow		3,500	29	20	182
Gopher machine		1,200	13	20	63
Pickup	1/2 ton 4x4, new	22,000	12,000	10	8,319
Truck	2 ton, used	18,000	3,500	20	2,710
ATV	4 wheeler, new	5,500	3,000	5	2,465
Auger		1,700	35	20	89
Front-end loader & backforks		5,800	64	10	1,026
Bin trailer		5,000	64	10	884
Ladders	35 units	4,500	N/A	10	N/A
Picking bags	35 units	1,500	N/A	5	N/A
Chain & pruning saws	3 units each, 1-loppers	3,000	N/A	3	N/A
Irrigation system	Micro, per acre	1,200	N/A	25	N/A
Wind machine	2 units, gasoline	34,000	35	25	962
Smudge Pots	3 units, per acre	30	15	10	5
Trellis system - apples	Three-wire vertical, per acre	1,800	N/A	25	N/A
Housing facilities	1 unit	40,000	N/A	30	0.00

Table 2. Machinery Cost Calculations.

Machine	Size or description	--- Variable costs ---		----- Fixed costs -----		Total cost
		Fuel & Lube	Repairs & Maint.	Depr. & Interest	Insurance	
----- Costs per hour -----						
Tractor	4 wheel dr 70hp, new	\$22.77	\$0.52	\$7.92	\$0.37	\$31.58
Tractor	2 wheel dr 50hp, old	18.98	0.45	\$9.22	0.51	29.16
Tractor	2 wheel dr 35 hp, old	18.98	0.17	4.21	0.23	23.59
Air-blast sprayer	400 gallon unit, PTO, new	0.00	8.20	14.84	0.40	23.44
Air-blast sprayer	400 gallon unit, PTO, older	0.00	2.07	6.36	0.17	8.61
Flail chopper	8' unit	0.00	2.55	6.95	0.16	9.66
Weed sprayer	100 gallon unit	0.00	0.69	5.60	0.17	6.47
Fertilizer spreader		0.00	0.94	17.77	0.61	19.32
Brush windrow		0.00	0.48	10.95	0.38	11.80
Gopher machine		0.00	0.50	8.83	0.30	9.63
----- Costs per mile -----						
Pickup	1/2 ton 4x4, new	\$0.29	\$0.05	\$0.22	\$0.07	\$0.63
Truck	2 ton, used	0.58	0.57	0.47	0.27	1.89
ATV	4 wheeler, new	0.83	0.02	0.32	0.01	1.18
----- Costs per acre -----						
Auger		\$0.00	\$0.29	\$4.47	\$0.00	\$4.76
Front-end loader & backforks		0.00	0.88	10.91	0.00	11.79
Bin trailer		0.00	0.76	9.41	0.00	10.16
Ladders	35 units	0.00	3.86	9.16	0.00	13.02
Picking bags	35 units	0.00	1.29	5.20	0.00	6.48
Chain & pruning saws	3 units each, 1-loppers	5.18	2.57	16.11	0.00	23.85
Irrigation system	Micro, per acre	0.00	12.00	99.00	0.00	111.00
Wind machines	2 units, gasoline	25.88	6.28	40.11	0.00	72.26
Smudge Pots	3 units, per acre	3.21	0.00	0.00	0.00	3.22
Trellis system - apples	Three-wire vertical, per acre	0.00	18.00	148.50	0.00	166.50
Housing facilities	1 unit	0.00	43.21	41.90	0.00	85.11

Table 3. Estimated Cost of Each Operation with Power Unit for a 13' Between-Row Spacing.

Operation	Tractor	-- Machine costs --					
		Miles per hour	Acres per hour	Labor cost per acre	Variable cost per acre	Fixed cost per acre	Total cost per acre
Air-blast sprayer	4 wheel dr 70hp	2.00	1.58	\$8.25	\$19.98	\$14.93	\$43.16
Flail chopper	4 wheel dr 70hp	2.00	2.68	4.85	9.64	5.75	20.25
Weed sprayer	2 wheel dr 35hp	3.50	2.07	6.28	9.59	4.94	20.82
Fertilizer spreader	2 wheel dr 50hp	3.00	3.31	3.93	6.15	8.50	18.58
Brush windrow	2 wheel dr 50hp	2.00	1.34	9.70	14.86	15.72	40.29
Gopher machine	2 wheel dr 50hp	2.50	3.15	4.12	6.32	5.99	16.43

Table 4. Input assumptions for establishing a medium-density apple orchard, (per acre basis).

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Full Prod
Prices per bin	\$150.00	\$150.00	\$150.00	\$150.00	\$150.00	\$150.00	\$150.00
Bins per acre	0	0	0	15	25	40	50
Cost of general orchard labor, per hour	\$11.50	\$11.50	\$11.50	\$11.50	\$11.50	\$11.50	\$11.50
Cost of tractor driver, per hour	\$13.00	\$13.00	\$13.00	\$13.00	\$13.00	\$13.00	\$13.00
Cost of harvest labor, per bin	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00
Production mgmt consultant fees	\$0.00	\$0.00	\$0.00	\$30.00	\$30.00	\$30.00	\$30.00
Hours of pruning and training labor	0.00	10.00	15.00	22.00	33.00	55.00	55.00
Hours of thinning labor	0.00	0.00	0.00	20.00	30.00	40.00	55.00
Hours of irrigating labor	0.00	3.50	3.50	3.50	3.50	3.50	3.50
Hours to Install Phermone Disruption	0.00	0.00	0.00	2.00	2.00	2.00	1.50
Hours to remove & replace tree labor	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Hours for frost protection labor	0.00	0.00	0.00	1.00	1.00	1.00	1.00
Hours of General Labor during Harvest	0.00	0.00	0.00	11.25	18.75	30.00	37.50
Cost of fertilizer - broadcast applied	\$40.00	\$40.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00
Cost of fertilizer - lime	\$25.00	\$0.00	\$25.00	\$25.00	\$25.00	\$25.00	\$25.00
Cost of herbicide strip maintenance	\$0.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00
Cost of insecticides & fungicides	\$0.00	\$275.00	\$325.00	\$375.00	\$425.00	\$475.00	\$575.00
Cost of Phermone Disruption	\$0.00	\$0.00	\$0.00	\$100.00	\$100.00	\$100.00	\$100.00
Cost of rodent materials	\$0.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00
Cost per bee hive	\$0.00	\$0.00	\$0.00	\$36.00	\$36.00	\$36.00	\$36.00
Times for fertilizer - broadcast applied	2.00	2.00	2.00	1.00	1.00	1.00	1.00
Times for herbicide strip spray	0.00	3.00	3.00	2.00	2.00	2.00	2.00
Times for insecticides & fungicides	0.00	4.00	6.00	8.00	10.00	12.00	15.00
Number of bee hives per acre	0.00	0.00	0.00	2.00	2.00	2.00	2.00
Times for rodent control	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Times for flailing/mowing orchard floor	0.00	5.00	5.00	5.00	5.00	5.00	5.00
Property taxes	\$30.00	\$30.00	\$30.00	\$30.00	\$30.00	\$30.00	\$30.00
Property insurance	\$25.00	\$25.00	\$25.00	\$25.00	\$25.00	\$25.00	\$25.00
Land values	\$6,000	\$6,000	\$6,000	\$6,000	\$6,000	\$6,000	\$8,500
Foreman housing (per month)	\$600	\$600	\$600	\$600	\$600	\$600	\$600
Irrigation assessment	\$35.00	\$35.00	\$35.00	\$35.00	\$35.00	\$35.00	\$35.00
Miscellaneous & overhead	\$75.00	\$75.00	\$75.00	\$75.00	\$75.00	\$75.00	\$75.00
Tree cost	\$6.75	\$6.75	\$6.75	\$6.75	\$6.75	\$6.75	\$6.75
Gasoline price	\$3.00	\$3.00	\$3.00	\$3.00	\$3.00	\$3.00	\$3.00
Diesel fuel price	\$3.30	\$3.30	\$3.30	\$3.30	\$3.30	\$3.30	\$3.30
Operating interest rate	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%
Machinery interest rate	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%
Land interest rate	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Establishment interest rate	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
% of operating capital borrowed	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%
Months to borrow operating capital	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Planted trees	0	558	2	2	2	2	2

