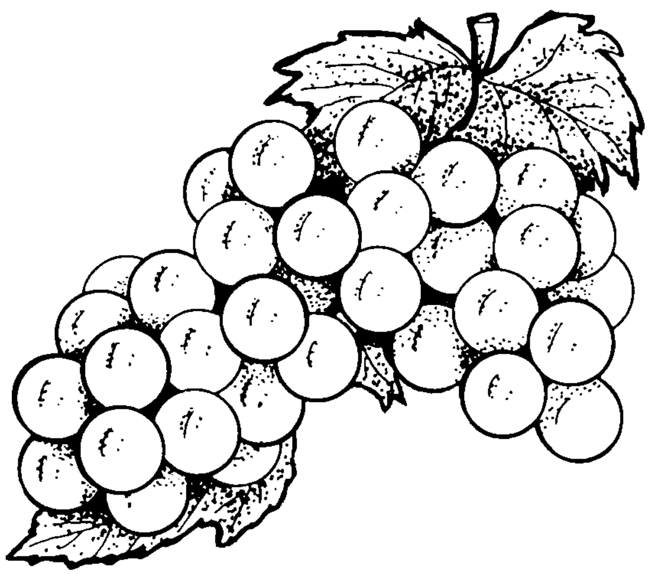
MARCH 1999 R.B. 99-01

ECONOMICS OF DRIP IRRIGATION FOR JUICE GRAPE VINEYARDS IN NEW YORK STATE



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ABSTRACT

Grape growers need investment and cost guidelines for drip irrigation to evaluate the economics of getting vines into production as quickly as possible and to avoid periods of drought during the productive life of the vineyard. The benefits of irrigation may include: better vine survival, earlier fruit production, greater yields, more efficient distribution of nutrients, less plant stress, reduced yield variability and improved fruit quality. Research was undertaken to determine drip irrigation investment and annual costs. This project was designed to assist growers in determining the investment, fixed and variable annual costs and expected returns from drip irrigation.

Irrigation suppliers provided typical equipment needs and investment costs for various drip irrigation designs. Economic worksheets are provided to assist growers in estimating fixed and variable costs of drip irrigation. The economics of yield data were applied to replicated multi-year irrigation studies to assist growers in determining yield response from drip irrigation.

Net present value (NPV) methodology was used to determine the discounted break-even investment results from published responses to drip irrigation. Growers with typical drip irrigation systems and various water sources can expect investments in drip irrigation of $550 to $1,150 per acre with 10 acre blocks of vines. Based upon eight years of data from trials in Fredonia, NY, in the Lake Erie grape belt, average yield increases due to irrigation on establishment and growing of Niagara grapes were 2.8 ton per production year per acre, resulting in a break-even investment of approximately $1,600 per acre. But on established minimal pruned Concord grapes, seven years of data showed a 1.1 ton increase due to irrigation and a break-even investment of only $200 per acre which was well below the total cost of a complete microirrigation drip system. On a new planting of Concords, with droughty soils, the analysis may very well show cost effectiveness.

Growers who were interviewed were unable to quantify the benefits and costs of drip irrigation but were pleased with their irrigated yields and brix responses from drip irrigation. This analysis has provided the economic rationale for the investment in microirrigation with some varieties and under certain soil types.

ACKNOWLEDGEMENTS

The authors are Charles H. Cuykendall, Senior Extension Associate and Gerald B. White, Professor, Department of Agricultural, Resource, and Managerial Economics, Cornell University; Barry E. Shaffer, Area Viticulture Extension Educator (Business Management) Fredonia, NY; Alan N. Lakso, Professor, Horticultural Science, Geneva NY; and Richard M. Dunst, Research Support Specialist III, Taschenburg Laboratory, Fredonia, NY. The authors express their appreciation to Warren C. Stiles, Larry Geohring, and Fran Dellamano for their data and input; and to Warren C. Stiles and Wayne A. Knoblauch for helpful reviews of the manuscript.

