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Economic Feasibility of Grape Production in Idaho

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Summary

Objective of this study was to evaluate the economic feasibility of producing grapes in Idaho. The history of past grape production, as indicated in the U.S. Census of Agriculture since 1910, was explored revealing grapes have been produced in Idaho in commercial quantities since before 1910.

Estimates were made on the acreage required to support a winery or juicing plant. Development of budgets for the grape enterprise was also investigated using various yield levels and estimating optimal life of vineyards for each yield level considered. The yield levels were 5 tons per acre through 8 tons per acre. Budgets used an assumed constant price of $120 per ton for grapes.

The yield data and associated gross and net income estimates for the grape enterprise were based on assumed average annual yields; therefore, the average income was constant over the period analyzed. These expected net incomes were discounted to determine future incomes and were used to determine an optimal life of the grape enterprise. Discount rates ranging from 3 to 8% were assumed in the optimal life analysis, to reflect differing methods of valuing expected future incomes. The optimal life of vineyards varied depending on the discount rate used to define the individual's preference for future income.

Once the budgets for the grape enterprise were developed, the next step was to plan budgets for the competing crops. The assumption was that if grapes were to be produced, they should have as much net income as the crops which are currently being grown. Crops currently being grown were identified and 4 common crop rotations were developed. In addition, the hop enterprise was budgeted. For hops, the same type of optimal life model used for grapes was employed to determine the optimal life of the hops enterprise.

After data were collected and the crop budgets developed, the internal rates of return for the perennial crops were calculated and compared to the annual rates of return from the crop rotation. The average annual internal rate of return for grapes varied from 14 to over 36%, depending on the yield and discount rate used in the analysis. The 14% internal rate of return was achieved for the 5 ton per acre yield and a 7% discount rate. The 36% rate of return was earned at the 7 and 8 ton yield levels and varying discount rates. The annual rates of return varied from 6 to 29% for the annual crop rotations. The internal rate of return for the hops enterprise was 39% at the 7% discount rate.

The conclusion was that with an expected internal rate of return in excess of 22.5% for the 6 to 8 ton per acre yield levels, grapes should compete effectively with annual crops produced in the area. Compared to hops, the yield levels for grapes would have to be 7 to 8 tons, under the prices assumed in the analysis. Potentially, the grape enterprise may tend to dominate the annual enterprises at the middle yield levels – 6 tons per acre – where grapes can be grown.

Analysis indicates the grapes industry could be significant to Idaho agriculture, depending on the variety of grapes grown and the ability of those types to adapt to Idaho climatic conditions. Because the grape plant itself has varied responses to cold temperatures, the variety of plant and the type of end product being produced must be identified.

Development of a high quality table wine process utilizing the low yielding vinifera varieties is unlikely. If the French hybrid – Seibel varieties – is desired for high quality table wine production, the competitive position becomes better under the assumed growing conditions of Idaho.

If determined that wine grape production is too risky, then Idaho growers could turn to the Concord variety, which in Idaho is capable of 8 ton yield levels. These grapes are well established in southwestern Idaho and are quite competitive with other crops at the assumed price of $120 per ton. The Concord variety is a wine grape as well as a juice and jelly grape. This flexibility may be desirable.

The grape enterprise appears to be able to compete with commonly grown field crops and hops. A limiting factor could be its range of climatic adaptation. The annual rates of return for field crops varied from 6 to 29% compared to the internal rate of return for grapes which varied from 14 to 36%. The hop enterprise does compete strongly with the grape enterprise, except for the highest yield levels assumed for the grape enterprise. Another factor which should be considered is a relatively small acreage is all that's needed to support a winery – 167 acres for a 100,000 gallon winery for an assumed yield of 4 tons per acre and half that acreage for a 100,000 gallon winery using 8 ton per acre yield. This consideration is important because small acreages with the site requirements may be found under Idaho conditions.

The impact of adverse weather does not appear to be an absolute limitation to the development of a wine industry in Idaho. The loss of a crop every 7 years does reduce the expected net income from the grape enterprise, but only marginally. A slight increase in the price of grapes would more than offset the effects of crop loss due to weather. With occasional vine winterkill, under the conditions considered in this analysis, a grower could afford to replant, except for the lower yield levels; if prices were increased, a grower could afford to replant for all levels.