Results of establishing a medium-density apple orchard in Hood River County

Cash flow analysis

A cash flow analysis for establishing a medium-density apple planting is contained in Table 5. A cash flow analysis shows the cash costs required to establish an orchard. Cash costs include labor, trees, irrigation and trellis support systems, fertilizer, chemicals, bee hives, machinery repairs, fuel, lube and oil, labor housing repairs and maintenance, operating (short-term) interest, machinery and housing insurance, irrigation water assessments, and property taxes. The income, variable costs, and cash fixed costs are shown for each of the 6 establishment years plus first full production year. Production begins in year 3 with 15 bins of apples per acre and increases to 50 bins at full production. Total variable costs are \$2,275 in the first year, with an additional \$117 of cash fixed costs for a total cash cost of \$2,392 per acre.

A positive cash flow begins in year 4, with gross income exceeding total cash costs by \$515 per acre. At full production, or in 5 years after planting, the orchard does not return a sufficient amount of gross income to pay all previous years' cash costs. There is \$9,731 per acre remaining over and above prior costs, and it is not until year 10 that all previous years' cash production costs are paid, Figure 3, page 12.

The major cost components in relation to total cash costs are shown in Figure 1 on page 11. Hired labor represents 35 percent of the total cash costs to establish this orchard, followed by machine costs, which include fuel, oil, and repairs, at 14 percent. Together, fertilizer and chemicals are tied with tree cost at 13 percent, making up the third and fourth largest expense categories.

The trellis support is 6 percent and irrigation system costs are 4 percent of the total cash costs. The remaining 15 percent of the total cash costs consists of operating interest (2 percent), insurance and taxes (2 percent), field preparations (4 percent), and other cost items (7 percent).

Economic costs and returns

The economic costs and returns for the establishment of a medium-density apple orchard are shown in Table 6 (page 10). Economic costs include all cash costs and ownership costs that are either an opportunity cost to the owner or money borrowed from a financial institution. These ownership costs include the principal and interest payments or a return on investment to the grower, or both, for machinery, housing, land, and funds to pay for previous years' establishment costs. The gross income and variable cash costs remain the same as in Table 5 (page 9) except that the trellis support and irrigation systems are amortized over their productive life in this analysis and included in fixed machine costs.

Gross income exceeds variable costs beginning in year 4 with \$515 per acre return to the grower. Additionally, at the end of the establishment period, \$23,844 per acre remains to repay all previous establishment costs. This cost is amortized over a 25-year period as an annual payment of \$2,558 per acre as shown in Table 13, Full Production Years, page 20.

The relative contribution of each cost component to the total economic cost is shown in Figure 2 (page 11). When all economic costs are included, both hired labor and interest are the largest cost items, at 23 percent of the total costs for the first 7 years of establishment. Machine costs (fuel, oil, repairs, depreciation and interest charges) are the third largest cost item, with

17 percent. Tree costs and fertilizer and chemicals are tied with 9 percent each. The remaining cost items, land charges and “other,” are 17 percent of the total economic costs.

The net projected returns for establishing a medium-density apple orchard are shown in Figure 3 (page 12). Both the cumulative cash and economic cost and returns are represented. The projected returns for this orchard will cover all cash costs of establishment in the 10th year. With the assumptions used in this study, however, this orchard is far short from covering all economic costs for the 25-year period. Determining the necessary levels of change to price or inputs that will make this orchard a prudent business investment requires a sensitivity analysis. Using this approach, we determined that profitability could be achieved by doing any one of the following:

- a) increasing the apple prices by 24.5 percent from \$150 to \$186.75 per bin,
- b) increasing anticipated yield by 24.5 percent (19, 31, 50, and 62 bins per acre for years 3, 4, 5, and 6, respectively), or

- c) decreasing the rate of return for previous years’ establishment costs to 1.85 percent for all ownership costs.

The results of these adjustments are shown in Figure 4. It should be noted that by reducing assumed interest rates to 1.85 percent, the amount of money required to establish this orchard in year 6 is decreased by \$7,902 per acre (from \$23,844 per acre to \$15,942). Increasing apple price or yield reduces the amount of money required in year 6 by about \$5,072 per acre. While growers often focus on reducing the cost of trees, fertilizers, and chemicals, it is apparent that labor and interest costs are the largest cost components in apple orchard renewal (Figures 1 and 2). Therefore, more emphasis should be placed on labor efficiencies and obtaining higher fruit prices or a combination of earlier and higher yields to reduce labor and interest costs. In order to make this strategy work, the additional revenues must be greater than the additional costs of inputs to achieve these increased prices or yields.

Table 5. Cash costs and returns of establishing a medium-density apple orchard.