Our appreciation is expressed to the growers who were interviewed for this study.

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Economics of Drip Irrigation for Juice Grape Vineyards in New York State

Introduction

Many New York fruit growers face the economic decisions of whether to expand acreage and/or replant existing vineyards. The investment required to establish and develop a vineyard often exceeds $4,000 per acre with little to no economic return for the first two to three years. (White et al. (6) The additional expenditure of around $550 to $1,150 per acre for drip irrigation must be carefully evaluated since it is crucial that the investment in the planting system yields the fastest possible returns. The benefits of irrigation may include: better vine survival, earlier fruit production, greater yields, more efficient distribution of nutrients, less plant stress, reduced yield variability and improved fruit quality. Of course, in wet years irrigation may have little or no effects or even a negative effect. This study determined the discounted break-even investment for both establishing Niagaras and established Concord vineyards.

The objective of this study was to gather information from growers, experiment stations, published reports, and plant scientists to establish a methodology for educators and growers to evaluate the economics of irrigation. This was done by presenting a format for individual growers to analyze their own specific set of resource mix of land, labor, capital and water. This method uses the costs and returns as reported on selected vineyards and at various experiment stations and analysis of the economic response to drip irrigation.

Drip irrigation was chosen for this study because of the often limited on-farm water supply and the need to minimize the wetting of the leaf surfaces in order to minimize the spread of plant diseases. Microirrigation includes any low volume application of water to the soil whether by drip, trickle, or micro-sprinkler/sprayers. Drip irrigation is the application of water through small emitters directly onto or below the soil surface, usually at or near the plant to be irrigated. An analysis of trickle irrigation (a general irrigation scheduling term for slow, low volume, frequent water applications to the soil) versus overhead traveler irrigation was reported by J.W. Worthington (8). In their study in Eastern United States they reported the trickle system, compared to overhead irrigation, used 54 percent less water, 74 percent less energy and 50 percent less investment while the labor cost remained the same. If a vineyard has a limited water supply, there are few alternatives except drip irrigation. Irrigation is not new to New York as a special US Census report in 1955 reported over 58,000 acres under irrigation of some kind and on relatively high value crops (5). The latest US Census of Agriculture information available is 1992, and it indicates that the number of farms in New York State using irrigation has increased while the total acres irrigated have decreased to 46,600 acres. When the 1997 Census data is available it likely will show an increase in both farms and acreage under irrigation due to the technology of microirrigation.

Methodology

To determine irrigation needs, microirrigation system choices and available data, a meeting, followed by several consultation sessions, was held with faculty members of Cornell University.

Those contributing to this project represented research and extension staff from the following departments: Fruit and Vegetable Science; Floriculture and Ornamental Horticulture; Agricultural and Biological Engineering; Agricultural, Resource, and Managerial Economics; Horticultural Sciences; and Cornell and Penn State Cooperative Extension. From these meetings priorities were set, a survey form was developed, and a list of microirrigation users with potential cost and yield data was compiled.

A three-page farm survey on microirrigation was completed on four Central New York fruit farms. The results of this survey clearly indicated that the selected operators could not easily and accurately quantify their microirrigation investments, operating costs or yield response. Since this project was to assist other potential growers in their investment and cost and benefit decisions the written survey results were of limited value. To obtain additional data a total of eight on-farm visits were made by the authors where specific data were gathered on microirrigation investments and operating costs. Since the farms did not have a non-irrigated control plot where water was not applied under similar soils, varieties, and management practices, the authors selected and used Niagara and Concord yield data from replicated, multi-year microirrigation projects as published from the Lake Erie Regional Center for Grape Research and Extension, Fredonia, NY.