Based on the analysis, the grape enterprise should be seriously but carefully considered as an alternative crop in Idaho. The grape enterprise has considerable flexibility in variety and product. In areas where climatic risks are high, the Concord variety may be grown, which can be utilized for jam, jelly, juice and wine. In lower risk areas, the French Seibel varieties may be used to produce wines under relatively less severe weather conditions. Where the climatic conditions are suitable, some vinifera varieties may be grown to produce varietal wines.

Table 1. Grape production in Idaho by counties, 1910-1969.

Counties	Census Years											
	1910	1920	1925	1930	1935	1940	1945	1950	1954	1959	1964	1969
Ada	X	X	X	X	X	X	X	X	X	X	X	
Adams		X	X	X	X	X	X	X	X	X	X	
Bannock				X		X	X	X	X	X	X	
Bear Lake				X	X							
Benewah			X	X	X	X	X	X	X	X	X	
Bingham	X	X	X	X	X	X	X	X	X	X	X	
Blaine				X				X				
Boise	X	X	X	X	X	X	X	X	X	X	X	
Bonner	X	X	X	X	X	X	X	X	X	X	X	
Bonneville					X	X						
Boundary		X	X	X	X	X	X	X	X	X	X	
Butte								X				
Camas								X				
Canyon	X	X	X	X	X	X	X		X	X	X	X
Caribou					X				X			
Cassia	X	X	X	X		X	X	X	X	X	X	
Clearwater		X	X	X	X	X	X	X	X	X	X	
Custer												
Elmore	X	X	X	X	X	X	X	X	X	X	X	X
Franklin		X	X	X	X	X	X	X	X	X	X	
Gem		X	X	X	X	X	X	X	X	X	X	X
Gooding		X	X	X	X	X	X	X	X	X	X	X
Idaho	X	X	X	X	X	X	X	X	X	X	X	
Jefferson				X	X	X	X	X	X	X	X	
Jerome		X	X	X	X	X	X	X	X	X	X	X
Kootenai	X	X	X	X	X	X	X	X	X	X	X	
Latah	X	X	X	X	X	X	X	X	X	X	X	
Lemhi		X	X	X	X	X	X	X	X	X	X	
Lewis		X	X	X	X	X	X	X	X			
Lincoln	X	X	X	X	X	X	X	X		X	X	X
Madison								X	X	X	X	
Minidoka		X	X	X	X	X	X	X	X	X	X	
Nez Perce	X	X	X	X	X	X	X	X	X	X	X	
Oneida	X	X		X	X	X	X	X				
Owyhee	X	X	X	X	X	X	X	X	X	X	X	
Payette		X	X	X	X	X	X	X	X	X	X	X
Power					X	X	X	X	X			
Shoshone						X	X	X	X	X	X	
Twin Falls	X	X	X	X	X	X	X	X	X	X	X	X
Valley								X	X			
Washington	X	X	X	X	X	X	X	X	X	X	X	X
Total	16	27	27	32	32	33	32	36	33	30	30	9

Economic Feasibility of Grape Production in Idaho

The research reported was initiated through a Short Term Applied Research (STAR) grant program administered by the University of Idaho. This feasibility study was part of a comprehensive study which aimed at determining the economic feasibility of a grape and wine industry in Idaho. Interest in this study stemmed from an increasing demand for wine in the United States. Wine consumption per capita has increased 50% the past 15 years and is projected to increase an additional 50% by 1980 (2).

This study was to determine the economics of producing grapes in Idaho. The competitive situation of grapes vis-a-vis other crops was the problem to be researched. A complicating factor in this procedure was grapes are a perennial crop, not an annual one. Therefore, one had to account for the time that the land was devoted to grape production. To do this, all future income was determined — discounting the return expected from grapes — and compared to the returns expected from other crops that could have been produced in the area.

Another problem was very little history existed of commercial grape production in Idaho. Most of the commercial plantings are less than 10 years old and mainly the American Concord variety. Only detailed information available was from a vineyard owner near Caldwell, who has grown the Seibel variety of French hybrids for about 10 years. His yields varied annually from 2 to 8 tons per acre. Although the grower at this vineyard did not keep detailed cost-of-production records, he did provide considerable information comparing his costs with those reported in a Washington State University Farm Business Management Report (2). This report indicated costs of production very similar to his.

Very little literature revealing costs of producing grapes in the Pacific Northwest existed and there were no such studies for Idaho, mainly because very few farmers have seriously considered Idaho as a grape-producing state.