Income:	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Full Prod
Yield (bins/acre)	0.00	0.00	0.00	15.00	25.00	40.00	50.00
Price (dollars/bin)	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>
Gross income(dollars/acre)	0.00	0.00	0.00	2,250.00	3,750.00	6,000.00	7,500.00
Variable Costs (per acre):							
Field preparation	1,200.00	30.00	0.00	0.00	0.00	0.00	0.00
Trees	0.00	3,766.50	13.50	13.50	13.50	13.50	13.50
Irrigation System	0.00	1,200.00	0.00	0.00	0.00	0.00	0.00
Trellis System	0.00	1,800.00	0.00	0.00	0.00	0.00	0.00
Paint trees	0.00	30.00	0.00	0.00	0.00	0.00	0.00
Fertilizer	713.65	0.00	85.00	85.00	85.00	85.00	85.00
Chemicals	0.00	325.00	375.00	425.00	475.00	525.00	625.00
Phermone Disruption	0.00	0.00	0.00	100.00	100.00	100.00	100.00
Prod. mgmt consultant fees	0.00	0.00	0.00	30.00	30.00	30.00	30.00
Bee rental	0.00	0.00	0.00	72.00	72.00	72.00	72.00
Rodent materials	0.00	20.00	20.00	20.00	20.00	20.00	20.00
Harvest labor	0.00	0.00	0.00	429.38	715.63	1,145.00	1,431.25
General labor	23.93	1,373.67	341.84	696.18	954.18	1,338.68	1,535.93
Machine costs	172.57	1,134.02	418.47	544.35	584.30	624.26	684.20
Housing facilities	43.21	43.21	43.21	43.21	43.21	43.21	43.21
Miscellaneous & overhead	75.00	75.00	75.00	75.00	75.00	75.00	75.00
Interest: operating capital	<u>47.35</u>	<u>145.29</u>	<u>29.16</u>	<u>53.84</u>	<u>67.32</u>	<u>86.52</u>	<u>100.20</u>
Total variable costs	2,275.71	9,942.69	1,401.18	2,587.45	3,235.14	4,158.18	4,815.28
Gross income - variable cost	-2,275.71	-9,942.69	-1,401.18	-337.45	514.86	1,841.82	2,684.72
Fixed costs (per acre):							
Insurance	51.53	51.53	51.53	51.53	51.53	51.53	51.53
Water assessment	35.00	35.00	35.00	35.00	35.00	35.00	35.00
Property taxes	<u>30.00</u>	<u>30.00</u>	<u>30.00</u>	<u>30.00</u>	<u>30.00</u>	<u>30.00</u>	30.00
Total fixed cost	116.53	116.53	116.53	116.53	116.53	116.53	116.53
Total cost	2,392.24	10,059.22	1,517.71	2,703.99	3,351.67	4,274.71	4,931.82
Net projected returns	-2,392.24	-10,059.22	-1,517.71	-453.99	398.33	1,725.29	2,568.18
Cumulative returns	-2,392.24	-12,451.46	-13,969.18	-14,423.16	14,024.84	12,299.55	-9,731.36

Table 6. Economic costs and returns of establishing a medium-density apple orchard.

Income:	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Full Prod
Yield (pounds/acre)	0.00	0.00	0.00	15.00	25.00	40.00	50.00
Price (dollars/pound)	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>	<u>150.00</u>
Gross income(dollars/acre)	0.00	0.00	0.00	2,250.00	3,750.00	6,000.00	7,500.00
Variable Costs (per acre):							
Field preparation	1,200.00	30.00	0.00	0.00	0.00	0.00	0.00
Trees	0.00	3,766.50	13.50	13.50	13.50	13.50	13.50
Paint trees	0.00	30.00	0.00	0.00	0.00	0.00	0.00
Fertilizer	713.65	0.00	85.00	85.00	85.00	85.00	85.00
Chemicals	0.00	325.00	375.00	425.00	475.00	525.00	625.00
Phermone Disruption	0.00	0.00	0.00	100.00	100.00	100.00	100.00
Prod. mgmt consultant fees	0.00	0.00	0.00	30.00	30.00	30.00	30.00
Bee rental	0.00	0.00	0.00	72.00	72.00	72.00	72.00
Rodent materials	0.00	20.00	20.00	20.00	20.00	20.00	20.00
Harvest labor	0.00	0.00	0.00	429.38	715.63	1,145.00	1,431.25
General labor	23.93	1,373.67	341.84	696.18	954.18	1,338.68	1,535.93
Machine costs	172.57	1,134.02	418.47	544.35	584.30	624.26	684.20
Housing facilities	43.21	43.21	43.21	43.21	43.21	43.21	43.21
Miscellaneous & overhead	75.00	75.00	75.00	75.00	75.00	75.00	75.00
Interest: operating capital	<u>47.35</u>	<u>145.29</u>	<u>29.16</u>	<u>53.84</u>	<u>67.32</u>	<u>86.52</u>	<u>100.20</u>
Total variable costs	2,275.71	6,942.69	1,401.18	2,587.45	3,235.14	4,158.18	4,815.28
Gross income - variable cost	-2,275.71	-6,942.69	-1,401.18	-337.45	514.86	1,841.82	2,684.72
Fixed costs (per acre):							
Insurance	51.53	51.53	51.53	51.53	51.53	51.53	51.53
Water assessment	35.00	35.00	35.00	35.00	35.00	35.00	35.00
Property taxes	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Machine costs	8.50	676.70	360.63	480.56	510.43	540.29	585.09
Foreman housing	102.86	102.86	102.86	102.86	102.86	102.86	102.86
Housing facilities	41.90	41.90	41.90	41.90	41.90	41.90	41.90
Land interest cost	480.00	480.00	480.00	480.00	480.00	480.00	680.00
Interest on establishment costs	<u>0.00</u>	<u>310.05</u>	<u>1,188.61</u>	<u>1,565.28</u>	<u>1,885.24</u>	<u>2,154.94</u>	<u>2,272.94</u>
Total fixed cost	749.79	1,728.04	2,290.54	2,787.14	3,136.96	3,436.53	3,799.33
Total cost	3,025.50	8,670.73	3,691.72	5,374.59	6,372.10	7,594.71	8,614.61
Net projected returns	-3,025.50	-8,670.73	-3,691.72	-3,124.59	-2,622.10	-1,594.71	-1,114.61
Cumulative returns	-3,025.50	-11,696.23	-15,387.95	-18,512.55	-21,134.65	-22,729.35	23,843.96

Figure 1. Cash Costs to Establish a Medium-Density Apple Orchard the First Seven Years of Establishment