To supplement the various investment data received from on-farm interviews, the authors contacted various local microirrigation suppliers and asked them to design a typical system for establishment of a new ten acre vineyard. In addition, the data from the Irrigation Workshop sponsored by Cornell Cooperative Extension of Chemung, Cortland, Tioga, and Tompkins counties was drawn upon to provide system costs and investments using various water sources and irrigation methods. Many research projects today are designed to not only reduce costs but also to protect the environment as well. Drip irrigation seems to contribute to both of these objectives. In addition to increasing productivity, drip irrigation, as reported by D.W. Wolfe (7), may produce a more consistent quality product, conserve energy and water, and reduce fertilizer and pesticide leaching to ground water. Geohring et al. (2) reported that drip irrigation improved efficiency of nitrogen use on peppers, thus, reducing both cost and potential runoff for nitrogen pollution.

The typical investments for various systems were determined, then the operating and fixed costs were assigned. The yield response to microirrigation as reported from controlled experiments was converted to dollars per acre; then the net present value was determined using net present value analysis methods (1). The findings of costs, investments and response to irrigation are presented in table form. The tables include columns for individual growers to analyze their system or projections for their cost analysis of microirrigation.

Investment in Drip Irrigation

The variables that determine the irrigation system, power source and ultimately the amount of capital investment include:

a. water source: distance from desired use, elevation differential, availability

b. acres to be irrigated and frequency of application

c. type of crop and soil

d. existing equipment on the farm

Some reasonable investment estimates can be determined from systems on neighboring farms with similar conditions and from companies who sell and design irrigation supplies.

Local irrigation suppliers estimated typical investment amounts for drip irrigation of grape vineyards (Table 1). The examples shown are for establishing a new 10 acre block with 15 mil tape distribution and a readily available electrical power source. The estimated life for the tape system was specified to be seven years. Many of the growers did not know how long the tape would last, but after five years were experiencing no abnormal repair cost, nor obsolescence. Some of the grape growers in the project indicated that they were using the pressure compensating tube system because of less mechanical damage and related weather problems. The life of pressure compensating tube is specified to be 15 years.

Investment costs per acre used were typical. The investment costs of the water source, power source, filters, valves and many other fittings are fixed costs and do not generally vary with acreage. One will find a range in the per acre investments, but most growers surveyed were irrigating about ten acres with each system, or in a ten acre zone. Some growers were able to mount their pump, sand filter, suction and discharge hose on a two-wheel flat trailer and move this $2,000 - $3,000 investment to other fields that had an available water source. This lowered their fixed costs significantly, as they were able to irrigate more acres with the same portable microirrigation power and filter source.

Annual operating costs will vary dependent upon the frequency of irrigation, amount of water applied per irrigation, cost of municipal water if used, number of zones irrigated, and the degree of mechanization. In general, the variable costs are proportionate to the amount of water pumped. The most important variable cost is labor, which is used for monitoring, repair, maintenance and any required hose or pipe moving. The fixed costs will occur regardless of amount of water used and will generally be the depreciation and interest costs based upon the amount of investment.

Depreciation often amounts to two-thirds to three-quarters of the fixed costs. It can be argued that the more a line is used, the faster it wears out, but realistically a system is depreciated over a straight-line basis over the assumed life. In reality, most of the growers do not know how long the system will last as they have not replaced them but rather have expanded coverage to other acres.

Table 1.

Investment in Drip Irrigation Equipment for Grape Vineyards[1]

	Tape	Tube	Your Farm
3HP Submersible electric pump	$1,300	$1,300	$________
Electrical line up to 500' for service	300	300	________
Filter and check valve	100	100	________
1200 feet 2" poly pipe (60¢/ft.)	720	720	________
1000 feet 1½" poly pipe (37¢/ft.)	370	370	________
Fittings, valves, and clamps	310	310	________
55,000 feet 15 mil tape or press. comp. tube	1,650	7,650	________
Fittings and pressure regulator	150	150	________
Trencher	200	200	________
Labor (4 man days)	400	400	________
Other:*________________________________			
TOTAL	$5,500	$11,500	$________
Per Acre	$550	$1,150	$________

*Your "other" should include if applicable:

1. In place of electric investments, you may have 5HP gas pump, fittings and suction approximating $800.
2. Filter and check valves for pond or stream would cost $900 additional.
3. Different footage of materials for higher or lower density plantings.