Objectives

1. Develop budgets for alternative grape varieties.
2. Evaluate the opportunity of grape production compared to other crops.
3. Evaluated the economic risk of grape production in Idaho.

History

Grape growing has a long history in Idaho. The first "Census of Agriculture," taken in 1910, indicates there were 68,269 vines producing 604,227 lb. of grapes (1). The most bearing and non-bearing vines were reported in 1930 with 126,235 reported. producing 1,056,071 lb. of grapes. The maximum grape production occurred in 1935 when 109,349 vines produced 1,160,876 lb. Since 1930, number of grape vines declined with the fewest in 1964 — 18,632 vines producing 204,641 lb.

The number of counties which have produced grapes in Idaho is surprising, with 16 counties growing grape crops in 1910 (Table 1). This may not be accurate, since not all of the present counties had been created and some areas were not included in counties. Counties reporting grapes numbered 36 in 1950. Between 1950 and 1969 the number of counties in Idaho reporting grapes decreased to 9.

Table 2. Estimated Idaho grape acreage, 1935-1969, for selected counties[1]

Acres By Counties	Census Years								
	1930	1935	1940	1945	1950	1954	1959	1964	1969
Ada	28.9	35.8	19.6	12.3	7.8	6.3	3.3	1.5	--
Canyon	57.0	35.0	36.6	22.9	27.5	29.6	20.5	25.9	117.0
Clearwater	3.5	3.9	1.3	3.8	0.9	0.4	0.4	0.3	--
Elmore	2.0	1.7	2.5	1.4	3.9	0.4	2.2	0.4	0.3
Franklin	7.3	2.5	1.2	0.3	1.6	2.0	1.2	1.6	--
Gem	29.1	13.9	28.7	18.4	9.3	18.3	14.6	12.7	5.0
Gooding	15.4	15.0	9.2	5.1	4.8	1.4	2.4	1.9	3.0
Idaho	5.9	4.8	1.8	2.4	1.5	0.4	0.4	0.3	--
Nez Perce	44.5	54.3	26.5	13.4	8.5	5.1	1.6	1.2	--
Owyhee	3.8	0.4	0.5	1.9	1.9	0.6	0.4	0.2	--
Payette	0.5	3.8	7.7	2.0	4.0	1.6	2.2	1.1	16.0
Twin Falls	29.5	18.3	19.6	8.4	7.3	3.1	4.0	0.6	1.0
Washington	1.4	1.2	2.8	0.7	3.4	0.6	1.3	0.2	15.0
State	257.3	223.2	180.8	109.1	97.1	73.7	56.7	49.5	159.0

[1]Source of data was Census of Agriculture

Table 3. Estimated Idaho grape yields for selected counties[1]

Ton/Acre By Counties	1935	1940	1945	1950	1954	1959	1964	1969
Ada	2.9	2.3	1.9	2.1	0.1	1.7	2.9	--
Canyon	2.8	3.2	2.6	4.0	1.0	2.1	3.2	1.8
Clearwater	1.7	1.8	1.2	1.1	0.2	0.6	0.7	--
Elmore	3.6	4.5	3.0	3.6	0.5	0.7	2.4	1.9
Franklin	1.9	2.7	3.5	0.8	--	3.9	1.5	--
Gem	4.4	2.2	3.0	4.4	1.9	4.3	1.8	0.6
Gooding	1.8	3.6	1.8	1.3	1.4	1.9	1.1	1.0
Idaho	2.0	3.0	2.0	1.4	1.6	2.2	1.7	--
Nez Perce	1.8	1.9	5.0	2.9	1.2	2.0	1.9	--
Owyhee	5.2	0.6	1.0	2.2	2.1	3.0	5.5	--
Payette	4.4	3.6	1.6	1.5	2.1	2.8	3.4	1.1
Twin Falls	4.3	2.6	4.0	2.6	1.6	2.1	1.8	0.8
Washington	2.9	4.2	2.3	1.1	1.4	1.1	3.9	2.7
State	2.6	2.6	2.7	2.8	1.2	2.6	2.6	1.7

[1]Source of data was Census of Agriculture.

The largest acreage of grapes estimated[1] for Idaho was 257.3 acres in 1930 (Table 2). The area declined to a low of 49.5 acres in 1964. The state's reported grape acreage has since increased to 159.0 acres, mostly in commercial Concord grape plantings.