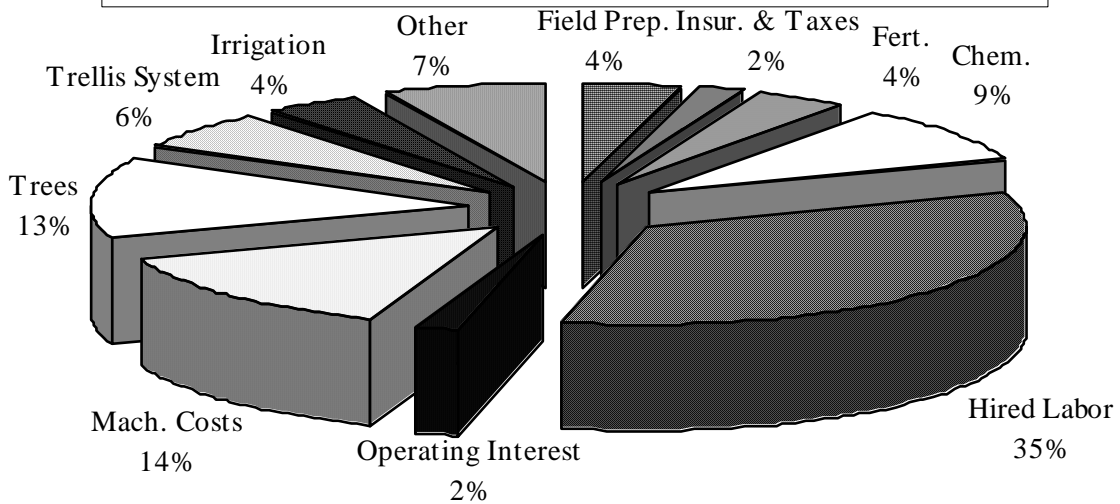
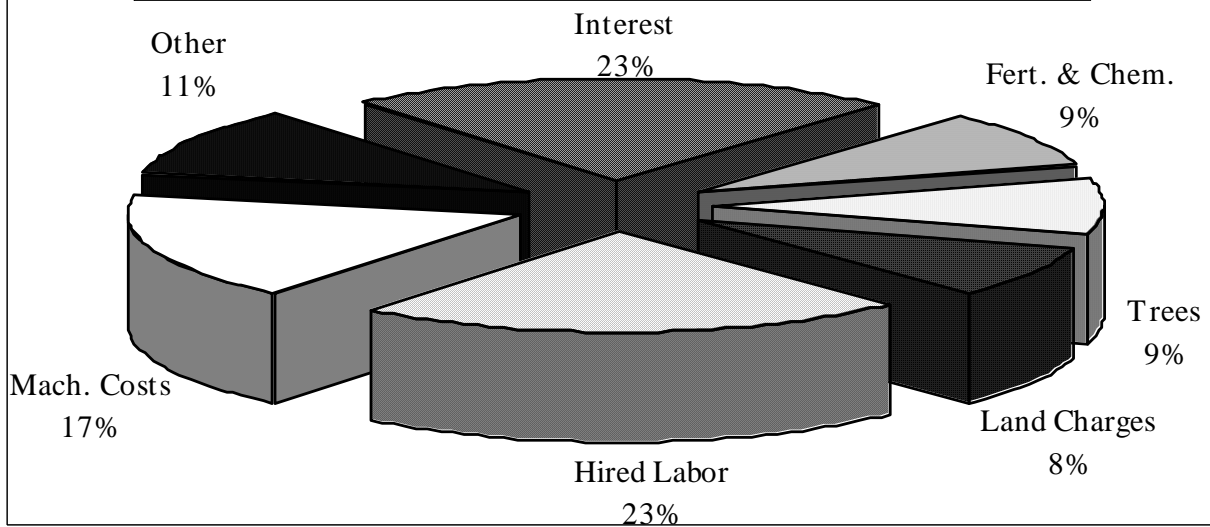
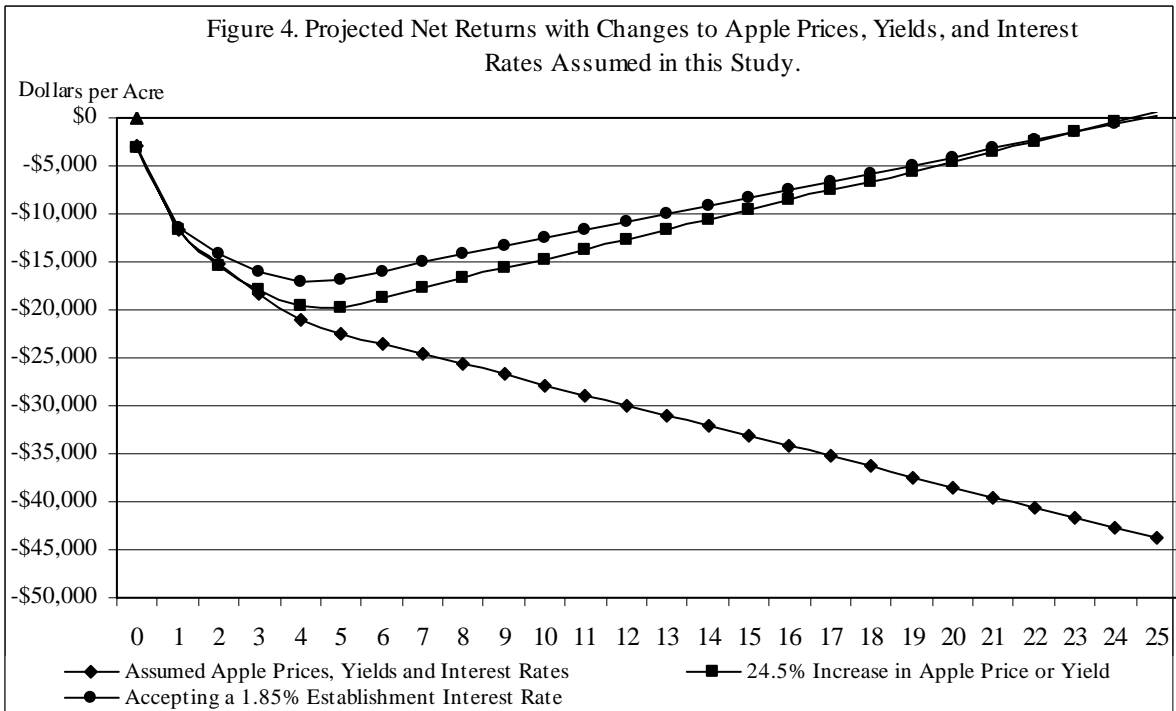
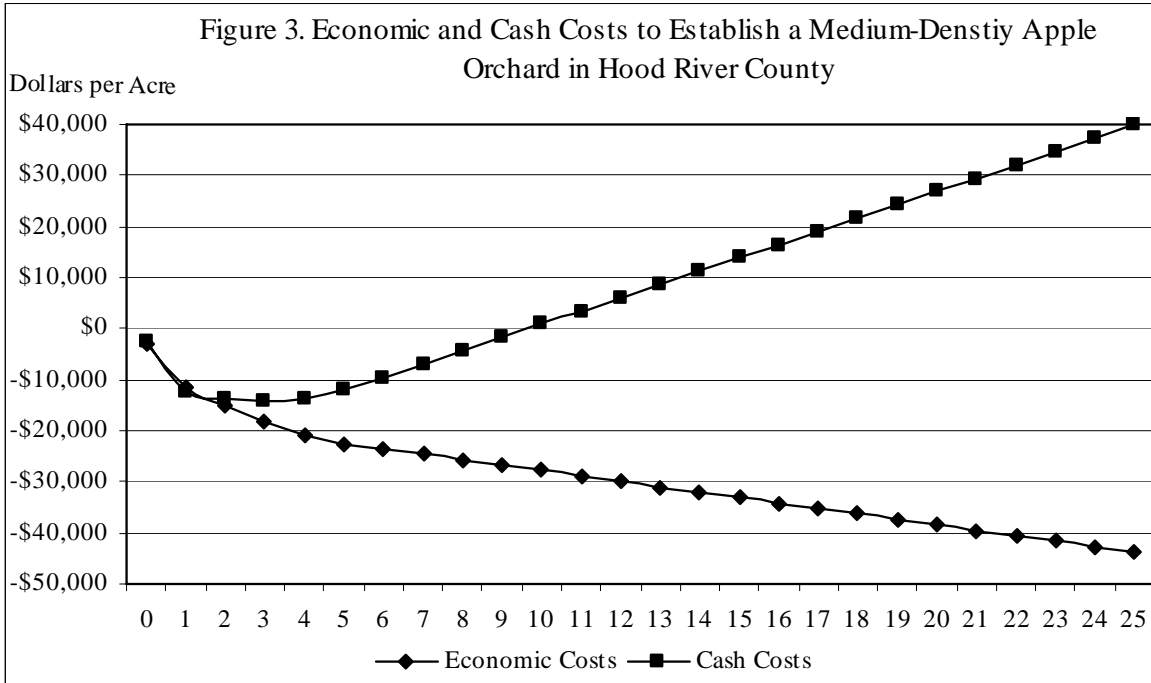


