A.E. Ext. 81-26

November 1981

AN ANALYSIS OF APPLE ORCHARD REPLANTING COSTS AND POTENTIAL PROFITABILITY

W.D. Gerling

Department of Agricultural Economics
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York 14853

ACKNOWLEDGMENTS

I wish to acknowledge and thank Dr. C. G. Forshey, Dr. Richard Weires, Dr. David Rosenberger and Warren Smith, all of the Hudson Valley Laboratory, for the help with the technical material.

Within the Department of Agricultural Economics, I wish to acknowledge and thank those who provided valuable assistance with the economic analysis - Dr. Jerry White, Dr. George Casler, Dr. Robert Milligan and Dr. Wayne Knoblauch. Partial support for this research report was provided by the Cohn Foundation.

TABLE OF CONTENTS

An Analysis of Apple Orchard Replanting Costs and Potential Profitability

W. D. Gerling*

INTRODUCTION

In recent years many apple growers in Eastern New York have planted new orchards. Some have been planted on sites where orchards were recently removed, others have been planted on sites which have not been orchards for some time. While this planting and replanting has been extensive, there remain a large number of orchards with trees 30 years of age or older. Among the major concerns facing growers are when to replant these orchards, what are the replanting costs, and does the potential profitability of these plantings justify the cost? This publication provides answers to these questions. The tables within this publication were designed to encourage individual growers to make those changes needed to more closely represent their individual situations.

METHODOLOGY AND DATA SOURCES

All the costs were calculated on a per acre basis. The budgets were constructed using practices representative of Eastern New York. Costs and receipts were based on representative prices in Eastern New York in 1980. Data kept by five growers on plantings started in 1974 and 1975 provided valuable information on grower practices and costs. Additional information was collected as part of the yearly Survey of Growing and Harvesting Costs in Eastern New York done by the author, and as a part of an orchard yield and packout study for which data has been collected for several years.

The land to be planted is specified to be presently orchard and the existing trees must be removed. An allowance was made for the cost of minor site improvement (Table 1). However, no drainage costs, such as tile drains or diversion ditches, were included. Growers will need to add the cost associated with major site reshaping, large drainage programs and irrigation to the costs included in this publication when such costs are expected.

---

* Regional Extension Specialist, Hudson Valley Laboratory, Box 727, Highland, NY 12528.

Table 1. Site Preparation Cost for One Acre of Apples.

Activity	Labor hours	Equipment hours	Labor[2] cost	Equipment[3] cost	Material cost	Other cost	Total
Bulldoze old trees[1]		5.0		$300.00			$300.00
Lime (3 Ton)					90.00		90.00
Plow	1.5	1.5	$ 9.00	17.40			26.40
Disc	3.5	3.5	21.00	43.23			64.23
Pick stone + roots	6.0	2.0	36.00	23.20			59.20
R.E. tax[4]						$ 20.00	20.00
Management[4]						85.00	85.00
Total	11.0	12.0	$66.00	$383.83	$90.00	$105.00	$644.83

The trees are planted on a 14 x 20 foot spacing using 155 trees per acre. This density is representative of what many growers are using with M7A, MM106, or MMIII rootstocks. The varieties planted with this system include Empire, Red Delicious, McIntosh, Tydeman, Jonamac, Rome Beauty and several others. Planting is done with a tree planter. If a tractor and PTO auger are used the hours of labor and equipment cost would be considerably greater. In addition, a greater amount of labor would be needed for orchard layout.

The trees are trained to a central leader using spreaders and summer pruning. All fruit is removed in the first three years with light crops being allowed starting in the fourth year. At maturity the trees will fill the space within the row and will be maintained at a height of 12 to 14 feet. A herbicide strip is used to control weeds within the row throughout the life of the planting. More detailed information on practices included in the publication may be found in Forshey (1980) and Forshey (1976).

Table 1 details the cost associated with clearing the old trees and working the site. The costs within the table are representative of 1980 input prices in Eastern New York and are calculated on a per acre basis. Site preparation costs are $644.82.

Tables 2 through 6 illustrate the annual costs associated with the orchard establishment period. These tables include the cost of planting the orchard as well as all those costs associated with the care and early development of the trees on a year by year basis. Table 7 represents the cost associated with year six and after. At this point an orchard is beginning to yield a significant amount of apples and is normally treated the same as older orchards with respect to cultural practices. The biggest change is that the insect and disease control program is more intensive.

Growers who feel that their costs are significantly different than those found in Tables 1-7 are encouraged to prepare similar tables for their operations, substituting their own cost for those they feel are too high or too low.

Table 2. Year One Planting and Growing Cost for One Acre of Apples.

Activity	Labor hours	Equipment hours	Labor[2] cost	Equipment[3] cost	Material cost	Other cost	Total
Layout	3.0	1.0	$ 18.00	$ 6.25			$ 24.25
Plant[5]	12.5	2.5	75.00	42.13	$620.00		737.13
Water trees	2.0	1.0	12.00	5.75			17.75
Disc	1.0	1.0	6.00	12.35			18.35
Harrow	3.0	3.0	18.00	21.30			39.30
Prune + train[6]	3.0		18.00				18.00
Pick stone	6.0	2.0	36.00	23.20			59.20
Mouse guards[7]	13.0	1.5	78.00	9.38	116.25		203.63
Insect + disease[8] Control	1.3	1.3	7.80	25.42	29.90		63.12
Hand weed	2.5		15.00				15.00
Grass seed[9]	.3	.3	1.80	2.13	40.20		44.13
Cultipack	.3	.3	1.80	2.07			3.87
Mouse bait[10]	.3	.3	1.80	2.13	4.00		7.93
Fertilize[11]	.5	.5	3.00	3.55	15.89		22.44
R.E. tax[4]						$ 20.00	20.00
Management[4]						85.00	85.00
Total	48.7	14.7	$292.20	$155.66	$826.24	$105.00	$1379.10

Table 3. Year Two Growing Cost for One Acre of Apples.

Activity	Labor hours	Equipment hours	Labor[2] cost	Equipment[3] cost	Material cost	Other cost	Total
Prune[6]	4.0		$ 24.00		$ 27.90		$ 51.90
Tree replacement	1.0	1.0	6.00	$ 5.65	20.00		31.65
Herbicide spray[12]	.8	.8	4.80	6.96	19.71		31.47
Insect + disease control[8]	1.8	1.8	10.80	35.19	43.68		89.67
Mow (3X)	2.4	2.4	14.40	21.84			36.24
Hand thin + train[13]	4.0		24.00				24.00
Hand weed + grub	2.5		15.00				15.00
Mouse control[10]	.3	.3	1.80	2.13	4.00		7.93
Fertilizer[11]	.5	.5	3.00	3.55	23.83		30.38
R.E. tax[4]						$ 20.00	20.00
Management[4]						85.00	85.00
Total	17.3	6.8	$103.80	$75.32	$139.12	$105.00	$403.24

Table 4. Year Three Growing Cost for One Acre of Apples.

Activity	Labor hours	Equipment hours	Labor[2] cost	Equipment[3] cost	Material cost	Other cost	Total
Prune[6]	5.0		$ 30.00		$ 13.95		$ 43.95
Tree replacement	.5	.5	3.00	$ 2.83	8.00		13.83
Herbicide spray[12]	.8	.8	4.80	6.96	19.71		31.47
Insect + disease control[8]	1.8	1.8	10.80	35.19	43.68		89.67
Mow (3X)	2.4	2.4	14.40	21.84			36.24
Hand thin + train[13]	5.0		30.00				30.00
Mouse control[10]	.3		1.80	2.13	4.00		7.93
Hand weed + Grub[11]	2.5		15.00				15.00
Fertilizer	.5	.5	3.00	3.55	31.78		38.33
Lime (2 tons)					60.00		60.00
R.E. tax[4]						$ 20.00	20.00
Management[4]						85.00	85.00
Total	18.8	6.3	$112.80	$72.50	$181.12	$105.00	$471.42

Table 5. Year Four Growing Cost for One Acre of Apples.

Activity	Labor hours	Equipment hours	Labor[2] cost	Equipment[3] cost	Material cost	Other cost	Total
Prune[6]	8.0	3.0	$ 48.00	$ 18.75			$ 66.75
Herbicide spray[12]	.8	.8	4.80	6.96	$ 19.71		31.47
Insect + disease control[8]	2.7	2.7	16.20	52.79	154.62		223.61
Mow (4X)	3.2	3.2	19.20	29.12			48.32
Hand thin + train[13]	3.0	1.0	18.00	6.25			24.25
Mouse control[10]	.3	.3	1.80	2.13	4.00		7.93
Hand weed + grub[11]	2.5		15.00				15.00
Fertilizer	.5	.5	3.00	3.55	39.77		46.32
R.E. tax[4]						$ 20.00	20.00
Management[4]						85.00	85.00
Total	21.0	11.5	$126.00	$119.55	$218.10	$105.00	$568.65

Table 6. Year Five Growing Cost for One Acre of Apples.

Activity	Labor hours	Equipment hours	Labor[2] cost	Equipment[3] cost	Material cost	Other cost	Total
Prune[6]	9.0	3.0	$ 54.00	$ 18.75			$ 72.75
Brush removal	3.0	1.0	18.00	12.44			30.44
Insect + disease control[8]	2.7	2.7	16.20	52.79	$154.62		223.61
Herbicide spray[12]	.8	.8	4.80	6.96	19.71		31.47
Mow (4X)	3.2	3.2	19.20	29.12			48.32
Mouse control[10]	.3	.3	1.80	2.13	4.00		7.93
Hand weed, thin, etc.	4.0	1.0	24.00	6.25			30.25
Fertilizer[11]	.5	.5	3.00	3.55	47.66		54.21
Bee rental[14]					8.33		8.33
R.E. tax[4]						$ 20.00	20.00
Management[4]						85.00	85.00
Total	23.5	12.5	$141.00	$131.99	$234.32	$105.00	$612.31

Table 7. Year Six and beyond Growing Cost for One Acre of Apples.