[1]Existing 30 gpm well will supply 5 zones, on a nearly level 10 acre field with 8' row width.

Operating Costs

These costs vary with the design of the system, intensity of use (as dictated by weather), degree of mechanization, water source, mechanical damage and age of the installation. To get an economic evaluation of the irrigation system, the operating costs as well as the additional revenues generated must be estimated accurately.

Typical operating costs are listed in Table 2. The power source includes electric, gas or diesel fuel. Repair costs have been reported as nominal in the earlier years. Labor costs are variable and depend upon the system. Growers reported the labor cost of detecting leaks, but once found, the cost of repair is small for plastic inserts or plugs compared to the labor expended in routine checking of the system.

Table 2.

Annual Operating Costs (per acre) for Drip Irrigation[1]

	Typical	Your Farm
Power Source	$25.00	$ _________
Repairs	45.00	__________
Labor: Spring, Summer, Fall	68.00	__________
Additional Fertilizer, Pesticide and Application Cost	--.--	__________
Additional Product Harvesting, Hauling and Marketing[2]	--.--	__________
City Water Metered		__________
Total	$138.00	$ _________

[1]Combination of survey and engineering formulas.
[2]Variations dependent upon year and variety; used harvest and hauling costs of $37.00 per ton. (White, et al. 4)

Hired labor and management labor can fall into either or both operating and fixed cost allocations. Much of the labor hired to operate and manage this important technology is fixed.

When asked to estimate total labor requirements for the system many growers allocated a spring start up time, a weekly operating and scouting time, plus a fall shut down. Labor and management costs were allocated at a rate of $8.50 per hour in the typical cost column. This rate was based upon average New York hired labor rates and fringe benefits reported by New York Agricultural Statistics 1996, adjusted for inflation.

When any management operational change in methodology or a new technology like microirrigation is adopted, it should result in increased saleable product or quality. When the microirrigation results in increased yield, the costs to harvest, haul and market an additional product must be included in your total cost analysis.

Those irrigation systems with a direct water charge, like a city meter, should include this as an operating cost. Growers with city water experienced no filter costs, but more in labor and piping charges to get the water to the desired location.

Fertigation

Fertigation allows nutrients dissolved in water to be more quickly delivered to the root zone. This is an additional potential benefit of microirrigation that may affect yield, quality and growth. The fertigation cost will vary depending upon whether fertigation is used for supplemental or all nutrient applications. Those that applied fertilizer through irrigation felt that they must purchase easily soluble nutrients and closely monitor the system for any leaks or "blowouts". Those who used fertigation reported reduced costs of application but higher initial investment costs of electrical technology and storage.

Fixed Costs

Grape growers who already have an investment in irrigation equipment can often adapt existing water sources and power sources into use for microirrigation. Those who design and purchase a new system must allocate costs based on the life of the system as shown in Table 3. An interest or opportunity cost of capital, based upon half the investment costs, has been allocated at 8 percent in Table 3. There is a 23 percent difference in the fixed cost allocation estimates mainly due to less capital investment for the tape versus pressure compensating tube system.

Table 3.

Annual Fixed Cost (per acre) for Irrigation System

Annualized Fixed Costs	15 mil tape[1]	Pressure Compensating Tubing[2]	Your Farm
Depreciation	$78.00	$77.00	$___________
Interest[3]	22.00	46.00	____________
Insurance	--.--	--.--	____________
Total	$100.00	$123.00	____________

[1]Based on 7 year straight line life and $550 per acre investment on 10 acres.
[2]Based on 15 year straight line life and $1,150 per acre investment on 10 acres.
[3]Based on 8 percent cost of borrowed funds.