Figure 2. Economic Costs to Establish a Medium-Density Apple Orchard the First Seven Years of Establishment





Conclusion

Historically, most growers have renewed orchards only when production levels no longer covered the cost of production. Today, however, lack of competitive advantages with certain apple varieties in the Hood River Valley have increased interest in replacing old orchards with modern higher-density apple orchards.

Higher-density orchards can offer higher returns that are obtained earlier in the life of the orchard. These early returns can reduce interest costs and therefore improve the profitability and feasibility of an orchard investment. The tradeoff, however, is higher risk due to larger up-front costs and significantly greater management expertise requirements.

This cost of establishment study is meant to provide useful information to apple producers who are considering replacing an existing orchard or planting a new block. As with any enterprise budget, using your own current costs in the analysis will likely make it more meaningful.

Using the Crop Profitability Analysis (CPA) Program to Analyze Different Price and Yield Scenarios

So many different types of scenarios as to price and yields over the years can occur due to freeze, rain, hail, birds and market conditions that it is infeasible to cover even a small sample of these scenarios in this bulletin. However, the Crop Profitability Analysis (CPA) program developed by Oregon State University, Washington State University, and the University of California at Davis, is a Windows based program designed to help agricultural producers in making long-run cropping decisions. CPA is designed to use data from annual budgets as

input and generate financial analyses of the potential economic performance of perennial crops such as tree fruit, nut, berry and wine grapes under numerous different long-run scenarios. The CPA program can be obtained free of charge by going on the Internet at <http://oregonstate.edu/oain> click on the [Ag Tools for Managing Risk](#) and download it along with the companion Budget Editor program. Both programs are fully documented. In addition, the data from this publication for the establishment and production of medium-density apples can also be downloaded by clicking on [Oregon](#) under “Ready-to-use budget files for CPA and ECL,” and then clicking on [Apple Budgets](#). All assumptions as to prices received, yields obtained, or input items, amounts, and costs can be readily changed using Budget Editor and CPA to modify the budgets provided so the user can develop a set of annual budgets that most fit his/her situation.

CPA generates three reports for each plan analyzed. “Net Returns and Present Value by Year” gives the net returns and net present value by year and the total net returns and total net present value for each plan along with the annual equivalent. “Accumulated Net Returns” shows the annual returns, annual cost, net returns, and accumulated net returns for each plan. It calculates the number of years the returns are greater than costs, the year returns are greater than total costs of previous years, and the total cash costs to establish. “Net Present Value Profile” calculates the net present value and the annual equivalent at various interest rates for the base plan and the comparison plan. It also calculates the beginning and ending investment values and the internal

rate of return for each plan. CPA also graphs the net returns by year, accumulated net returns by year, the net present value at varying discount rates, and the annual equivalent at varying discount rates.

It is recommended by the authors that before investing in any long-run perennial

crop, that the potential investor use the CPA program to fully analyze the potential investment under varying price and yield scenarios to help decided if the potential investment is likely to be economical feasible to or not.

APPENDIX A

Enterprise Budgets for a Medium-Density Apple Orchard in Hood River County

Table 7. Year 0, medium-density apple establishment, \$/acre economic costs and returns.