Activity	Labor hours	Equipment hours	Labor[2] cost	Equipment[3] cost	Material cost	Other cost	Total
Prune[6]	12.0	3.0	$ 72.00	$ 18.75			$ 90.75
Brush removal	3.0	1.0	18.00	12.44			30.44
Herbicide spray[12]	.8	.8	4.80	6.96	$ 19.71		31.47
Insect + disease control[8]	2.7	2.7	16.20	52.79	171.38		240.37
Mow (4X)	3.2	3.2	19.20	29.12			48.32
Mouse control[10]	.3	.3	1.80	2.13	4.00		7.93
Fertilizer[11]	.5	.5	3.00	3.55	20.35		26.90
Bee rental[14]					8.33		8.33
Lime (.67 ton)[15]					20.10		20.10
Misc. hand work	3.0	1.0	18.00	6.25			24.25
R.E. tax[4]						$ 20.00	20.00
Management[4]						85.00	85.00
Total	25.5	12.5	$153.00	$131.99	$243.87	$105.00	$633.86

ESTABLISHMENT COST

Table 8 illustrates the costs associated the establishment period. These costs, taken from Tables 1-6, total $4079.55. However, this does not truly represent the cost of planting an acre. These costs fail to recognize the cost of having capital tied up for an extended period. If a grower relies on borrowed capital to do the replanting, this cost is easily recognized and accounted for. However, even if a grower is using his own capital this cost exists. If the grower did not have his capital invested in the new planting, it would be available for use elsewhere in the business or for outside investments. This loss or delay of earning potential must be recognized as a cost of the new planting. This cost is often referred to as the opportunity cost. The interest rate used for the opportunity cost should reflect the alternative uses of money adjusted for inflation and risk. In this publication, a real rate of interest is used. To calculate this rate, the following computation is made:

$$\text{real rate of interest} = \frac{1 + \text{interest rate}}{1 + \text{inflation rate}} - 1.$$

For a 14 percent nominal rate of interest and a 9 percent rate of inflation:

$$\text{real rate of interest} = \frac{1.14}{1.09} - 1$$

$$\text{real rate} = .046 \cong .05.$$

Thus the real rate of interest is 5 percent. To that is added a risk premium, which may vary by grower, but is assumed to be 5 percent in this publication. Therefore, the interest rate used for discounting is the real rate of interest plus a risk premium, or 10 percent.

Table 8. Establishment Cost

Year	Cost
Site preparation	$ 644.83
Year 1	1379.10
Year 2	403.24
Year 3	471.42
Year 4	568.65
Year 5	612.31
Total	$4079.55

Using this 10% rate to calculate the opportunity cost, the total cost through year five is $6174.16 (Table 9).

Table 9. Development Cost Including Interest.

Year	Growing Cost	Interest[17]	Annual Total	Accumulated Total
Site preparation	$ 644.83	$ 100.00	$ 744.83	$ 744.83
Year 1	1379.10	174.48	1553.58	2298.41
Year 2	403.24	329.84	733.08	3031.49
Year 3	471.42	403.15	874.57	3906.06
Year 4	568.65	490.61	1059.26	4965.32
Year 5	612.31	596.53	1208.84	6174.16
Total	$4079.55	$2094.61	$6174.16	

POTENTIAL PROFITABILITY

The potential profitability of a new planting depends on many factors, ranging from the care that it receives, which is primarily a management factor, to the weather conditions that prevail throughout its life and the market conditions that exist for the industry. A relatively minor change in any of these can have a great impact on profitability.

Two methods of evaluating the potential profit of the new planting are illustrated in this publication. The first is the method most growers presently use. It considers the years until the orchard covers yearly costs, the years until the investment is recovered and the total projected profit that might be expected over the planning period. The second method is one that considers the value of money over time, called a discounted cash flow analysis.

Traditional Grower Method of Evaluating Profitability

Table 10 illustrates the method of evaluating the potential profitability of a new planting that most growers have traditionally used. It considers the potential cash receipts, growing and harvesting expenses, and an interest charge on the money invested to arrive at an annual profit and accumulated profit. In this budget a price of $4.50 per bushel and a mature yield of 1,000 bushels are used to calculate the cash receipts. The price represents the value of the fruit on a tree run basis out of the orchard at harvest time. Annual growing costs are taken from the budgets included in Tables 1-7. Harvesting cost is included at the rate of $1.25 per bushel harvested. This charge includes the cost of bins, equipment, housing for the pickers, supervisory labor, fruit hauling within the orchard as well as the cost of the pickers' labor. The interest charge is calculated at the

Table 10. Potential Profit from 1000 Bushel Per Acre Average Mature Yield and a Price of $4.50 per Bushel.

Year	Yield/ acre	Gross income at $4.50/bu.	Annual growing cost	Harvesting[16] cost at $1.25/bu.	Interest[17] on investment	Total annual cost	Annual profit	Accumulated profit
Site Preparation	0	0	644.83	0	100.00	744.83	-744.83	-744.83
Year 1	0	0	1379.10	0	174.78	1553.58	-1553.58	-2298.41
2	0	0	403.24	0	329.84	733.08	-733.08	-3031.49
3	0	0	471.42	0	403.15	874.57	-874.57	-3906.06
4	10	45.00	568.65	12.50	490.61	1071.76	-1026.76	-4932.82
5	50	225.00	612.31	62.50	593.28	1268.09	-1043.09	-5975.91
6	150	675.00	633.86	187.50	697.59	1518.95	-843.95	-6819.86
7	300	1350.00	633.86	375.00	781.99	1790.85	-440.85	-7260.71
8	700	3150.00	633.86	875.00	826.07	2334.93	815.07	-6445.64
9	1000	4500.00	633.86	1250.00	744.56	2628.42	1871.58	-4574.06
10	1000	4500.00	633.86	1250.00	557.41	2441.27	2058.73	-2515.33
11	1000	4500.00	633.86	1250.00	351.53	2235.39	2264.61	250.72
12	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	2766.86
13	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	5283.00
14	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	7799.14
15	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	10315.28
16	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	12831.42
17	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	15347.56
18	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	17863.70
19	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	20379.84
20	1000	4500.00	633.86	1250.00	100.00	1983.86	2516.14	22895.98

rate of 10% on the accumulated investment at the beginning of each year plus $100 interest on the value of the land ($1000 per acre at 10%). The third year interest calculation is made as follows: [Accumulated investment at the end of Year 2 x 10%] + the interest on land value = interest change in year three. Thus [$3031.49 x .10] + $100 = $403.15.

Using the specifications of the budget illustrated in Table 10, a grower would have a peak total investment of $7260.71 per acre invested in the orchard. This would occur in year 7. Starting in the eighth year the cash receipts exceed the total expenses so as to produce a net profit for the year. In year 11 the cost of developing the orchard is recovered and the orchard begins to show an accumulated profit. Over the twenty year life of the orchard included in the budget, it returns an accumulated profit of $22,895.98.

The yield potential of the orchard and the price received per bushel are two factors which have a major impact on profitability. To evaluate the impact of yield on the potential profitability of the new orchard, budgets were prepared using a yield of 800 bushels per acre and 600 bushels per acre. These budgets are included in Appendix Table 1 and Appendix Table 2, respectively. Figure 1 illustrates the impact of yield on the potential profitability of the orchard over the twenty years. The price received for apples and the annual growing expenses are constant for all three yield levels. The harvest expense varies with the amount of fruit harvested and the interest varies with the accumulated investment.

It is interesting to note that through the first seven years there is not much difference between the performance of the orchard at the various yield levels. However from the eighth year the difference becomes important. At 800 bushels per acre the orchard does not break even until the thirteenth year and the total accumulated profit is reduced to $12,359.51. At the 600 bushels per acre yield the orchard does not break even at the end of the planning period. While an average mature yield of more than 600 bushels may not seem like a difficult goal, one does not have to look far to find orchard blocks producing 600 bushels of apples or less per acre.

To evaluate the impact of price on the profitability of the planting, budgets were prepared using a price of $4.00 and $3.50 per bushel in addition to the $4.50 already discussed. These budgets are included in Appendix Tables 3-6. Appendix Tables 3 and 4 are based on a mature yield of 1,000 bushels per acre while Appendix Tables 5 and 6 are based on a mature yield of 800 bushels per acre.

The impact of the three price levels on profitability at the 1000 bushel per acre average mature yield is illustrated in Figure 2. As was already discussed at $4.50 per bushel, the planting breaks even in year eleven and has an accumulated profit of $22,895.98 at the end of year 20. At a $4.00 per bushel price the planting does not break even until year 13 and has an accumulated profit of $15,000.03. At a price of $3.50 per bushel the planting does not break even until year 16. The accumulated profit is reduced to $6,815.17. While this graph illustrates the importance of the market conditions on the profits of a new planting, it also illustrates