According to estimates of 490 vines per acre, 6 counties historically had a significant acreage of grapes before 1964 — Ada, Canyon, Gem, Gooding, Nez Perce and Twin Falls. In 1969 Canyon, Payette and Washington counties reported relatively large increases in acreages, reflecting greater interest in the grape enterprise by Idaho farmers (Table 2).

Another measurement of grape production in Idaho is the review of average yield per acre (Table 3). Yields per acre varied from 0.1 tons in 1954 in Ada County to 5.5 tons in Owyhee County in 1964. Applying a 15% yield inflation factor, 5.5 tons is equivalent to 6.5 tons per acre for the bearing acreage.[2] Finding yields 3.0 to 4.0 tons per acre was not uncommon. Average state yields in census years have varied between 1.2 tons per acre in 1954 to 2.8 tons per acre in 1950.

Yields reported in the Census were assumed to be less than maximum because most of the counties were not commercial producers. Grapes were grown mainly for home use. If these producers were commercial operations, yields would have been higher.

[1]Census reports prior to 1969 did not include acreage statistics. Acreage estimate for these years was made by assuming the average number of grapevines per acre was 490 (common planting distance).

[2]Yields were estimated for the total acreage planted to grapes since consistent data on bearing and nonbearing vines were not available. Yields tend to be conservative because acreage on which they are based included bearing and nonbearing vines. The average grape yields were biased downward approximately 15% using total acreage rather than the bearing acreage only.

The majority of grapes grown in Idaho were American varieties, which are more hardy than the French types. In Canyon, Clearwater and Nez Perce counties, vinifera grape and French hybrid varieties have been successfully grown on a quasi-commercial basis. There is potential for grape production in Idaho provided:

1. Climatic factors are not too limiting.
2. Appropriate processing facilities are provided.

The first condition is critical because a consistent production pattern needs to exist before a grape industry can be established. The second condition can be fulfilled only when, and if, grape producers could supply a sufficient quantity of grapes to meet the minimum capacity requirements for the economic operation of juicing plants or wineries.

Table 4. Acres of grapes required to support a winery processing facility (5)

Yield/ Acres	Volume of winery or juicing plant (1000's of gallons)				
	100	250	500	750	1,000
4 tons	167	417	834	1,253	1,667
5 tons	134	334	667	1,000	1,334
6 tons	112	278	556	834	1,112
7 tons	96	239	477	715	953
9 tons	84	209	417	625	834

Note: The capacity estimates were based on 150 gallons of grape juice per ton of grapes.

The relationship between yield and capacity of juicing plants for a winery or concentrating grape juice are indicated in Table 4. If the capacity of the processing plant is 500,000 gallons of juice, area needed to supply this would be 834 acres, assuming a 4 ton average yield; 667 acres with a 5 ton average yield; 556 acres with a 6 ton average yield; 477 acres with a 7 ton average yield; and 417 acres with an 8 ton average yield per acre.

The resulting conclusion suggests extremely large acreages of grapes would not be required to begin a processing industry in Idaho. In fact, if a considerable acreage develops, more than one processing facility would be required. Grape production in the Pacific Northwest is based on Concord variety — concentrated to make grape juice, jellies, jams and frozen grape concentrate — which is already well established in the lower Yakima Valley of Washington. Success of the Idaho grape producer will depend on these factors:

1. Pacific Northwest demand for grapes for processing, juicing and wine.
2. Expansion of grape production in Washington.
3. Climatic factors affecting Idaho producers' ability to grow grapes.

Input-Output Data

Field data in this study — obtained from interviews and visits with 2 Idaho grape growers in the Caldwell area — determined the grape growers had basically relied on the "Costs of Establishing Concord Grapes on the Vertical Trellis in the Yakima Valley"(2). A difference was grapes had to be hauled from Caldwell to Prosser, Wash., at a subsidized hauling cost of $8.50 per ton.

Data from the WSU Extension publication were used to develop grape enterprise budgets for this feasibility study, modified to fit Idaho conditions and assumptions concerning yields and the expected life of vineyards.

Costs for alternative crops were obtained from data collected on alfalfa seed, alfalfa hay, barley, corn, grain, potatoes, sugar beets and sweet corn (6). Cost data were also obtained for hops from a WSU study (3).