VARIABLE CASH COSTS	Description	Labor	Machinery	Materials	Total
Remove trees, roots and rip (2x)	2.0 custom	\$0.00	\$0.00	\$1,200.00	\$1,200.00
Disc	2.0 applications	20.00	14.76	0.00	34.76
Soil Sample	1.0 x/acre	0.00	0.00	43.65	43.65
Fumigation	1.0 custom	0.00	0.00	605.00	605.00
Fertilizer	1.0 application	3.93	6.15	40.00	50.08
Lime	1.0 custom	0.00	0.00	25.00	25.00
Pickup, truck & ATV	1.0 x/acre	0.00	151.65	0.00	151.65
Housing facilities	1.0 x/acre	0.00	0.00	43.21	43.21
Miscellaneous and overhead	1.0 x/acre	0.00	0.00	75.00	75.00
Interest: operating capital	6.0 months	<u>0.00</u>	<u>0.00</u>	<u>47.35</u>	<u>47.35</u>
Total variable costs		23.93	172.57	2,079.21	2,275.71
FIXED CASH COSTS				Unit	Total
Pickup, truck & ATV insurance				acre	26.53
Water assessment				acre	35.00
Property insurance				acre	25.00
Property taxes				acre	<u>30.00</u>
Total fixed cash costs					116.53
FIXED NON-CASH COSTS				Unit	Total
Machinery and equipment insurance, depreciation & interest				acre	8.50
Pickup, truck & ATV - depreciation & interest				acre	74.95
Foreman housing				acre	102.86
Housing facilities				acre	41.90
Land interest charge				acre	<u>480.00</u>
Total fixed non-cash costs					708.21
Total fixed costs					824.75
Total of all costs per acre					\$3,100.46

Table 8. Year 1, medium-density apple establishment, \$/acre economic costs and returns.

VARIABLE CASH COSTS	Description	Labor	Machinery	Materials	Total	
Plant trees	40.0 hours	\$980.00	\$777.30	\$3,766.50	\$5,523.80	
Painting trees	12.0 hours	138.00	0.00	30.00	168.00	
Training trees	10.0 hours	115.00	0.00	0.00	115.00	
Fertilizer application	1.0 applications	3.93	6.15	40.00	50.08	
Insecticides and fungicides	4.0 applications	33.00	79.92	275.00	387.91	
Herbicide strip maintenance (.30x)	3.0 applications	18.85	28.77	50.00	97.63	
Seed cover crop	20.0 lbs	16.25	15.68	30.00	61.93	
Flailing/mowing orchard floor	5.0 times	24.26	48.22	0.00	72.48	
Rodent control	1.0 application	4.12	6.32	20.00	30.45	
Irrigation	3.5 hours	40.25	20.00	0.00	60.25	
Pickup, truck & ATV	1.0 x/acre	0.00	151.65	0.00	151.65	
Housing facilities	1.0 x/acre	0.00	0.00	43.21	43.21	
Miscellaneous and overhead	1.0 x/acre	0.00	0.00	75.00	75.00	
Interest: operating capital	6.0 months	<u>0.00</u>	<u>0.00</u>	<u>145.29</u>	<u>145.29</u>	
Total variable costs		1,373.67	1,134.02	4,475.00	6,982.69	
FIXED CASH COSTS					Unit	Total
Pickup, truck & ATV insurance				acre	26.53	
Water assessment				acre	35.00	
Property insurance				acre	25.00	
Property taxes				acre	<u>30.00</u>	
Total fixed cash costs					116.53	
FIXED NON-CASH COSTS					Unit	Total
Machinery and equipment insurance, depreciation & interest				acre	676.70	
Pickup, truck & ATV - depreciation & interest				acre	74.95	
Foreman housing				acre	102.86	
Housing facilities				acre	41.90	
Land interest charge				acre	480.00	
Prior year's establishment costs - Interest				acre	<u>310.05</u>	
Total fixed non-cash costs					1,686.46	
Total fixed costs					1,803.00	
Total of all costs per acre					\$8,785.68	

Table 9. Year 2, medium-density apple establishment, \$/acre economic costs and returns.

VARIABLE CASH COSTS	Description	Labor	Machinery	Materials	Total
Pruning and training	15.0 hours	\$172.50	\$0.00	\$0.00	\$172.50
Tree removal & tree replacement	1.0 hours	24.50	19.72	13.50	57.72
Fertilizer & lime application	2.0 applications	7.86	12.31	85.00	105.16
Herbicide strip maintenance (.30x)	3.0 applications	18.85	28.77	50.00	97.63
Insecticides and fungicides	6.0 applications	49.49	119.88	325.00	494.37
Flailing/mowing orchard floor	5.0 times	24.26	48.22	0.00	72.48
Rodent control	1.0 hours	4.12	6.32	20.00	30.45
Irrigation	3.5 hours	40.25	20.00	0.00	60.25
Ladders & pruning equip.	1.0 x/acre	0.00	11.60	0.00	11.60
Pickup, truck & ATV	1.0 x/acre	0.00	151.65	0.00	151.65
Housing facilities	1.0 x/acre	0.00	0.00	43.21	43.21
Miscellaneous and overhead	1.0 x/acre	0.00	0.00	75.00	75.00
Interest: operating capital	6.0 months	<u>0.00</u>	<u>0.00</u>	<u>29.16</u>	<u>29.16</u>
Total variable costs		341.84	418.47	640.87	1,401.18
FIXED CASH COSTS				Unit	Total
Pickup, truck & ATV insurance				acre	26.53
Water assessment				acre	35.00
Property insurance				acre	25.00
Property taxes				acre	<u>30.00</u>
Total fixed cash costs					116.53
FIXED NON-CASH COSTS				Unit	Total
Machinery and equipment insurance, depreciation & interest				acre	360.63
Pickup, truck & ATV - depreciation & interest				acre	74.95
Foreman housing				acre	102.86
Housing facilities				acre	41.90
Land interest charge				acre	480.00
Prior year's establishment costs - Interest				acre	<u>1,188.61</u>
Total fixed non-cash costs					2,248.97
Total fixed costs					2,365.50
Total of all costs per acre					\$3,766.68

Table 10. Year 3, medium-density apple establishment, \$/acre economic costs and returns.