FIGURE 1. APPLES: ACCUMULATED PROFIT AT THREE DIFFERENT YIELD LEVELS AT $4.50 PER BUSHEL

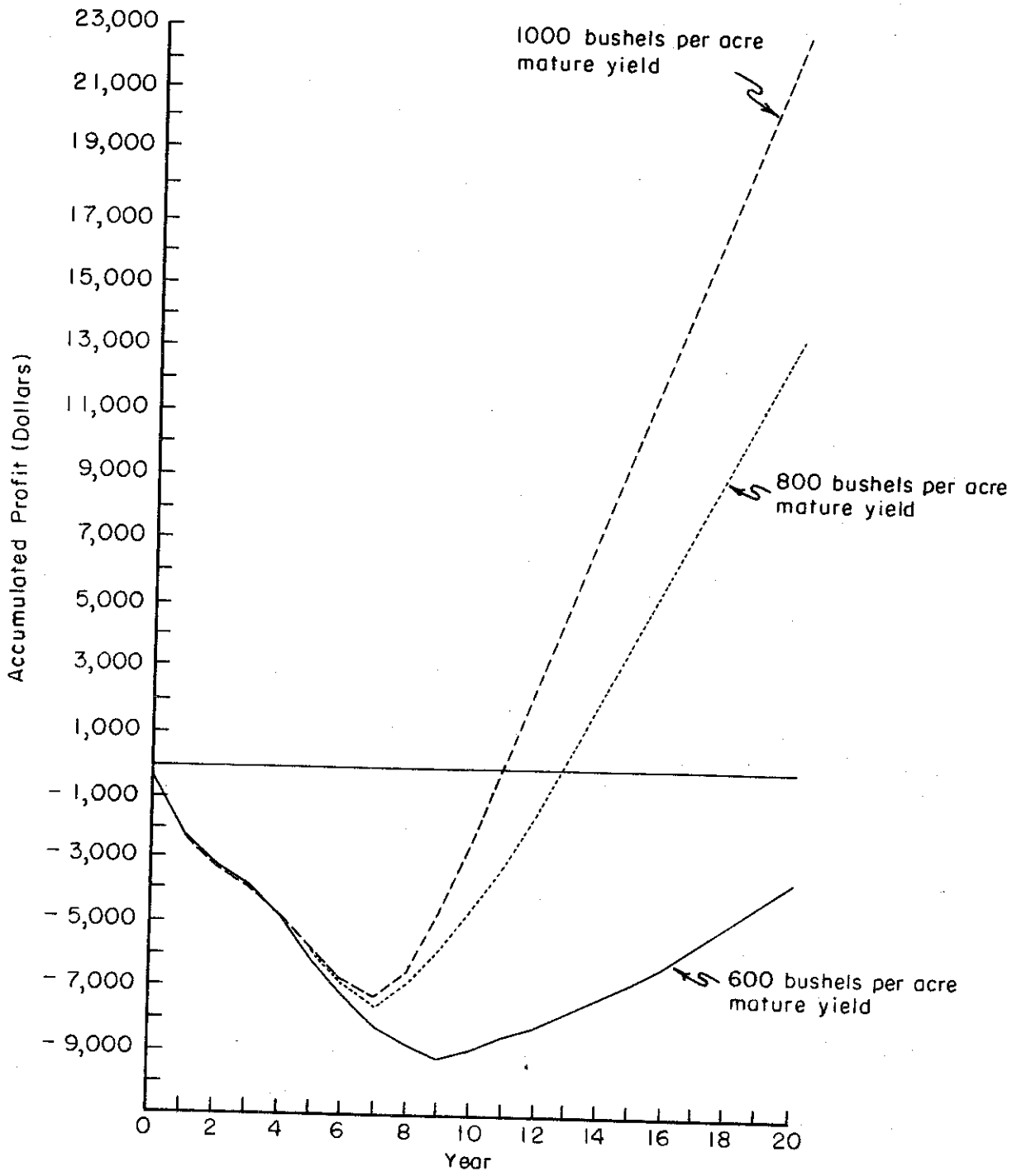
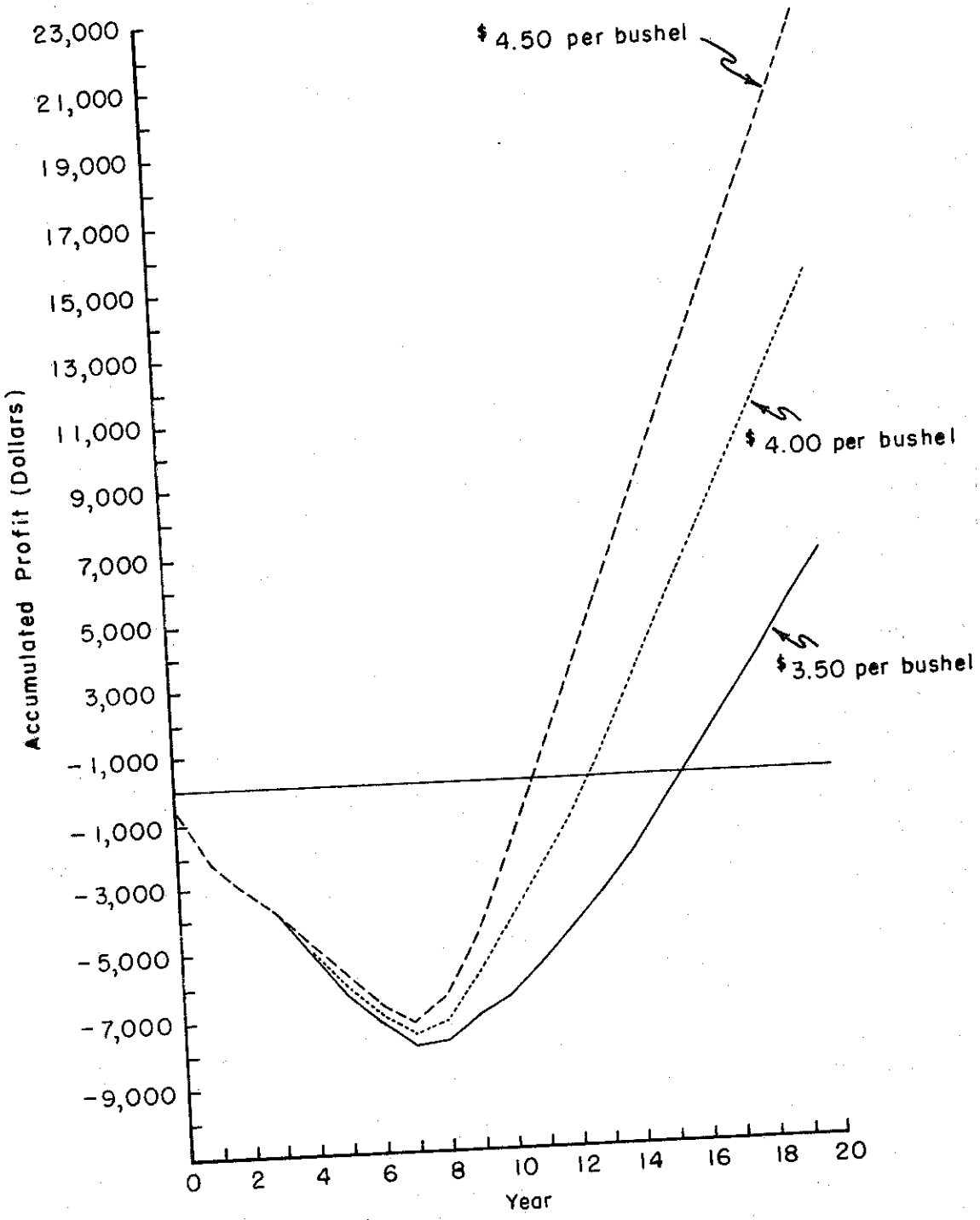


FIGURE 2. APPLES: ACCUMULATED PROFIT AT THREE PRICE LEVELS AT 1000 BUSHEL PER ACRE YIELD



the importance of producing high quality apples. The growers with higher quality fruit are rewarded with a higher average price per bushel of fruit sold under most market conditions.

It is interesting to note that at the $3.50 per bushel price and 800 bushels per acre mature yield the orchard does not break even. The accumulated profit is a negative $2601.50 (Appendix Table 6).

Discounted Cash Flow Analysis

When evaluating the potential profit of an investment, it is important to remember that money received in the future is not worth as much as money received today (Aplin, Casler, and Francis). If you were offered the choice of receiving a $1000 today or receiving the same $1000 one year from now, you would normally choose to have it today. This is because the money has some earning potential itself or potential for making purchases that will add to your enjoyment. If we assume you were to invest the $1000 you received today at 10% interest, it would be worth $1100 one year from today. In other words, assuming a 10% interest rate it should make no difference to you whether you receive $1000 today or $1100 one year from today.

To more accurately evaluate the potential profit of a new planting the future earnings should be corrected to what they are worth in today's dollars. In other words, we need to calculate the present value of the future earnings. The simplest way to do this is to use a present value table (Table 11). We multiply the expected income for a given year by the appropriate discount factor. To calculate the present value of $1000 received five years from now assuming a 10% discount factor, the calculation would be made as follows $100 x .6209 = $620.90. At an interest rate of 10% it should make no difference to you if you received $620.90 today or $1000 five years from now.

The discounted cash flow analysis of the profit potential of the planting with a mature yield of 1000 bushels per acre and a price of $4.50 per bushel is shown in Table 12. Using this method of analysis we no longer have to consider interest on the dollars invested. Using the discount factor and the cash flow approach accomplishes this consideration. Using the discounted cash flow analysis the new planting shows a net annual profit beginning in the seventh year (the net annual profit changes from a negative to positive). It breaks even in year twelve and produces income having a net present value of $5091.32 over the twenty years.

As with the traditional grower method of analyzing the investment, we need to consider the impact of yield and price on the profitability of the orchard planting. The impact of yield is evaluated in Appendix Tables 7 and 8. These tables as well as Table 12 are summarized in Figure 3. Figure 3 illustrates the impact of the average mature yield of the orchard on the accumulated net present value of the profit. As discussed above, at 1000 bushels per acre average mature yield the orchard breaks even during year 12 and produces income having a present value of $5091.32 over the twenty years. At a 800 bushels per acre average mature yield the orchard

Table 11. Present Value of $1 Received at the End of ...[1/]

Year	6%	8%	10%	12%	14%	16%
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.9434	.9259	.9091	.8929	.8772	.8621
2	.8900	.8573	.8262	.7972	.7695	.7432
3	.8396	.7938	.7513	.7118	.6750	.6407
4	.7921	.7350	.6830	.6355	.5921	.5523
5	.7478	.6806	.6209	.5674	.5194	.4761
6	.7050	.6302	.5645	.5066	.4556	.4104
7	.6651	.5835	.5132	.4523	.3996	.3538
8	.6274	.5403	.4665	.4039	.3506	.3050
9	.5919	.5002	.4241	.3606	.3075	.2630
10	.5584	.4632	.3855	.3220	.2697	.2267
11	.5268	.4289	.3505	.2875	.2366	.1954
12	.4970	.3971	.3186	.2567	.2076	.1685
13	.4688	.3677	.2897	.2292	.1821	.1452
14	.4423	.3405	.2633	.2046	.1597	.1252
15	.4173	.3152	.2394	.1827	.1401	.1079
16	.3936	.2919	.2176	.1631	.1229	.0930
17	.3714	.2703	.1978	.1456	.1078	.0802
18	.3503	.2502	.1799	.1300	.0946	.0691
19	.3305	.2317	.1635	.1161	.0829	.0596
20	.3118	.2145	.1486	.1037	.0728	.0514
21	.2942	.1987	.1351	.0926	.0638	.0443
22	.2775	.1839	.1228	.0826	.0560	.0382
23	.2618	.1703	.1117	.0738	.0491	.0329
24	.2470	.1577	.1015	.0659	.0431	.0284
25	.2330	.1460	.0923	.0588	.0378	.0245

[1/] The rate used should reflect risk, inflation, and capital cost as discussed earlier in this publication.