From a monetary standpoint, price used to estimate the value of grapes was $120 per ton — conservative for wine grapes but in line with the prices expected for Concord grapes. This was

Table 5. Estimated per acre costs and returns for establishing vineyards in Idaho, 1971[1]

	1st year	2nd year	3rd year	4th year	5th year	6th & more years
Establishment Costs						
Land preparation	8.82					
Field survey on staking	4.67					
Plants[2]	122.50	18.75				
Planting (8x10 ft. spacing)	27.75	20.00				
Trellising		401.35				
Subtotal	163.74	440.10				
Annual Growing Costs						
Cultivating & weed center	40.50	36.72	34.72	24.72	24.72	24.72
Irrigation[3]	11.30	9.30	9.30	9.30	9.30	9.30
Insect & disease control	4.25	4.25	4.25	14.55	14.55	14.55
Summer training of vines		52.00	9.00	4.50	4.50	4.50
Prune string and tieing		45.20	56.90	61.80	61.80	61.80
Cover crop			7.50	7.50	7.50	7.50
Chopping vines				5.15	5.15	5.15
Fertilizer				7.50	7.50	7.50
Subtotal	56.05	147.47	121.67	135.02	135.02	135.02
Harvesting Costs						
Harvesting[4]			36.00	54.00	85.00	85.00
Swamping			5.00	7.50		
Hauling			17.00	25.50	34.00	42.50
Supervision			2.70	4.05		
Subtotal			60.70	91.05	119.00	127.50
Annual Operating Costs	219.79	587.57	182.37	226.07	254.02	254.02

within the range of the prices paid for Concord grapes, reflecting a minimum price which Idaho growers might expect to receive. The prices for other crops were typical of those received by Idaho farmers in 1970.

Other data and impressions were obtained from field trips made to the Caldwell area in the summer and fall of 1971. Data gained from the trips indicated that mechanical harvesting was the most feasible and desirable way to harvest grapes. These field trips also permitted a visit to the new grape juicing plant at Meridian, Idaho.

Technical production information was provided by Anton Horn, Extension Horticulturist, University of Idaho, who was familiar with horticultural enterprises in the state.

The grape growers interviewed — Mark Howells and A. P. Batts and Sons — explained the problems of producing grapes in Idaho. An outline of their production processes and costs and verification of costs reported in the WSU cost study compared to their own experiences was included.

Grape Enterprise Budgets

Budgets used in this analysis are shown in Tables 5 and 6. Table 5 is the summary of the costs and returns for the grape enterprise. Table 6 contains the capital investment cost associated with the grape enterprise.

Costs of establishing the vineyard were incurred the first 2 years, after which costs were primarily for harvesting until the fifth year. From the fifth year, costs of harvesting were constant because mechanical harvesting was used. Volume of grapes harvested had no effect on unit harvesting costs.

Income generated by the grape enterprise was variable because no reliable guidelines were available to establish expected yield level. Grower experience indicated yield levels from 4 to 8 tons per acre. The budgeting assumed that vineyards would achieve a 4 ton average yield in the fifth year and 6, 7 and 8 ton averages in the seventh year.

Table 5. (Cont'd)

Fixed Costs						
Taxes	15.00	15.00	15.00	15.00	15.00	15.00
Water	10.00	10.00	10.00	10.00	10.00	10.00
General overhead[5]	10.99	29.38	7.60	9.50	11.10	12.95
Interest on operating capital[6]	10.00	26.10	5.95	8.85	10.00	11.60
Depreciation on bldgs & equip	33.25	33.25	33.25	33.25	33.25	33.25
Interest on land, bldgs & equip	72.92	72.92	72.92	72.92	72.92	72.92
Subtotal	152.16	186.65	144.72	149.52	152.27	155.72
TOTAL COSTS	371.95	774.22	327.09	375.59	406.29	409.74
Income						
Yield (tons)			2.0	3.0	4.0	5.0
Crop value			240.00	360.00	480.00	600.00
NET INCOME	-371.95	-774.22	-87.09	-15.59	73.71	190.26

[1]Based on a 20 acre grape enterprise on a 40 acre farm

[2]490 grape plants per acre

[3]Includes labor, ditch repair and corrugating

[4]Harvesting costs for the first 2 years were based on hand picking costs ($18 per ton) and from the fifth year on the grapes were assumed to be mechanically harvested ($85 per acre)

[5]5% of operating costs

[6]6 months at 9%

Also assumed was the vinifera varieties of grapes, under Idaho conditions, would achieve average yields between 4 and 6 tons per acre; the Seibel varieties (French hybrids) would achieve average yield levels of 5 to 7 tons per acre; the Concord variety would yield 6 to 8 tons per acre. This study used conservative yield levels which do not reflect potential impact of high level management, under which yields might increase by 50%.