GROSS INCOME		Quantity	Unit	\$/Unit	Total	Price/bin	
Apples		15.00	bins	150.00	<u>2,250.00</u>	<u>150.00</u>	
Total gross income					2,250.00	150.00	
VARIABLE CASH COSTS		Description	Labor	Machinery	Materials	Total	Cost/bin
Pruning and training	22.0	hours	\$253.00	\$0.00	\$0.00	\$253.00	\$16.87
Thinning	20.0	hours	230.00	0.00	0.00	230.00	15.33
Tree removal & tree replacement	1.0	hours	24.50	19.72	13.50	57.72	3.85
Raking and shredding brush	1.0	x/acre	14.56	24.50	0.00	39.06	2.60
Fertilizer and lime - custom applied	1.0	applications	3.93	6.15	85.00	95.08	6.34
Herbicide strip maintenance (.30x)	2.0	applications	12.57	19.18	50.00	81.75	5.45
Insecticides and fungicides	8.0	applications	65.99	159.83	375.00	600.83	40.06
Pheromone disruption (1/2 rate)	1.0	hours	11.50	0.00	100.00	111.50	7.43
Production mgmt consultant fees	1.0	x/acre	0.00	0.00	30.00	30.00	2.00
Bee rental	2.0	hives	0.00	0.00	72.00	72.00	4.80
Flailing/mowing orchard floor	5.0	times	24.26	48.22	0.00	72.48	4.83
Rodent control	1.0	hours	4.12	6.32	20.00	30.45	2.03
Frost protection	1.0	hour	11.50	35.37	0.00	46.87	3.12
Irrigation	3.5	hours	40.25	20.00	0.00	60.25	4.02
Ladders, pruning, & picking equip.	1.0	x/acre	0.00	12.89	0.00	12.89	0.86
Harvesting costs	15.0	bins	429.38	40.50	0.00	469.88	31.33
General labor	11.3	hours					
Pickup, truck & ATV	1.0	x/acre	0.00	151.65	0.00	151.65	10.11
Housing facilities	1.0	x/acre	0.00	0.00	43.21	43.21	2.88
Miscellaneous and overhead	1.0	x/acre	0.00	0.00	75.00	75.00	5.00
Interest: operating capital	6.0	months	<u>0.00</u>	<u>0.00</u>	<u>53.84</u>	<u>53.84</u>	<u>3.59</u>
Total variable costs			1,125.56	544.35	917.55	2,587.45	172.50
FIXED CASH COSTS				Unit	Total	Cost/bin	
Pickup, truck & ATV insurance				acre	26.53	1.77	
Water assessment				acre	35.00	2.33	
Property insurance				acre	25.00	1.67	
Property taxes				acre	<u>30.00</u>	<u>2.00</u>	
Total fixed cash costs					116.53	7.77	
FIXED NON-CASH COSTS				Unit	Total	Cost/bin	
Machinery and equipment insurance, depreciation & interest				acre	480.56	32.04	
Pickup, truck & ATV - depreciation & interest				acre	74.95	5.00	
Foreman housing				acre	102.86	6.86	
Housing facilities				acre	41.90	2.79	
Land interest charge				acre	480.00	32.00	
Prior year's establishment costs - Interest				acre	<u>1,565.28</u>	<u>104.35</u>	
Total fixed non-cash costs					2,745.56	183.04	
Total fixed costs					2,862.10	190.81	
Total of all costs per acre					\$5,449.55	\$363.30	
Net projected returns					-\$3,199.55	-\$213.30	

Table 11. Year 4, medium-density apple establishment, \$/acre economic costs and returns.

GROSS INCOME						
		Quantity	Unit	\$/Unit	Total	Price/bin
Apples		25.00	bins	150.00	<u>3,750.00</u>	<u>150.00</u>
Total gross income					3,750.00	150.00
VARIABLE CASH COSTS						
	Description	Labor	Machinery	Materials	Total	Cost/bin
Pruning and training	33.0 hours	\$379.50	\$0.00	\$0.00	\$379.50	\$15.18
Thinning	30.0 hours	345.00	0.00	0.00	345.00	13.80
Tree removal & tree replacement	1.0 hours	24.50	19.72	13.50	57.72	2.31
Raking and shredding brush	1.0 x/acre	14.56	24.50	0.00	39.06	1.56
Fertilizer & lime application	1.0 applications	3.93	6.15	85.00	95.08	3.80
Herbicide strip maintenance (.30x)	2.0 applications	12.57	19.18	50.00	81.75	3.27
Insecticides and fungicides	10.0 applications	82.49	199.79	425.00	707.28	28.29
Pheromone disruption (1/2 rate)	1.0 hours	11.50	0.00	100.00	111.50	4.46
Production mgmt consultant fees	1.0 x/acre	0.00	0.00	30.00	30.00	1.20
Bee rental	2.0 hives	0.00	0.00	72.00	72.00	2.88
Flailing/mowing orchard floor	5.0 times	24.26	48.22	0.00	72.48	2.90
Rodent control	1.0 hours	4.12	6.32	20.00	30.45	1.22
Frost protection	1.0 hour	11.50	35.37	0.00	46.87	1.87
Irrigation	3.5 hours	40.25	20.00	0.00	60.25	2.41
Ladders, pruning, & picking equip.	1.0 x/acre	0.00	12.89	0.00	12.89	0.52
Harvesting costs	25.0 bins	715.63	40.50	0.00	756.13	30.25
General labor	18.8 hours					
Pickup, truck & ATV	1.0 x/acre	0.00	151.65	0.00	151.65	6.07
Housing facilities	1.0 x/acre	0.00	0.00	43.21	43.21	1.73
Miscellaneous and overhead	1.0 x/acre	0.00	0.00	75.00	75.00	3.00
Interest: operating capital	6.0 months	<u>0.00</u>	<u>0.00</u>	<u>67.32</u>	<u>67.32</u>	<u>2.69</u>
Total variable costs		1,669.81	584.30	981.03	3,235.14	129.41
FIXED CASH COSTS				Unit	Total	Cost/bin
Pickup, truck & ATV insurance				acre	26.53	1.06
Water assessment				acre	35.00	1.40
Property insurance				acre	25.00	1.00
Property taxes				acre	<u>30.00</u>	<u>1.20</u>
Total fixed cash costs					116.53	4.66
FIXED NON-CASH COSTS				Unit	Total	Cost/bin
Machinery and equipment insurance, depreciation & interest				acre	510.43	20.42
Pickup, truck & ATV - depreciation & interest				acre	74.95	3.00
Foreman housing				acre	102.86	4.11
Housing facilities				acre	41.90	1.68
Land interest charge				acre	480.00	19.20
Prior year's establishment costs - Interest				acre	<u>1,885.24</u>	<u>75.41</u>
Total fixed non-cash costs					3,095.38	123.82
Total fixed costs					3,211.92	128.48
Total of all costs per acre					\$6,447.05	\$257.88
Net projected returns					-\$2,697.05	-\$107.88

Table 12. Year 5, medium-density apple establishment, \$/acre economic costs and returns.