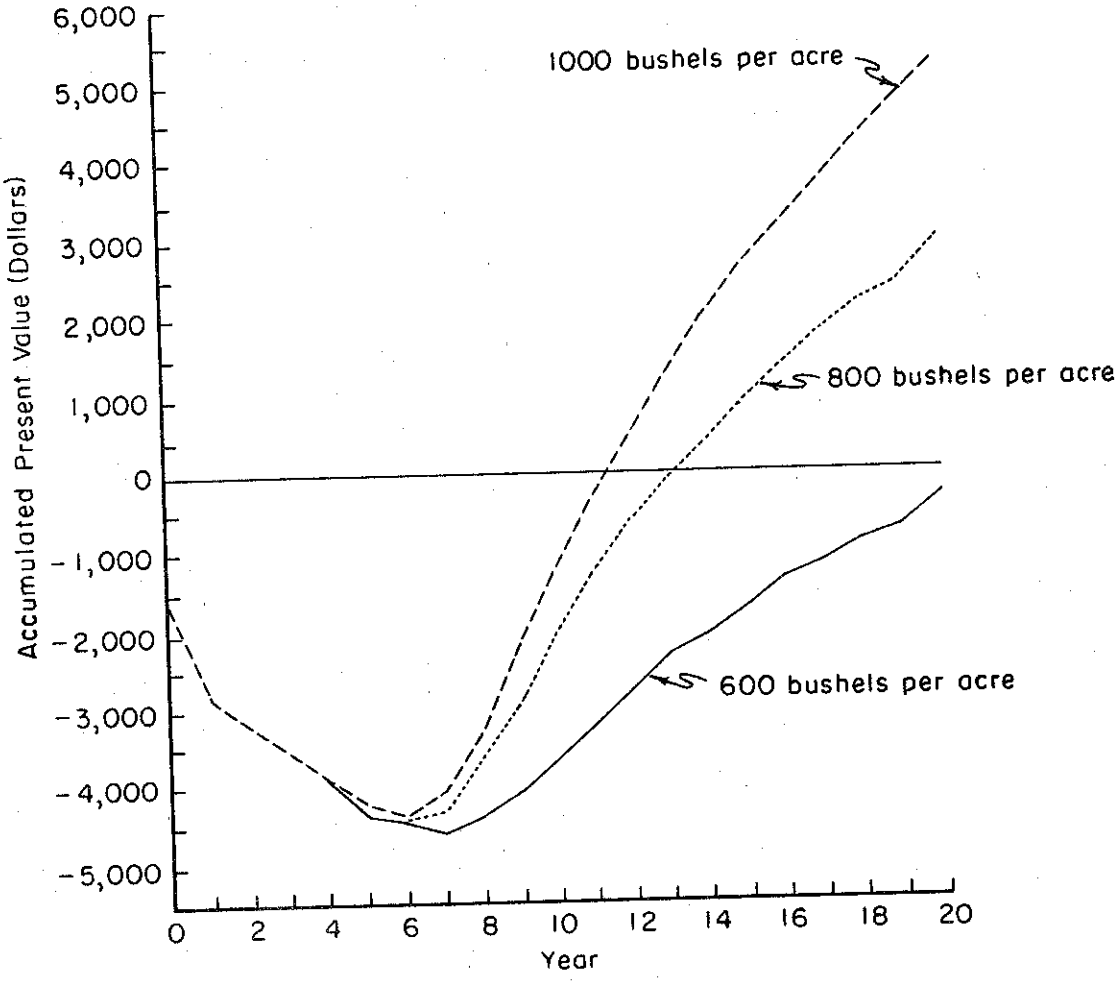
Table 12. Present Value of the Potential Profit from 1000 Bushels Per Acre Average Mature Yield at a Price of $4.50 per Bushel.

Year	Gross Income*	Annual* growing cost	Harvest cost	Net annual profit	Discount factor	Annual present value of profit	Accumulated present value of profit
Value of land		$1000.00		$-1000.00	1.0000	$-1000.00	$-1000.00
Site preparation	0	644.83	0	-644.83	1.0000	-644.08	-1644.08
Year 1	0	1379.10	0	-1379.10	.9091	-1253.74	-2897.82
2	0	403.24	0	-403.24	.8264	-333.24	-3231.06
3	0	471.42	0	-471.42	.7513	-354.18	-3585.24
4	45.00	568.65	12.50	-536.15	.6830	-366.19	-3951.48
5	225.00	612.31	62.50	-449.81	.6209	-279.29	-4230.72
6	675.00	633.86	187.50	-146.36	.5645	-82.62	-4313.34
7	1350.00	633.86	375.00	341.14	.5132	175.07	-4138.27
8	3150.00	633.86	875.00	1641.14	.4665	765.59	-3372.68
9	4500.00	633.86	1250.00	2616.14	.4241	1109.51	-2263.17
10	4500.00	633.86	1250.00	2616.14	.3855	1008.52	-1254.65
11	4500.00	633.86	1250.00	2616.14	.3505	916.96	-337.69
12	4500.00	633.86	1250.00	2616.14	.3186	833.50	495.81
13	4500.00	633.86	1250.00	2616.14	.2897	757.90	1253.71
14	4500.00	633.86	1250.00	2616.14	.2633	688.83	1942.54
15	4500.00	633.86	1250.00	2616.14	.2394	626.30	2568.84
16	4500.00	633.86	1250.00	2616.14	.2176	569.27	3138.11
17	4500.00	633.86	1250.00	2616.14	.1978	517.47	3655.58
18	4500.00	633.86	1250.00	2616.14	.1799	470.64	4126.22
19	4500.00	633.86	1250.00	2616.14	.1635	427.74	4553.96
20	4500.00	633.86	1250.00	2616.14	.1486	388.76	4942.72
Value of land after 20 years				1000.00	.1486	148.60	5091.32

*Taken from Table 10.

Net present value = $5091.32.

FIGURE 3. APPLES: ACCUMULATED PRESENT VALUE AT THREE YIELD LEVELS AT $4.50 PER BUSHEL



breaks even during Year 14 and produces income having a present value of $2815.36. When the yield is projected at only 600 bushels per acre at maturity, the orchard never breaks even. On a discounted or present value basis the orchard produces an accumulated loss of $407.34 at the end of the twenty years. Both methods of anlayzing the investment illustrate the need to produce more than 600 bushels per acre when the orchard reaches maturity when we receive an average price of $4.50 per bushel.

The impact of price is considered in Appendix Tables 9 through 12. Appendix Tables 9 and 10 evaluate the impact of price on profits when the orchard is projected to have an average mature yield of 1000 bushels per acre. These tables are summarized in Figure 4. As discussed above at $4.50 per bushel the orchard breaks even in the twelfth year, and produces a profit with a net present value of $5091.32. At an average per bushel price of $4.00 the orchard breaks even in year thirteen and produces a profit with a net present value of $3199.79. When an average price of $3.50 per bushel is used the orchard does not breakeven until year 16 and produces a profit with a net present value of $1309.48.

Again it is interesting to note that at a $3.50 price per bushel the orchard is not able to return the accumulated investment (breakeven) if it has average mature yield of 800 bushels per acre (Appendix Table 12).

WHEN TO REPLANT OLD ORCHARD BLOCKS?

The decision of when to replant an old orchard block has always been difficult. Many growers feel that as long as the old block is profitable, it should remain. This reasoning, however, completely ignores the income producing capacity of the new planting. What growers really need to examine is whether the potential profit of the new planting exceed the income produced by the old block. To do this, we need to convert the accumulated income potential of the new planting to a value that can be compared to the yearly income of an existing block of apples. We need to multiply the net present value of the block by the amortization factor. Table 13 contains an amortization table.

To make this calculation for the new planting that will average 1000 bushels per acre at maturity (Table 12) we would multiply the accumulated net present value of profit by the amortization factor for 20 years at 10% (from Table 13). This would be done as follows:

$$\$5091.32 \times .1175 = \$598.23$$

This calculation, which converts net present value to an annual equivalent cash flow,[1] indicates that if you anticipated that your new plantings would average 1,000 bushels per acre per year at maturity and

---

[1]The annual equivalent cash flow is the annual amount for 20 years which has a present value equal to the net present value of the new planting.

FIGURE 4. APPLES: ACCUMULATED PRESENT VALUE AT THREE PRICE LEVELS AT 1000 BUSHEL PER ACRE YIELD

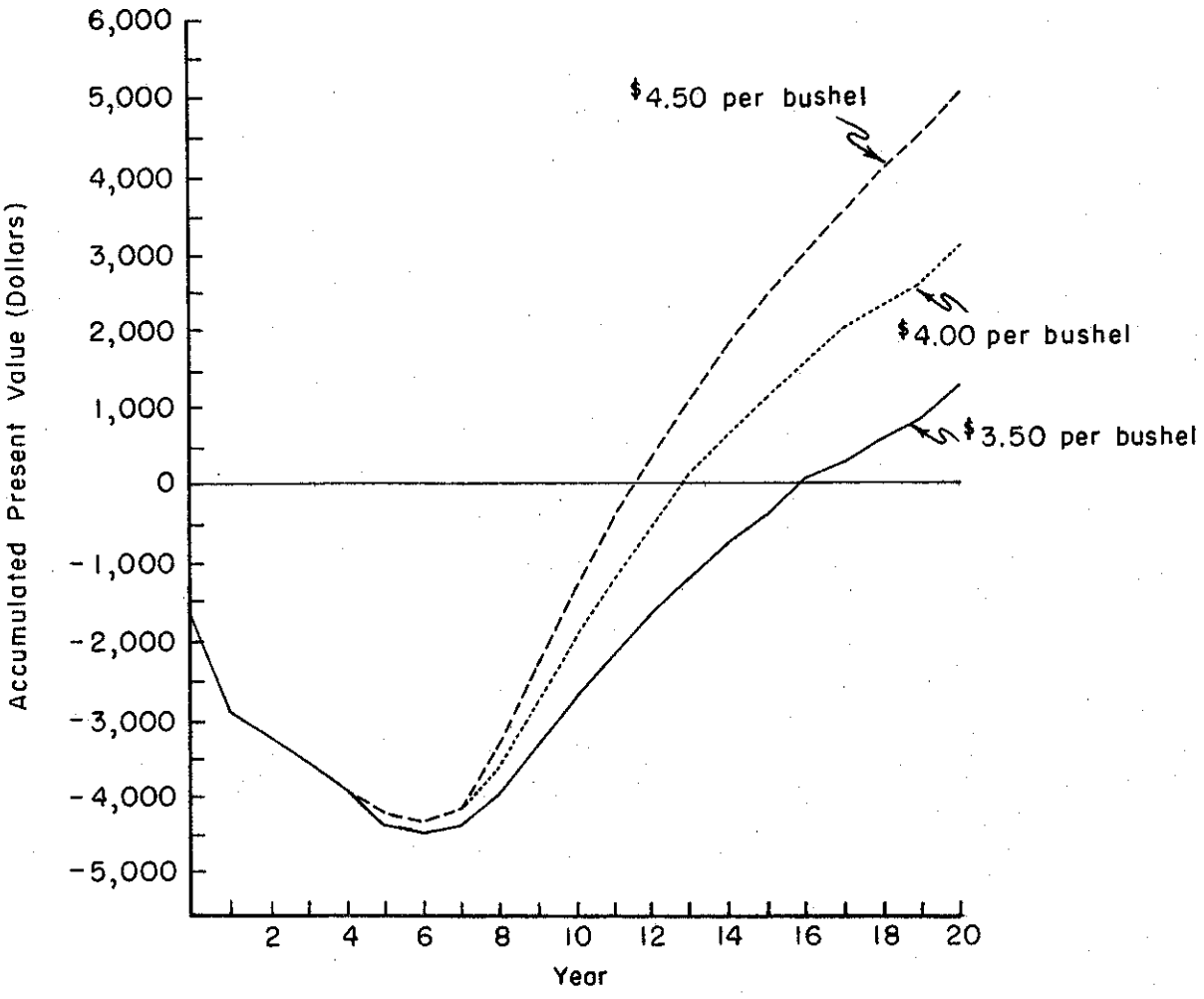


Table 13. Amortization Table.