Annual Costs

Annual costs are the sum of operating costs (Table 2) and fixed costs (Table 3). Investment decisions are made based upon estimation of both fixed and variable costs plus the projected net additional receipts as shown in Table 4 and Table 6. Many factors, such as the value of juice brix improvement, timeliness to market, and risk aversion are hard to quantify, but should enter into the decision to acquire new technologies like drip irrigation. Any technology that on paper indicates a break-even may be well worth the risk reduction afforded by the ability to make timely applications of water to reduce drought in a very dry period, considering that drought can affect both the current season and the following year's performance.

Yield Response

Drought in vineyards will reduce vine productivity if water becomes limited. In the Northeast historically, there are years with severe limiting water conditions, perhaps two or three years out of ten. With vineyard practices like higher planting densities and minimal-pruned vines, this increases the demand for water. The use of drip irrigation can meet the additional needs of certain varieties and cultural practices in New York State in dry years.

Table 4.

Effect of Drip Irrigation on Annual Yields of Establishing and Growing Niagara Vineyards[†]

	Tons Per Acre								Cumulative	
Years	90	91	92	93	94	95	96	97	Total	Per Year*
No Irrigation	0	0	4.6	7.7	7.1	11.1	13.1	11.8	55.4	9.2
With Irrigation	0	0	10.0	9.0	11.9	12.5	18.5	9.8	71.3	12.0

*Significantly different at the 5 percent level.
[†]Vines were planted in 1990 and were balance pruned at 20+20 (20 buds/lb. pruning weight). Vineyard floor management was residual herbicides under the row and bloom treatment of row middles with glyphosate.

Table 4 indicates the effect on yields of Niagara grapes, which were established and grown with and without supplemental drip irrigation practices on a deep gravelly soil at Cornell's Vineyard Laboratory in Fredonia. In each year except 1997, there was a positive effect (Table 4.) due to the drip irrigation. In 1996 the irrigated vines produced 5.4 tons per acre more than the non-irrigated vines. The very heavy 18.5 ton/acre crop in 1996 caused a negative effect of 2.0 tons per acre the following year with irrigation, although 9.2 tons/acre is still above the commercial average yields for Niagaras.

In both Niagara establishment and the Concord pruning trial, the floor management was a water-conserving approach of residual herbicides under the vines and bloom-time glyphosate in the row middles. Water-conserving floor management and the deep soil, help the natural water balance so will reduce the need for irrigation. Conversely, competition by cover crops likely will increase the need and economic benefits of irrigation. It is important to note that 1991 was a very warm, sunny, dry year (Table 5.). With irrigation the young vines were able to grow much more. This resulted in an above average increase in yield for 1992 irrigated plots.

Table 5.

Annual Rainfall in Inches
At Vineyard Lab in Fredonia, NY

Years	Rainfall May-Sept	Diff. From 30 Year Average
1990	22.1	4.1
1991	12.2	-5.8
1992	22.3	4.3
1993	15.9	-2.1
1994	19.8	1.8
1995	12.9	-5.1
1996	23.0	5.0
1997	24.2	6.2
Average 90-97	19.0	1.0
30 Year Average	18.0	

Table 6.

Effect of Drip Irrigation on Annual Yields of Mature Minimal Pruned Concord Vineyards

	Tons Per Acre							Cumulative	
Years	90	91	92	93	94	95	96	Total	Per Year*
No Irrigation	10.7	12.4	10.1	10.9	12.2	11.8	12.6	80.7	11.5
With Irrigation	11.4	14.6	11.4	10.1	14.0	11.4	15.3	88.2	12.6

*Significantly different at the 5 percent level.

In a similar drip irrigation experiment, on mature Concords, at the same location in Fredonia, the results were different. In a report of continuing research for 1996 Lakso et al., reported that drip irrigation does not pay with the balanced or 80 node pruning regimes. However, established Concords with minimal pruning and with irrigation, showed a 1.1 ton per acre average increase from 1990 to 1996 over the non-irrigated vines (Table 6). In 1993 and 1995 (dry years) the non-irrigated yields exceed the irrigated yields by .8 and .4 tons per acre, respectively. The following years of 1994 and 1995 showed significant positive carryover affects of the irrigation. Lakso et al. (3) reported that the primary effect of irrigation on minimally-pruned vines was to reduce variability among plots with different soil water holding capacities as mean block yields varied from 11.5 to 12.6 tons per acre for irrigated, and 10.0 to 12.4 tons per acre for the non-irrigated plots.