GROSS INCOME						
		Quantity	Unit	\$/Unit	Total	Price/bin
Apples		40.00	bins	150.00	<u>6,000.00</u>	<u>150.00</u>
Total gross income					6,000.00	150.00
VARIABLE CASH COSTS						
	Description	Labor	Machinery	Materials	Total	Cost/bin
Pruning and training	55.0 hours	\$632.50	\$0.00	\$0.00	\$632.50	\$15.81
Thinning	40.0 hours	460.00	0.00	0.00	460.00	11.50
Tree removal & tree replacement	1.0 hours	24.50	19.72	13.50	57.72	1.44
Raking and shredding brush	1.0 x/acre	14.56	24.50	0.00	39.06	0.98
Fertilizer & lime application	1.0 applications	3.93	6.15	85.00	95.08	2.38
Herbicide strip maintenance (.30x)	2.0 applications	12.57	19.18	50.00	81.75	2.04
Insecticides and fungicides	12.0 applications	98.99	239.75	475.00	813.74	20.34
Pheromone disruption (1/2 rate)	1.0 hours	11.50	0.00	100.00	111.50	2.79
Production mgmt consultant fees	1.0 x/acre	0.00	0.00	30.00	30.00	0.75
Bee rental	2.0 hives	0.00	0.00	72.00	72.00	1.80
Flailing/mowing orchard floor	5.0 times	24.26	48.22	0.00	72.48	1.81
Rodent control	1.0 hours	4.12	6.32	20.00	30.45	0.76
Frost protection	1.0 hour	11.50	35.37	0.00	46.87	1.17
Irrigation	3.5 hours	40.25	20.00	0.00	60.25	1.51
Ladders, pruning, & picking equip.	1.0 x/acre	0.00	12.89	0.00	12.89	0.32
Harvesting costs	40.0 bins	1,145.00	40.50	0.00	1,185.50	29.64
General labor	30.0 hours					
Pickup, truck & ATV	1.0 x/acre	0.00	151.65	0.00	151.65	3.79
Housing facilities	1.0 x/acre	0.00	0.00	43.21	43.21	1.08
Miscellaneous and overhead	1.0 x/acre	0.00	0.00	75.00	75.00	1.88
Interest: operating capital	6.0 months	<u>0.00</u>	<u>0.00</u>	<u>86.52</u>	<u>86.52</u>	<u>2.16</u>
Total variable costs		2,483.68	624.26	1,050.23	4,158.18	103.95
FIXED CASH COSTS				Unit	Total	Cost/bin
Pickup, truck & ATV insurance				acre	26.53	0.66
Water assessment				acre	35.00	0.88
Property insurance				acre	25.00	0.63
Property taxes				acre	<u>30.00</u>	<u>0.75</u>
Total fixed cash costs					116.53	2.91
FIXED NON-CASH COSTS				Unit	Total	Cost/bin
Machinery and equipment insurance, depreciation & interest				acre	540.29	13.51
Pickup, truck & ATV - depreciation & interest				acre	74.95	1.87
Foreman housing				acre	102.86	2.57
Housing facilities				acre	41.90	1.05
Land interest charge				acre	480.00	12.00
Prior year's establishment costs - Interest				acre	<u>2,154.94</u>	<u>53.87</u>
Total fixed non-cash costs					3,394.95	84.87
Total fixed costs					3,511.49	87.79
Total of all costs per acre					\$7,669.66	\$191.74
Net projected returns					-\$1,669.66	-\$41.74

Table 13. Full production, medium-density apple establishment, \$/acre economic costs and returns.

GROSS INCOME						
	Quantity	Unit	\$/Unit	Total	Price/bin	
Apples	50.00	bins	150.00	<u>7,500.00</u>	<u>150.00</u>	
Total gross income				7,500.00	150.00	
VARIABLE CASH COSTS						
	Description	Labor	Machinery	Materials	Total	Cost/bin
Pruning and training	55.0 hours	\$632.50	\$0.00	\$0.00	\$632.50	\$12.65
Thinning	55.0 hours	632.50	0.00	0.00	632.50	12.65
Tree removal & tree replacement	1.0 hours	24.50	19.72	13.50	57.72	1.15
Raking and shredding brush	1.0 x/acre	14.56	24.50	0.00	39.06	0.78
Fertilizer and lime - custom applied	1.0 applications	3.93	6.15	85.00	95.08	1.90
Herbicide strip maintenance (.30x)	2.0 applications	12.57	19.18	50.00	81.75	1.64
Insecticides and fungicides	15.0 applications	123.74	299.69	575.00	998.43	19.97
Pheromone disruption (1/2 rate)	1.0 hours	11.50	0.00	100.00	111.50	2.23
Production mgmt consultant fees	1.0 x/acre	0.00	0.00	30.00	30.00	0.60
Bee rental	2.0 hives	0.00	0.00	72.00	72.00	1.44
Flailing/mowing orchard floor	5.0 times	24.26	48.22	0.00	72.48	1.45
Rodent control	1.0 hours	4.12	6.32	20.00	30.45	0.61
Frost protection	1.0 hour	11.50	35.37	0.00	46.87	0.94
Irrigation	3.5 hours	40.25	20.00	0.00	60.25	1.21
Ladders, pruning, & picking equip.	1.0 x/acre	0.00	12.89	0.00	12.89	0.26
Harvesting costs	50.0 bins	1,431.25	40.50	0.00	1,471.75	29.44
General labor	37.5 hours					
Pickup, truck & ATV	1.0 x/acre	0.00	151.65	0.00	151.65	3.03
Housing facilities	1.0 x/acre	0.00	0.00	43.21	43.21	0.86
Miscellaneous and overhead	1.0 x/acre	0.00	0.00	75.00	75.00	1.50
Interest: operating capital	6.0 months	<u>0.00</u>	<u>0.00</u>	<u>100.20</u>	<u>100.20</u>	<u>2.00</u>
Total variable costs		2,967.18	684.20	1,163.91	4,815.28	96.31
FIXED CASH COSTS				Unit	Total	Cost/bin
Pickup, truck & ATV insurance				acre	26.53	0.53
Water assessment				acre	35.00	0.70
Property insurance				acre	25.00	0.50
Property taxes				acre	<u>30.00</u>	<u>0.60</u>
Total fixed cash costs					116.53	2.33
FIXED NON-CASH COSTS				Unit	Total	Cost/bin
Machinery and equipment insurance, depreciation & interest				acre	585.09	11.70
Pickup, truck & ATV - depreciation & interest				acre	74.95	1.50
Foreman housing				acre	102.86	2.06
Housing facilities				acre	41.90	0.84
Land interest charge				acre	680.00	13.60
Amortized establishment costs				acre	<u>2,558.00</u>	<u>51.16</u>
Total fixed non-cash costs					4,042.81	80.86
Total fixed costs					4,159.35	83.19
Total of all costs per acre					\$8,974.63	\$179.49
Net projected returns					-\$1,474.63	-\$29.49