Year	6%	8%	10%	12%	14%	16%
1	1.0600	1.0800	1.1000	1.1200	1.1400	1.1600
2	.5454	.5608	.5762	.5917	.6073	.6230
3	.3741	.3880	.4021	.4163	.4307	.4453
4	.2886	.3019	.3155	.3292	.3432	.3574
5	.2374	.2505	.2638	.2774	.2913	.3054
6	.2034	.2163	.2296	.2432	.2572	.2714
7	.1791	.1921	.2054	.2191	.2332	.2476
8	.1610	.1740	.1874	.2013	.2156	.2302
9	.1470	.1601	.1736	.1877	.2022	.2171
10	.1359	.1490	.1627	.1770	.1917	.2069
11	.1268	.1401	.1540	.1684	.1834	.1989
12	.1193	.1327	.1468	.1614	.1767	.1924
13	.1130	.1265	.1408	.1557	.1712	.1872
14	.1076	.1213	.1357	.1509	.1666	.1829
15	.1030	.1168	.1315	.1468	.1628	.1794
16	.0990	.1130	.1278	.1434	.1596	.1764
17	.0954	.1096	.1247	.1405	.1569	.1740
18	.0924	.1067	.1219	.1379	.1546	.1719
19	.0869	.1041	.1195	.1358	.1527	.1701
20	.0872	.1019	.1175	.1339	.1510	.1687
21	.0850	.0998	.1156	.1322	.1495	.1674
22	.0830	.0980	.1140	.1308	.1483	.1664
23	.0813	.0964	.1126	.1296	.1472	.1654
24	.0797	.0950	.1113	.1285	.1463	.1647
25	.0782	.0937	.1102	.1275	.1455	.1640

return an average price of $4.50 per bushel, you should replant existing blocks when their profit is $598.23 or less per year.[2]

This method of evaluating when an old block should be removed assumes that the yield of the existing block is constant or decreasing. If the yield of the existing block is still increasing, this method is not appropriate.

While the decision to replant existing orchard blocks must be made on a block-by-block basis and includes many factors, a grower should begin considering replanting an old block at the point where the potential profit of the new planting exceeds the income produced by the present block. The above method enables the grower to make that calculation assuming his records are sufficient to provide the information needed.

A summary of all the varying yield and price assumptions which were analyzed are shown in Table 14. The net present value, the discounted payback period, and the annual equivalent cash flow are shown. Growers may choose the relevant yield and price assumption for their own situation, and make the calculation shown above in order to evaluate the replacement decision.

Table 14. Summary of Net Present Value, Discounted Payback, and Annual Equivalent Cash Flows Under Varying Yield and Price Assumptions.

Yield at Maturity and Price	Net Present Value ($)	Discounted Payback (yrs.)	Annual Equivalent Cash Flow ($)
1,000 bu @ 4.50	5.091	12	598
1,000 bu @ 4.00	3,199	13	375
1,000 bu @ 3.50	1,309	16	153
800 bu @ 4.50	2,815	14	330
800 bu @ 4.00	1,250	16	146
800 bu @ 3.50	(-)287	-	-
600 bu @ 4.50	(-)407	-	-

[2]Costs must include a land charge, all labor, materials, and the total cost of equipment.

SUMMARY

The costs and profitability of apple orchard replanting was evaluated. The planting system analyzed was on a 14 x 20 foot spacing (155 trees per acre), a planting density which is repesentative of that used by many growers in eastern New York with M7A, MM106, or MM111 rootstocks. Varieties planted with this system include Empire, Red Delicious, McIntosh, Tydeman, Jonamac, Rome Beauty, and several others.

The development costs of such a system, including interest, total $6174 per acre. The profitability of the system was evaluated using two different methods of analysis, three different yield levels, and three different price levels.

The first method of analysis (typically used by growers) incorporates interest charges on development costs, but does not consider the time value of money. The second method of analysis is the net present value method, the preferred method in which receipts and expenses were discounted by 10 percent (the real rate of interest plus a risk premium). A criterion for replacement was reviewed. When the profit from the existing orchard falls below $598, it was profitable to replace the existing orchard with the new system that is capable of producing 1,000 bushels mature yield and averaging $4.50 per bushel. This system has a net present value of $5,091 and a discounted payback period of 12 years. The evaluation was also conducted with lower yields (600 and 800 bushels) and lower prices ($4.00 and $3.50 per bushel). If a yield of 600 bushels is anticipated, net present value is negative regardless of which price is received. If yields of 800 bushels per acre and a price of $3.50 per bushel are anticipated, the system also has a negative net present value.

FOOTNOTES

1. Bulldozer work is contracted out at the rate of $60.00 per hour.

2. Labor is included at the rate of $6.00 per hour. This should include the employer's share of social security, workmen's compensation insurance, and the cash cost of any benefits.

3. See Table 15 for a detailed listing of equipment rates.

4. Real estate tax is included at the rate of $20 and management is included at the rate of $85 per acre. These figures are based on Gerling, W.D. A Survey of the Cost of Growing and Harvesting Apples in Eastern New York in 1980.

5. Density of 155 trees per acre at $4.00 per tree. Planting was done with a tree planter.

6. Pruning and training in year one includes heading back of leader, removal of side branches and early pinching-out of undesirable shoots. In years 2, 3, and 4 it includes dormant pruning and branch spreading as needed.

7. Mouse guards are 1/2 inch hardware cloth.

8. See Table 16 for pesticide listings. This cost includes fruit thinning materials.

9. Grass Seed:

10 lbs orchard grass	$14.60
6 lbs Timothy	13.60
6 lbs Bluegrass	9.00
1 bushel Oats	3.00
	$40.20

10. Mouse bait 10 pounds zinc phosphide corn $4.00.

11. Fertilizer:

Year 1	1.0 lb per tree	155 lbs	10-10-10	$15.89
Year 2	1.5 lb per tree	233 lbs	10-10-10	23.83
Year 3	2.0 lb per tree	310 lbs	10-10-10	31.78
Year 4	2.5 lb per tree	388 lbs	10-10-10	39.77
Year 5	3.0 lb per tree	465 lbs	10-10-10	47.66

Year 6 and On

100 lb Ammonium nitrate	$10.35	
potassium, boron, etc. as needed	10.00	
		$20.35

Most fertilizer is broadcasted throughout the life of the orchard.

12. Herbicide:

Paraquat	1 quart	$ 9.81
Simazine	1 pound	9.30
Charger E	1/2 pt	.60
		$19.71

13. Includes the cost of hand-thinning, summer pruning and some branch spreading.

14. Bee rental 1 hive for every 3 acres
$25 per hive ÷ 3 acres = $8.33/acre

15. Beginning in the sixth year 2 tons of lime is applied every 3 years. This is the equivalent of .67 tons per year.

16. Based on Gerling, W.D. A Survey of the Cost of Growing and Harvesting Apples in Eastern New York in 1980.

17. Interest is included at the rate of 10% on the accumulated investment plus $100 interest on the value of the land itself ($1000 per acre at 10%).

Table 15. Equipment Cost.

Item	Cost	Index cost	Years life	Annual depr.*	Interest 10%*	Fuel $1.25/ gal.	Repair + main.	Other cost 1%	Total annual cost*	Hours of use	Cost per hour	Rate used
Pick-up	$6000	$5040	5	$1008	$252	$1083	$720	$ 60	$3123	500	$6.25	$6.25
60hp diesel tractor	15000	9750	10	975	488	1800	390	150	3803	500	7.61	7.60
40hp diesel tractor	10000	6500	10	650	325	1440	420	100	2935	600	4.89	4.90
Airblast sprayer	30000	19500	10	1950	975	720	840	300	4785	400	11.96	11.95
Weed sprayer	3500	2275	10	227	114	-	189	35	565	150	3.77	3.80
3 pt fert spreader	1150	874	7	125	44	-	151	11	331	150	2.21	2.20
Rotary mower	5000	3800	7	543	190	-	471	50	1254	300	4.18	4.20
Plow 3-16	1400	770	15	51	38	-	17	14	120	30	4.00	4.00
Disc	3500	1925	15	128	96	-	98	35	357	75	4.76	4.75
Spraying tooth harrow	1600	880	15	59	44	-	45	16	164	75	2.19	2.20
Tree planter	1200	780	10	78	39	-	15	12	144	40	3.60	3.60
Cultipacker	1200	660	15	44	33	-	6	12	95	15	6.33	2.00
Water truck	2500	2100	5	420	105	400	200	25	1150	200	5.75	5.75
Dump truck	2500	2100	5	420	105	300	150	25	1000	150	6.67	6.70
Flat bed truck	5000	4250	5	850	213	800	350	50	2263	400	5.65	5.65
Brush chooper	7000	3850	10	385	193	-	563	70	1211	250	4.84	4.85

*Fixed costs of equipment (i.e., depreciation and interest) are not usually included in a net present value analysis. A more traditional approach for net present value analysis is to place the full cost of the equipment complement in the year in which it is purchased, and only charge variable costs annually. However, the method used here permits the use of the same equipment costs for both methods of analysis (the traditional grower method and the discounted cash flow analysis), and does not materially distort the net present value analysis. The total cost approach is also useful to illustrate the very high total cost of items of equipment used infrequently.

Table 16. Pest Control Program.