Capital investment costs were computed for a 20 acre vineyard. A complete list of the machinery and equipment needed to produce grapes is in Table 6 but fixed costs — taxes, insurance and miscellaneous operation — are not included.

Table 6. Estimated capital investment and annual costs for machinery, buildings and land (2)

Item	Purchase price	Salvage value	% charged to grapes	Assumed life of life	Annual[1] depreciation	Annual interest
Tractor - gas	4000.00	400.00	50	10 yrs.	180.00	88.00
Disc 6 ft.	400.00	40.00	80	10	28.80	13.18
Corrigator	300.00	25.00	50	10	13.75	6.50
Grape hoe	400.00	0.00	100	10	40.00	16.00
Auger	250.00	0.00	100	10	25.00	10.00
Chopper	350.00	50.00	100	10	30.00	16.00
Trailer	200.00	0.00	100	10	20.00	8.00
Sprayer[2]	650.00	0.00	80	8	32.00	20.80
Subtotal	6550.00	515.00			369.55	178.48
Pickup truck	2700.00	300.00	50	10	120.00	60.00
Buildings	3000.00	0.00	50	20	75.00	60.00
Shop and hard tools	2000.00	0.00	50	10	100.00	40.00
Land, $800 per acre[3]			100			1120.00
Subtotal	7700.00	300.00			295.00	1280.00
Grand total	14,250.00	815.00			664,55	1458.48
Per acre cost	356.25	20.38			33,23	72.92

[1]Straight line depreciation used throughout.

[2]Assumed that the sprayer is purchased in the fourth year.

[3]Includes irrigation system. Interest on land charged at 7%.

Analysis

Budgets from the preceding section were used to determine optimal economic life of vineyards, considering several assumptions. Yields varied from 5 to 8 tons per acre from 7 to 26 years, thereafter declining by ½ ton per acre every 7 years for 56 years (Fig. 1). When a vineyard gets older, its productive potential declines.

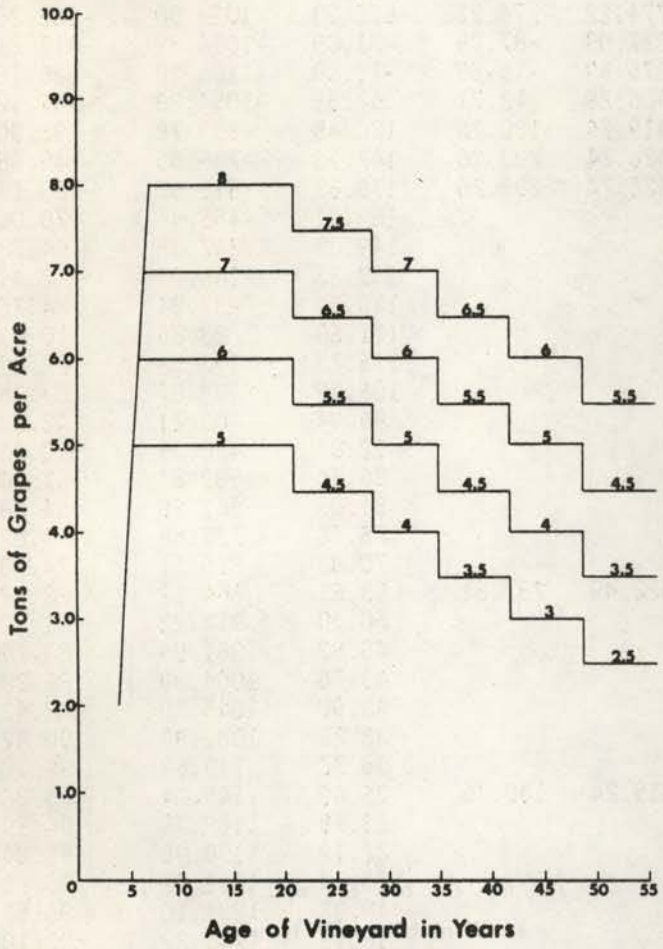

Fig. 1. Hypothetical yield patterns of grape vineyards over time

Although, more detailed work needs to establish actual yield functions for the enterprise, assumed yield levels in this study provide inferences on the economic potential of the grape enterprise in Idaho.