Economics of Drip Irrigation – New Planting

Table 4 indicates the annual and accumulated yield increase of Niagara grapes due to trickle irrigation. A partial budget of additional receipts and estimated additional costs was used in Table 7A and 7B to construct a net present value analysis at a 10 percent discount factor (8%

interest + 2% risk). Credit was given for the remaining estimated salvage value of the pump on the tape system in Table 7A and for the pump and tube system in Table 7B.

In establishing Niagara vineyards with the tape drip irrigation system, the present value method shows a value of $771 after an initial investment of $550 per acre. If a loan was obtained to finance the system, repayment of the investment would start in the fifth year after only $17 available for repayment, for the first four years. Full farm analysis would be used to see if the current cash flow would service the additional debt until year five. The analysis indicates that in present value terms, a grower could spend up to $1,321 per acre for a tape drip microirrigation system and break even.

Table 7A.

Net Present Value of Installation of Drip Irrigation (Tape) on Niagara Vineyard Establishment (1 Acre)

Year	Inc. Yield Tons/Acre	$ Additional Receipts[1]	$ Additional Costs[2]	$ Net Revenue	10 Percent Discount	NPV $	Cum. NPV $
0	(Initial Investment)				1.000	-550	-550
1	X	X	138	-138	.9091	-125	-675
2	X	X	138	-138	.8264	-114	-789
3	5.4	1,296	338	958	.7513	720	-69
4	1.3	312	186	126	.6830	86	17
5	4.8	1,152	316	836	.6209	519	536
6	1.6	384	197	187	.5645	106	642
7	1.6	384	197	187	.5132	96	738
7	(Salvage Value for Pump $65)				.5132	33	771
Totals	14.7	3,528	1,510	2,018		771	

[1]Calculated on $240.00 net receipts per ton.
[2]Includes operating costs of $138.00/ac. and harvest and hauling costs at $37 per ton.

For the net present value analysis the sixth, seventh, and eighth year yields were averaged and used in the sixth and seventh year. This was done because of the seven year tape life. By the sixth year, yields have probably reached their long-term trend, and annual variations of the difference between the irrigated and non-irrigated yields are due to variable weather effects.

For the pressure compensating tube system on Table 7B the present value method shows a value of $451 after an initial investment of $1,150 per acre. The analysis indicates that in present value terms, a grower could spend $1,601 per acre for the pressure compensating tube system and break even.

One will note in the eighth year, the irrigated plots had a two ton per acre smaller yield than the non-irrigated plots. This was due to over cropping the previous year where the irrigated plots produced 5.4 tons per acre more than the non-irrigated plots. The negative receipts and appropriate costs were charged against the irrigation system.

Table 7B.

Net Present Value of Installation of Drip Irrigation (Tube) on Niagara Vineyard Establishment (1 Acre)

Year	Inc. Yield Tons/Acre	$ Additional Receipts[1]	$ Additional Costs[2]	$ Net Revenue	10 Percent Discount	NPV $	Cum. NPV $
0	(Initial Investment)				1.000	-1,150	-1,150
1	X	X	138	-138	.9091	-125	-1,275
2	X	X	138	-138	.8264	-114	-1,389
3	5.4	1,296	338	958	.7513	720	-669
4	1.3	312	186	126	.6830	86	-583
5	4.8	1,152	316	836	.6209	519	-64
6	1.4	336	190	146	.5645	82	18
7	5.4	1,296	338	958	.5132	492	510
8	-2.0	-480	64	-544	.4665	-254	256
8	(Salvage Value for Pump and tubing $418)				.4665	195	451
Totals	16.3	3,912	1,708	2,204		451	

[1]Calculated on $240.00 net receipts per ton.
[2]Includes operating costs of $138.00/ac. and harvest and hauling costs at $37 per ton.