Year One		
5 sprays		
Dikar 2 lbs	$2.48	
Guthion 1/2 lb 50W	2.50	
	$5.98 x 5 sprays	$29.90
Year Two and Three		
2 Early Fungicide Sprays		
Dikar 2 lbs	$3.48 x 2 sprays	$ 6.96
Pink		
Dikar 2 lbs	$3.48	
Thiodan 1 lb 50W	4.10	
	$7.58	$ 7.58
Thinning		
Dikar 2 lbs	$3.48	
Sevin 2 lbs 50W	3.20	
NAA 2 oz	1.65	
	$8.33	$ 8.33
1st + 3rd Cover Sprays		
Dikar 2 lbs	$3.48	
Guthion 1/2 lb 50W	2.50	
	$5.98	$ 5.98
2nd Cover Spray		
Dikar 2 lbs	$3.48	
Guthion 1/2 lb 50W	2.50	
Plictran 4 oz 50W	4.60	
Vydate 1 pt	4.25	
	$14.83	$14.83
Total Year 2 + 3		$43.68
Year Four + Five		
Early Fungicide Sprays		
Dikar 5 lbs	$ 8.70 x 2 sprays	$17.40
Pink		
Dikar 5 lbs	$ 8.70	
Thiodan 3 lbs 50W	12.30	
	$21.00	$21.00
Petal Fall		
Dikar 5 lbs	$ 8.70	
Guthion 1.5 lbs 50W	7.50	
Phosphamidon 1/2 pt	3.68	
Plictran 12 oz	13.80	
	$33.68	$ 33.68
Thinning		
Dikar 5 lbs	$ 8.70	
Sevin 2 lbs 50W	3.20	
NAA 2 oz	1.65	
	$13.65	$ 13.65
1st + 4th cover sprays		
Dikar 4 lbs	$ 6.96	
Guthion 1.5 lbs 50W	7.50	
	$14.46 x 2 sprays	$ 28.92

Table 16. Continued.

Year Four + Five Continued.		
2nd Cover Spray		
Dikar 4 lbs	$ 6.96	
Guthion 1.5 lbs 50W	7.50	
Vydate 1 pt	4.25	
	$18.71	$ 18.71
3rd Cover Spray		
Dikar 4 lbs	$ 6.96	
Guthion 1.5 lbs 50W	7.50	
Plictran 12 oz	13.80	
	$21.26	$ 21.26
Total Year 4 + 5		$154.62
Year Six and On		
Dormant Spray		
Benlate 6 oz	$ 3.88	
Maneb 4 lbs 80W	7.80	
Oil 4 gals	10.80	
	$22.48	$ 22.48
Early Fungicide		
Benlate 6 oz	$ 3.88	
Maneb 4 lbs 80W	7.80	
	$11.68	$ 11.68
Petal Fall		
Dikar 5 lbs	$ 8.70	
Guthion 1.5 lbs 50W	7.50	
Phosphamidon 1/2 pt	3.68	
Plictran 12 oz	13.80	
	$33.68	$ 33.68
Thinning		
Dikar 5 lbs	$ 8.70	
Sevin 2 lbs	3.20	
NAA 2 oz	1.65	
	$13.65	$ 13.65
1st + 4th Cover Sprays		
Dikar 4 lbs	$ 6.96	
Guthion 1.5 lbs 50W	7.50	
	$14.46 x 2 sprays =	$ 28.92
2nd Cover Spray		
Dikar 4 lbs	$ 6.96	
Guthion 1.5 lbs 50W	7.50	
Vydate 1 pt	4.25	
	$18.71	$ 18.71
3rd Cover Spray		
Dikar 4 lbs	$ 6.96	
Guthion 1.5 lbs 50W	7.50	
Plictran 12 oz	13.80	
	$21.26	$ 21.26
Total Year Six and On		$171.38

REFERENCES

1. Aplin, Richard D., George L. Casler, and Cheryl P. Francis. 1977. Capital Invest Analysis; Using Discounted Cash Flows. Grid Publishing, Inc., Columbus Ohio.

2. 1981 Cornell Recommendation for Commercial Tree Fruit Production. N.Y. Stage College of Agriculture and Life Sciences, Cornell University, Ithaca, New York.

3. Forshey, C. G. 1980. Cultural Practice in Bearing Orchards. Cornell University, Ithaca, New York. Informational Bulletin 160.

4. Forshey, C. G. 1976. The Planting and Early Care of the Apple Orchard. Cornell University, Ithaca, New York. Informational Bulletin 65.

5. Gerling, W. D. A Survey of the Cost of Growing and Harvesting Apples in Eastern New York: 1980. Cooperative Extension, Hudson Valley Laboratory, Highland, New York.

APPENDIX

Appendix Table 1

Potential Profit from 800 Bushel Per Year Average Mature Yield and a Price of $4.50 per Bushel.

Year	Yield/ acre	Gross income at $4.50/bu.	Annual growing cost	Harvesting[16] cost at $1.25/bu.	Interest[17] on investment	Total annual cost	Annual profit	Accumulated profit
Site Preparation	0	0	644.83	0	100.00	744.83	-744.83	-744.83
Year 1	0	0	1379.10	0	174.48	1553.58	-1553.58	-2298.41
2	0	0	403.24	0	329.84	733.08	-733.08	-3031.49
3	0	0	471.42	0	403.15	874.57	-874.57	-3906.06
4	10	45.00	568.65	12.50	490.61	1071.76	-1026.76	-4932.82
5	50	225.00	612.31	62.50	593.28	1268.09	-1043.09	-5975.91
6	125	562.60	633.86	156.25	697.59	1487.70	-925.20	-6901.11
7	275	1237.50	633.86	343.75	790.11	1767.72	-530.22	-7431.33
8	600	2700.00	633.86	750.00	843.13	2226.99	473.01	-6958.32
9	800	3600.00	633.86	1000.00	795.83	2429.69	1170.31	-5788.01
10	800	3600.00	633.86	1000.00	678.80	2312.66	1287.34	-4500.67
11	800	3600.00	633.86	1000.00	550.07	2183.93	1416.07	-3084.60
12	800	3600.00	633.86	1000.00	308.46	1942.32	1657.68	-1426.92
13	800	3600.00	633.86	1000.00	242.69	1876.55	1723.45	296.53
14	800	3600.00	633.86	1000.00	100.00	1733.86	1866.14	2162.67
15	800	3600.00	633.86	1000.00	100.00	1733.86	1866.14	4028.81
16	800	3600.00	633.86	1000.00	100.00	1733.86	1866.14	5894.95
17	800	3600.00	633.86	1000.00	100.00	1733.86	1866.14	7761.09
18	800	3600.00	633.86	1000.00	100.00	1733.86	1866.14	9627.23
19	800	3600.00	633.86	1000.00	100.00	1733.86	1866.14	11493.37
20	800	3600.00	633.86	1000.00	100.00	1733.86	1866.14	13359.51

Appendix Table 2

Potential Profit from 600 Bushel Per Year Average Mature Yield and a Price of $4.50 per Bushel.

Year	Yield/ acre	Gross income at $4.50/bu.	Annual growing cost	Harvesting[16] cost at $1.25/bu.	Interest[17] on investment	Total annual cost	Annual profit	Accumulated profit
Site Preparation	0	0	644.82	0	100.00	744.83	-744.83	-744.83
Year 1	0	0	1379.10	0	174.48	1553.58	-1553.58	-2298.41
2	0	0	403.24	0	329.84	733.08	-733.08	-3031.49
3	0	0	471.42	0	403.15	874.57	-874.57	-3906.06
4	10	45.00	568.65	12.50	490.61	1071.76	-1026.76	-4932.82
5	40	180.00	612.31	50.00	593.28	1255.59	-1075.59	-6008.41
6	75	337.50	633.86	93.75	700.84	1428.45	-1090.95	-7099.36
7	150	675.00	633.86	187.50	809.94	1631.30	-956.30	-8055.66
8	250	1125.00	633.86	312.50	905.57	1851.93	-726.93	-8782.59
9	400	1800.00	633.86	500.00	978.26	2112.12	-312.12	-9094.71
10	600	2700.00	633.86	750.00	1009.47	2393.33	306.67	-8788.04
11	600	2700.00	633.86	750.00	978.80	2362.66	337.34	-8450.70
12	600	2700.00	633.86	750.00	945.07	2328.93	371.07	-8097.63
13	600	2700.00	633.86	750.00	907.96	2291.82	408.18	-7671.45
14	600	2700.00	633.86	750.00	867.15	2251.01	448.99	-7222.46
15	600	2700.00	633.86	750.00	822.25	2206.11	493.89	-6728.57
16	600	2700.00	633.86	750.00	772.86	2156.72	543.28	-6185.29
17	600	2700.00	633.86	750.00	718.53	2102.39	597.61	-5587.68
18	600	2700.00	633.86	750.00	658.77	2042.63	657.37	-4930.31
19	600	2700.00	633.86	750.00	593.03	1976.89	723.11	-4207.20
20	600	2700.00	633.86	750.00	520.72	1904.58	795.42	-3411.78

Appendix Table 3

Potential Profit from 1000 Bushels Per Acre Average Mature Yield and a Price of $4.00 per Bushel.

Year	Yield/ acre	Gross income at $4.00/bu.	Annual growing cost	Harvesting[16] cost at $1.25/bu.	Interest[17] on investment	Total annual cost	Annual profit	Accumu-lated profit
Site Preparation	0	0	644.83	0	100.00	744.83	-744.83	-744.83
Year 1	0	0	1379.10	0	174.78	1553.58	-553.58	-2298.41
2	0	0	403.24	0	329.84	733.08	-733.08	-3031.49
3	0	0	471.42	0	403.15	874.57	-874.57	-3906.06
4	10	40.00	568.65	12.50	490.61	1071.76	-1031.76	-4937.82
5	50	200.00	612.31	62.50	593.78	1268.58	-1068.58	-6006.40
6	150	600.00	633.86	187.50	700.64	1522.00	-922.00	-6928.40
7	300	1200.00	633.86	375.00	729.84	1801.70	-601.70	-7530.10
8	700	2800.00	633.86	875.00	853.01	2361.87	438.13	-7091.97
9	1000	4000.00	633.86	1250.00	809.20	2693.06	1306.94	-5785.03
10	1000	4000.00	633.86	1250.00	678.50	2562.36	1437.64	-4347.39
11	1000	4000.00	633.86	1250.00	534.74	2418.60	1581.40	-2765.99
12	1000	4000.00	633.86	1250.00	376.60	2260.46	1739.54	-1026.45
13	1000	4000.00	633.86	1250.00	202.64	2086.65	1913.50	887.05
14	1000	4000.00	633.86	1250.00	100.00	1983.86	2016.14	2903.19
15	1000	4000.00	633.86	1250.00	100.00	1983.86	2016.14	4919.33
16	1000	4000.00	633.86	1250.00	100.00	1983.86	2016.14	6935.47
17	1000	4000.00	633.86	1250.00	100.00	1983.86	2016.14	8951.61
18	1000	4000.00	633.86	1250.00	100.00	1983.86	2016.14	10967.75
19	1000	4000.00	633.86	1250.00	100.00	1983.86	2016.14	12983.89
20	1000	4000.00	633.86	1250.00	100.00	1983.86	2016.14	15000.03

Appendix Table 4

Potential Profit from 1000 Bushels Per Acre Average Mature Yield and a Price of $3.50 per Bushel.

Year	Yield/ acre	Gross income at $3.50/bu.	Annual growing cost	Harvesting[16] cost at $1.25/bu.	Interest[17] on investment	Total annual cost	Annual profit	Accumulated profit
Site Preparation	0	0	644.83	0	100.00	744.83	-744.83	-744.83
Year 1	0	0	1379.10	0	174.78	1553.58	-1553.58	-2298.41
2	0	0	403.24	0	329.84	733.08	-733.08	-3031.49
3	0	0	471.42	0	403.15	874.57	-874.57	-3906.06
4	10	35.00	568.65	12.50	490.61	1017.76	-1036.76	-4942.82
5	50	175.00	612.31	62.50	594.28	1269.09	-1094.09	-6036.91
6	150	525.00	633.86	187.50	703.69	1525.05	-1000.05	-7036.96
7	300	1050.00	633.86	375.00	803.70	1812.56	-762.56	-7799.52
8	700	2450.00	633.86	875.00	879.95	2388.81	61.19	-7738.33
9	1000	3500.00	633.86	1250.00	873.83	2757.69	742.31	-6996.02
10	1000	3500.00	633.86	1250.00	799.60	2683.44	816.54	-6179.48
11	1000	3500.00	633.86	1250.00	717.95	2601.81	898.19	-5281.29
12	1000	3500.00	633.86	1250.00	628.13	2511.99	988.01	-4293.28
13	1000	3500.00	633.86	1250.00	529.33	2413.19	1086.81	-3206.49
14	1000	3500.00	633.86	1250.00	420.65	2304.51	1195.49	-2010.98
15	1000	3500.00	633.86	1250.00	301.10	2184.96	1315.04	-695.94
16	1000	3500.00	633.86	1250.00	169.59	2053.45	1446.55	750.61
17	1000	3500.00	633.86	1250.00	100.00	1983.86	1516.14	2266.75
18	1000	3500.00	633.86	1250.00	100.00	1983.86	1516.14	3782.89
19	1000	3500.00	633.86	1250.00	100.00	1983.86	1516.14	5299.03
20	1000	3500.00	633.86	1250.00	10.00	1983.86	1516.14	6815.17

Appendix Table 5

Potential Profit from 800 Bushels Per Acre Average Mature Yield and a Price of $4.00 per Bushel.

Year	Yield/ acre	Gross income at $4.00/bu.	Annual growing cost	Harvesting[16] cost at $1.25/bu.	Interest[17] on investment	Total annual cost	Annual profit	Accumulated profit
Site Preparation	0	0	644.83	0	100.00	744.83	-744.83	-744.83
Year 1	0	0	1379.10	0	174.48	1553.58	-1553.58	-2298.41
2	0	0	403.24	0	329.84	733.08	-733.08	-3031.49
3	0	0	471.42	0	403.15	874.57	-874.57	-3906.06
4	10	40.00	568.65	12.50	490.61	1071.76	-1031.76	-4937.82
5	50	200.00	612.31	62.50	593.78	1268.59	-1068.59	-6005.41
6	125	500.00	633.86	156.25	700.64	1490.75	-990.75	-6997.16
7	275	1100.00	633.86	343.75	799.72	1777.33	-677.33	-7674.49
8	600	2400.00	633.86	750.00	867.45	2251.31	148.69	-7525.80
9	800	3200.00	633.86	1000.00	852.58	2486.44	713.56	-6812.24
10	800	3200.00	633.86	1000.00	781.22	2415.08	784.92	-6027.32
11	800	3200.00	633.86	1000.00	702.73	2336.59	863.41	-5163.91
12	800	3200.00	633.86	1000.00	616.39	2260.25	949.75	-4214.16
13	800	3200.00	633.86	1000.00	522.42	2156.28	1043.72	-3190.44
14	800	3200.00	633.86	1000.00	418.04	2051.90	1148.10	-2042.34
15	800	3200.00	633.86	1000.00	303.23	1937.09	1262.91	-779.43
16	800	3200.00	633.86	1000.00	176.94	1810.80	1389.20	629.77
17	800	3200.00	633.86	1000.00	100.00	1733.86	1466.14	2095.91
18	800	3200.00	633.86	1000.00	100.00	1733.86	1466.14	3562.05
19	800	3200.00	633.86	1000.00	100.00	1733.86	1466.14	5028.19
20	800	3200.00	633.86	1000.00	100.00	1733.86	1466.14	6494.33

Appendix Table 6

Potential Profit from 800 Bushels Per Acre Average Mature Yield and a Price of $3.50 per Bushel.

Year	Yield/ acre	Gross income at $3.50/bu.	Annual growing cost	Harvesting[16] cost at $1.25/bu.	Interest[17] on investment	Total annual cost	Annual profit	Accumulated profit
Site Preparation	0	0	644.83	0	100.00	744.83	-744.83	-744.83
Year 1	0	0	1379.10	0	174.48	1553.58	-1443.58	-2298.41
2	0	0	403.24	0	329.84	733.08	-733.08	-3031.49
3	0	0	471.42	0	413.15	874.57	-874.57	-3906.06
4	10	35.00	568.65	12.50	490.61	1071.76	-1036.76	-4942.82
5	50	175.00	612.31	62.50	594.28	1269.09	-1094.09	-6036.91
6	125	437.50	633.86	156.25	703.69	1493.80	-1056.30	-7093.21
7	275	962.50	633.86	343.75	809.32	1786.93	-824.43	-7917.64
8	600	2100.00	633.86	750.00	891.76	2275.62	-175.62	-8093.26
9	800	2800.00	633.86	1000.00	909.33	2543.19	256.81	-7836.45
10	800	2800.00	633.86	1000.00	883.65	2517.51	282.49	-7553.96
11	800	2800.00	633.86	1000.00	855.40	2489.26	310.74	-7243.22
12	800	2800.00	633.86	1000.00	824.32	2458.18	341.82	-6901.40
13	800	2800.00	633.86	1000.00	790.14	2424.00	376.00	-6525.40
14	800	2800.00	633.86	1000.00	752.54	2386.40	413.60	-6111.80
15	800	2800.00	633.86	1000.00	711.18	2345.04	454.96	-5656.84
16	800	2800.00	633.86	1000.00	665.68	2299.54	500.46	-5156.38
17	800	2800.00	633.86	1000.00	615.64	2249.50	550.50	-4605.88
18	800	2800.00	633.86	1000.00	560.59	2194.45	605.55	-4000.33
19	800	2800.00	633.86	1000.00	500.03	2133.89	666.11	-3334.22
20	800	2800.00	633.86	1000.00	433.42	2067.28	732.72	-2601.50

Appendix Table 7

Present Value of Potential Profit at $4.50 Per Bushel,
800 Bushels Per Acre Average Mature Yield.

Year	Gross income*	Annual* growing cost	Harvest cost	Net annual profit	Discount factor	Annual present value of profit	Accumulated present value of profit
Value of land		$1000.00		$-1000.00	1.0000	$-1000.00	$-1000.00
Site preparation	0	644.83	0	-644.83	1.0000	-644.83	-1644.83
Year 1	0	1379.10	0	-1379.10	.9091	-1253.74	-2898.57
2	0	403.24	0	-403.24	.8264	-333.24	-3231.81
3	0	471.42	0	-471.42	.7513	-354.18	-3585.99
4	45.00	568.65	12.50	-536.15	.6830	-366.19	-3952.18
5	225.00	512.31	62.50	-449.81	.6209	-279.29	-4231.47
6	562.50	633.86	156.25	-227.61	.5645	-128.49	-4359.96
7	1237.50	633.86	343.75	259.89	.5132	133.38	-4226.58
8	2700.00	633.86	750.00	1316.14	.4665	613.98	-3612.60
9	3600.00	633.86	1000.00	1966.14	.4241	833.84	-2778.76
10	3600.00	633.86	1000.00	1966.14	.3855	757.95	-2020.81
11	3600.00	633.86	1000.00	1966.14	.3505	689.13	-1331.68
12	3600.00	633.86	1000.00	1966.14	.3186	626.41	-705.73
13	3600.00	633.86	1000.00	1966.14	.2897	569.59	-135.68
14	3600.00	633.86	1000.00	1966.14	.2633	517.68	382.00
15	3600.00	633.86	1000.00	1966.14	.2394	470.69	852.69
16	3600.00	633.86	1000.00	1966.14	.2176	427.83	1280.52
17	3600.00	633.86	1000.00	1966.14	.1978	388.90	1669.42
18	3600.00	633.86	1000.00	1966.14	.1799	353.71	2023.13
19	3600.00	633.86	1000.00	1966.14	.1635	321.46	2344.59
20	3600.00	633.86	1000.00	1966.14	.1486	292.17	2636.76
Value of land after 20 years				1000.00	.1486	148.60	2815.36

*Taken from Appendix Table 1.

Net present value = $2815.36

Appendix Table 8

Present Value of Potential Profit at $4.50 Per Bushel,
600 Bushels Per Acre Average Mature Yield.