The net present value, based upon the yield response comparing the two irrigation systems (tube and tape), is $451 to $771 at a 10 percent discount factor. Since the net present value is positive, it will return more than 10 percent used in the analysis. In this study the internal rate of return would be 18% for the tube irrigation system and 31% for the tape system. These returns are far above the cost of capital for most farms; one would conclude that either investment is economical. Based upon the positive values it would pay to make the investment, but projected yields, lower product prices, higher costs, or shorter equipment life may reduce the net present value available for investment projections. Careful and complete analysis is very important. Your analysis on your farm with your given set of acres, labor, risk tolerance, the level of the land and water availability will determine whether you should establish or add drip irrigation to your operations.

Drip Irrigation on Mature Concords With Minimal Pruning

The yield response and net present value data from the Lake Erie Regional Center for Grape Research and Extension in Fredonia, NY on established Concords with minimal pruning are presented in Table 8. The net revenue from microirrigation over the seven years from 1990 to 1996 is $257 per acre. Even without a net present value analysis, this revenue from the additional 1.1 ton per acre per year due to irrigation is not enough to purchase or pay back either a tape or tube microirrigation system. It should be noted that these results were obtained on a 30-year old Concord vineyard on a deep gravel soil. It is possible that on new plantings of Concords, especially on soils with limitations or with permanent sod competition, would also demonstrate net economic benefits from irrigation.

Table 8.

Net Present Value of Installation of Drip Irrigation (Tape) on Mature Concord Vineyard with Minimal Pruning (1 Acre)

Year	Inc. Yield Tons/Acre	$ Additional Receipts[1]	$ Additional Costs[2]	$ Net Revenue	10 Percent Discount	NPV $	Cum. NPV $
0	(Initial Investment)				1.000	-550	-550
1	0.7	140	164	-24	.9091	-22	-572
2	2.2	440	219	221	.8264	183	-389
3	1.3	260	186	74	.7513	56	-333
4	-0.8	-160	108	-268	.6830	-183	-516
5	1.8	360	205	155	.6209	96	-420
6	-0.4	-80	123	-203	.5645	-115	-535
7	2.7	540	238	302	.5132	155	-380
7	(Salvage value for pump $65)				.5132	33	-347
Totals	7.5	1,500	1,243	257		-347	

[1]Calculated on $200.00 net receipts per ton.
[2]Includes operating costs of $138.00/ac. and harvest and hauling costs at $37.00 per ton.

There may be other circumstances that would influence your investment decision, such as, yield response being greater due to droughty soils, risk aversion required by your lender, lower investment projections due to more acreage to spread fixed costs over. In any net present value analysis it is important to select a discount rate appropriate for the farm investment (See Casler et al. (1) for a discussion of selection of a discount rate.)

Other Effects Of Irrigation

In a study at Fredonia on establishing and continuing Niagara vineyards, it was found that over the first four years, fertigation had no effect other than the benefits of irrigation water. In 1996, while the yield of the irrigated plots was significantly larger (at the 5% level) the clusters per vine were more (at the 5% level) but the juice brix was less than 1 degree lower in the irrigated treatment. This reduction must be evaluated further as it may affect the economic evaluation of the irrigation technology if the reduction in sugar levels fall below that acceptable by grape processors.

Economics of Drip Irrigation – Existing Planting

Due to limited land resources and the high cost of vineyard establishment some growers are installing drip irrigation on established vineyards. The data in Table 9 indicated the net average yield of 1.08 to 3.6 tons per acre needed to justify an investment of $550 to $1,150 per acre in an established vineyard. The yield responses in the establishment of Niagaras had results comparable to those shown in this table, while the established Concords did not respond to these levels under conditions previously described.