Year	Gross Income*	Annual* growing cost	Harvest cost	Net annual profit	Discount factor	Annual present value of profit	Accumulated present value of profit
Value of land		$1000.00		$-1000.00	1.0000	$-1000.00	$-1000.00
Site preparation	0	644.83	0	-644.83	1.0000	-644.83	-1644.82
Year 1	0	1379.10	0	-1379.10	.9091	-1253.74	-2898.57
2	0	403.24	0	-403.24	.8264	-333.24	-3231.81
3	0	471.42	0	-471.42	.7513	-354.18	-3585.99
4	45.00	568.65	12.50	-536.15	.6830	-366.19	-3952.18
5	180.00	612.31	50.00	-482.31	.6209	-299.47	-4251.65
6	337.50	633.86	93.75	-390.11	.5645	-220.22	-4471.87
7	675.00	633.86	187.50	-146.36	.5732	-75.11	-4546.98
8	1125.00	633.86	312.50	178.64	.4665	83.36	-4463.62
9	1800.00	633.86	500.00	666.14	.4241	282.51	-4181.11
10	2700.00	633.86	750.00	1316.14	.3855	507.37	-3673.74
11	2700.00	633.86	750.00	1316.14	.3505	461.31	-3212.43
12	2700.00	633.86	750.00	1316.14	.3186	419.32	-2793.11
13	2700.00	633.86	750.00	1316.14	.2897	381.29	-2411.82
14	2700.00	633.86	750.00	1316.14	.2633	346.54	-2065.28
15	2700.00	633.86	750.00	1316.14	.2394	315.08	-1750.20
16	2700.00	633.86	750.00	1316.14	.2176	286.39	-1463.81
17	2700.00	633.86	750.00	1316.14	.1978	260.33	-1205.48
18	2700.00	633.86	750.00	1316.14	.1799	236.77	-966.71
19	2700.00	633.86	750.00	1316.14	.1635	215.19	-751.52
20	2700.00	633.86	750.00	1316.14	.1486	195.58	-555.94
Value of land after 20 years				1000.00	.1486	148.60	-407.34

*Taken from Appendix Table 2.
Net present value = $407.24

Appendix Table 9

Present Value of Potential Profit at $4.00 Per Bushel,
1000 Bushels Per Acre Average Mature Yield.

Year	Gross income*	Annual* growing cost	Harvest cost	Net annual profit	Discount factor	Annual present value of profit	Accumulated present value of profit
Value of land		$1000.00		$-1000.00	1.0000	$-1000.00	$-1000.00
Site preparation	0	644.83	0	-644.83	1.0000	-644.83	-1644.83
Year 1	0	1379.10	0	-1379.10	.9091	-1253.74	-2898.57
2	0	403.24	0	-403.24	.8624	-333.24	-3231.81
3	0	471.42	0	-471.42	.7572	-354.18	-3585.99
4	40.00	568.65	12.50	-541.15	.6830	-369.61	-3955.60
5	200.00	612.31	62.50	-474.80	.6209	-294.80	-4250.40
6	600.00	633.86	187.50	-221.36	.5645	-124.96	-4375.36
7	1200.00	633.86	375.00	191.14	.5132	98.09	-4277.27
8	2800.00	633.86	875.00	1291.14	.4664	602.32	-3674.95
9	4000.00	633.86	1250.00	2116.14	.4241	897.45	-2777.50
10	4000.00	633.86	1250.00	2116.14	.3855	815.77	-1961.73
11	4000.00	633.86	1250.00	2116.14	.3505	741.71	-1220.02
12	4000.00	633.86	1250.00	2116.14	.3186	674.20	-545.82
13	4000.00	633.86	1250.00	2116.14	.2897	613.05	67.23
14	4000.00	633.86	1250.00	2116.14	.2633	557.18	624.41
15	4000.00	633.86	1250.00	2116.14	.2394	506.60	1131.01
16	4000.00	633.86	1250.00	2116.14	.2176	460.47	1591.48
17	4000.00	633.86	1250.00	2116.14	.1978	418.57	2010.05
18	4000.00	633.86	1250.00	2116.14	.1799	380.69	2390.74
19	4000.00	633.86	1250.00	2116.14	.1635	345.99	2736.73
20	4000.00	633.86	1250.00	2116.14	.1486	314.46	3051.19
Value of land after 20 years				1000.00	.1486	148.60	3199.79

*Taken from Appendix Table 3.
Net present value = $3199.79

Appendix Table 10

Present Value of Potential Profit at $3.50 Per Bushel,
1000 Bushels Per Acre Average Mature Yield.

Year	Gross Income*	Annual* growing cost	Harvest cost	Net annual profit	Discount factor	Annual present value of profit	Accumulated present value of profit
Value of land		$1000.00		$-1000.00	1.0000	$-1000.00	$-1000.00
Site preparation	0	644.83	0	-644.83	1.0000	-644.83	-1644.83
Year 1	0	1379.10	0	-1379.10	.9091	-1253.74	-2898.57
2	0	403.24	0	-403.24	.8264	-333.24	-3231.81
3	0	471.42	0	-471.42	.7531	-354.18	-3585.99
4	35.00	568.65	12.50	-546.15	.6830	-373.02	-3959.01
5	175.00	612.31	62.50	-499.81	.6209	-310.33	-4269.34
6	525.00	633.86	187.50	-296.36	.5645	-167.29	-4436.63
7	1050.00	633.86	375.00	41.14	.5132	21.11	-4415.52
8	2450.00	633.86	875.00	942.14	.4665	439.51	-3976.01
9	3500.00	633.86	1250.00	1616.14	.4241	685.40	-3290.61
10	3500.00	633.86	1250.00	1616.14	.3855	623.02	-2667.59
11	3500.00	633.86	1250.00	1616.14	.3505	566.46	-2101.13
12	3500.00	633.86	1250.00	1616.14	.3186	514.90	-1586.23
13	3500.00	633.86	1250.00	1616.14	.2897	468.20	-1118.03
14	3500.00	633.86	1250.00	1616.14	.2633	425.53	-692.50
15	3500.00	633.86	1250.00	1616.14	.2394	386.90	-305.60
16	3500.00	633.86	1250.00	1616.14	.2176	351.67	46.07
17	3500.00	633.86	1250.00	1616.14	.1978	319.67	365.74
18	3500.00	633.86	1250.00	1616.14	.1799	290.74	656.48
19	3500.00	633.86	1250.00	1616.14	.1635	264.24	920.72
20	3500.00	633.86	1250.00	1616.14	.1486	240.16	1160.88
Value of land after 20 years				1000.00	.1486	148.60	1309.48

*Taken from Appendix Table 4.
Net present value = $1309.48

Appendix Table 11

Present Value of Potential Profit at $4.00 Per Bushel,
800 Bushels Per Acre Average Mature Yield.

Year	Gross Income*	Annual* growing cost	Harvest cost	Net annual profit	Discount factor	Annual present value of profit	Accumulated present value of profit
Value of land		$1000.00		$-1000.00	1.0000	$-1000.00	$-1000.00
Site preparation	0	644.83	0	-644.00	1.0000	-644.00	-1644.00
Year 1	0	1379.10	0	-1379.10	.9091	-1253.74	-2897.74
2	0	403.24	0	-403.24	.8264	-333.24	-3230.98
3	0	471.42	0	-471.42	.7513	-354.18	-3585.16
4	40.00	568.65	12.50	-541.15	.6830	-369.61	-3954.77
5	200.00	612.31	62.50	-474.81	.6209	-294.81	-4249.58
6	500.00	633.86	156.25	-290.11	.5645	-163.77	-4413.35
7	1100.00	633.86	343.75	122.39	.5132	62.81	-4350.54
8	2400.00	633.86	750.00	1016.14	.4665	474.03	-3876.51
9	3200.00	633.86	1000.00	1566.14	.4241	644.20	-3212.31
10	3200.00	633.86	1000.00	1566.14	.3855	603.75	-2608.56
11	3200.00	633.86	1000.00	1566.14	.3505	548.93	-2059.63
12	3200.00	633.86	1000.00	1566.14	.3186	498.97	-1560.66
13	3200.00	633.86	1000.00	1566.14	.2897	453.71	-1106.95
14	3200.00	633.86	1000.00	1566.14	.2633	412.36	-694.59
15	3200.00	633.86	1000.00	1566.14	.2394	374.93	-319.66
16	3200.00	633.86	1000.00	1566.14	.2176	340.79	21.13
17	3200.00	633.86	1000.00	1566.14	.1978	309.78	330.91
18	3200.00	633.86	1000.00	1566.14	.1799	281.75	612.66
19	3200.00	633.86	1000.00	1566.14	.1635	256.06	868.72
20	3200.00	633.86	1000.00	1566.14	.1486	232.73	1101.45
Value of land after 20 years				1000.00	.1486	148.60	1250.05

*Taken from Appendix Table 5.
Net present value = $1250.05

Appendix Table 12

Present Value of Potential Profit at $3.50 Per Bushel,
800 Bushels Per Acre Average Mature Yield.

Year	Gross income*	Annual* growing cost	Harvest cost	Net annual profit	Discount factor	Annual present value of profit	Accumulated present value of profit
Value of land		$1000.00		$-1000.00	1.0000	$-1000.00	$-1000.00
Site preparation	0	644.83	0	-644.83	1.0000	-644.83	-1644.83
Year 1	0	1379.10	0	-1379.10	.9091	-1253.74	-2898.57
2	0	403.24	0	-403.24	.8264	-333.24	-3231.81
3	0	471.42	0	-471.42	.7513	-354.18	-3585.99
4	35.00	568.65	12.50	-546.15	.6830	-373.02	-3959.01
5	175.00	612.31	62.50	-499.81	.6209	-310.33	-4269.34
6	437.50	633.86	156.25	-352.61	.5645	-199.05	-4468.39
7	962.50	633.86	343.75	15.11	.5132	-7.75	-4476.14
8	2100.00	633.86	750.00	716.14	.4665	334.08	-4142.06
9	2800.00	633.86	1000.00	1166.14	.4241	494.56	-3647.50
10	2800.00	633.86	1000.00	1166.14	.3855	449.55	-3197.95
11	2800.00	633.86	1000.00	1166.14	.3505	408.73	-2789.65
12	2800.00	633.86	1000.00	1166.14	.3186	371.53	-2418.12
13	2800.00	633.86	1000.00	1166.14	.2897	337.83	-2080.29
14	2800.00	633.86	1000.00	1166.14	.2633	307.04	-1773.25
15	2800.00	633.86	1000.00	1166.14	.2394	279.17	-1453.08
16	2800.00	633.86	1000.00	1166.14	.2176	253.75	-1240.33
17	2800.00	633.86	1000.00	1166.14	.1978	230.66	-1009.67
18	2800.00	633.86	1000.00	1166.14	.1799	209.79	-799.88
19	2800.00	633.86	1000.00	1166.14	.1635	190.66	-609.22
20	2800.00	633.86	1000.00	1166.14	.1486	173.29	-435.93
Value of land after 20 years				1000.00	.1486	148.60	-287.33

*Taken from Appendix Table 6.
Net present value = (-)$287.33