Table 9.
Average Yield Increase Per Acre Required for 5 Years, at Various Prices for Irrigation Investment Recovery From Existing Grape Vineyards

Price/ Ton	Yield Increase Each Year[1]	Operating Expenses[2]	Nominal Value of Net Ret.[3]	10 % Discount Factor[4]	Present Value[5]
Tape Investment					
$160	2.30 ton	$223	$145	3.791	$550
$200	1.75 ton	$203	$147	3.791	$557
$240	1.40 ton	$190	$146	3.791	$553
$300	1.08 ton	$178	$146	3.791	$553
Pressure Compensating Tube Investment					
$160	3.60 ton	$271	$305	3.791	$1,156
$200	2.70 ton	$238	$302	3.791	$1,145
$240	2.20 ton	$219	$309	3.791	$1,171
$300	1.70 ton	$201	$309	3.791	$1,171

[1] 5 production years average increase
[2] Assumes $138/acre operating and harvesting and hauling costs of $37/ton.
[3] Gross receipts minus operating and harvesting costs of additional fruit.
[4] Present value factor of $1.00 received annually at the end of each year for 5 years.
[5] Present value near the estimated investment for tape or compensating pressure tubes from Table 1.

Summary and Implications

Interviews of grape growers, research associates, suppliers and published research were obtained to provide data on the adaptation and results of microirrigation of grape vineyards. All growers reported positive results with microirrigation, but were unable to quantify their costs and benefits. They reported that the consequences of too little water availability in drought years easily offset the investment and operating costs of a microirrigation system.

The response curve to microirrigation in certain varieties is very favorable under typical New York State moisture conditions and one may justify the investment and costs if water is available. Wide variations exist in costs due to the source of water, location of water and power, and the topography to be irrigated.

Our analysis showed that both pressure compensating tubing (15 year projected life) or 15 mil tape (7 year projected life) would be profitable investments in establishing Niagara juice-grape vineyards in Western New York. The tape reached a discounted payback in the fifth year and the tubing in the seventh year after the investment. Furthermore, we found that the break-even yield increase necessary for irrigation (using pressure compensating tubing) was 1.7 tons to 3.6 tons per acre for prices of $300 down to $160 per ton. The break-even yield increase for the tape system was 1.08 to 2.3 ton per acre, dependent upon the market prices. These yield increases are attainable in some vineyards, especially where soils are limiting because they are shallow, sandy, or subject to poor nutrition.

The greatest probability that irrigation systems will be beneficial should occur in vineyards on shallow soils with low water holding capacity, with permanent cover crops, and with young establishing vines. This would be especially beneficial to own-rooted Niagaras, or with mature, heavily-cropped systems like minimal pruning or Geneva Double Curtain. Conversely, lightly cropped single curtain and heavily pruned vines on heavier deeper soils will need less water and should show less response from irrigation.

While some growers have installed the pressure compensating tubing, the tape system has a place in farm situations where the area to be planted is level and where capital is limited. Much of the benefit from drip irrigation is often realized in the first five years of a new planting, (Niagara's continued to show benefits after 5 years) and the tape system permits the attainment of these early benefits for much less investment.

Growers will continually face increased investment costs in additional and reestablished vineyards. To mitigate the economic risk of drought and to get more rapid production they will be likely to adopt microirrigation. Growers who have existing irrigation systems will continue to add more zones of irrigation dependent upon their available water supply.

This analysis provides a methodology to make an informed estimate about combining the specific set of resources on your farm. Many times the irrigation investment decision is driven by risk reduction, alternative investments, debt capacity, and most importantly, water availability. The reduction in water requirements with microirrigation systems compared to overhead irrigation, which wets the total area, has made microirrigation an economic and an environmentally friendly alternative. All of the progressive farmers surveyed were convinced that microirrigation pays on their farms, but they had little data to prove their assumption. This analysis has proved the economic rationale for the investment in microirrigation for Niagara establishment, but not for the established Concord cultivar.

The economic work was supported through Hatch Project No. 536, USDA. The vineyard trials were supported by grants from the NY Wine/Grape Foundation and the NY Grape Production Research Fund to A. Lakso.

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