The budgetary model adapted from J. Edwin Farris (4) essentially optimized vineyard replacement based on maximizing net revenue overtime. The procedure was to discount expected net income each year using this formula:

$$1)\ PV = 1/(1 + r)^n$$

Where: PV = present value of net income,
r = discount rate (7%), and
n = number of years

The next step was to sum the present values accumulated each year and convert them to present value annuities using the annuity formula whose present value is 1.0, as shown in this equation:

$$(2)\ A = 1/(1 + v^n),$$

Where: A = annuity value,
$v = 1/(1 + r)$,
n = number of years, and
r = discount rate (7%)

When estimated annual net income — not discounted — is less than the value of its annuity, the vineyard should be replaced because the expected net incomes from a new vineyard would be greater.

Using this replacement model, the age of the vineyard varies with the discount rate used — normally, the higher the discount rate the shorter the life of the vineyard. The yield and price levels also affect the income generated by the grape enterprise.

To illustrate the analysis, a 6 ton yield level and a discount rate of 7% were selected. The analysis only needs cost data to proceed. The complete budgetary model is shown in Table 7.

Discounted net returns provide an estimate of future income compared to current income. In the early years of vineyard establishment when a net loss is occurring, these losses were also discounted, but net losses were estimated because losses would be incurred in the future. The discount rate of 7% was assumed to reflect capital investment costs for the pay-out period of 43 years. Because net income is related to the assumed average yield of 6 tons per acre, the annual net income stabilized at $310.26 from 7 to 21 years and declined slowly thereafter. The present value of the net income, however, declined from $252 in year 7 to $3.83 in year 43 when the vineyard should be replaced.

Analysis of the economic potential of grapes in Idaho included assumed average yields varying 5 to 8 tons per acre by 1 ton increments. For each yield level, the discount rate used to determine the optimal age of vineyard varied 3 to 8%. These 2 factors permit comparison of yield levels while interest rates reflect the competition of grapes with other crops. The replacement model also indicated time required to recoup the original investment in the grape vineyard. In the previous vineyard — 6 tons per acre average yield — the time required to pay off the original investment was 12 years.

Optimal life of the test case vineyard was: 36 years for the 5 ton yield level over all discount rates; 36 years for the 6 ton yield level using 3, 4 and 5% discount rates and 43 years for the 6, 7 and 8% discount rates; and 43 years for the 8 ton yield level using 3, 4, 5 and 6% discount rates and 50 years for the 7 and 8% discount rates.

Most important factors affecting the optimal age of the vineyard were the yield and discount rate — the higher the income the longer the economic life because the objective of the model is to maximize income. As the discount rate increases, it tends to extend the optimal life of the vineyard.

Table 7. Estimated yields, income, costs, and optimal economic life of grapes in southwestern Idaho[1]

Age	Grape yield (tons)	Total revenue	Annual operating costs	Annual harvesting costs	Annual fixed costs	Annual total costs	Annual net income	Present value of net income	Accum. present value of net income	Annuity value of accum. net income
1	---	$ ---	$ 56.05	$ ---	$315.90	$371.95	$-371.95	$-347.57	$ -347.57	$-371.95
2	---	---	147.47	---	626.75	774.22	-774.22	-676.23	-1023.80	-566.26
3	2.0	240.00	121.67	60.70	144.72	327.09	-87.09	-71.09	-1094.89	-417.21
4	3.0	360.00	135.02	91.05	149.52	375.59	-15.59	-11.89	-1106.78	-326.75
5	4.0	480.00	135.02	119.00	152.27	406.29	73.71	52.55	-1054.23	-257.12
6	5.0	600.00	135.02	127.50	155.72	419.24	180.26	120.45	-933.78	-195.90
7	6.0	720.00	135.02	136.00	155.72	426.74	293.26	147.13	-786.65	-145.96
8	6.0	720.00	135.02	136.00	155.72	426.74	293.26	170.68	-615.97	-103.16
9								159.51	-456.46	-70.06
10								149.08	-397.38	-44.78
11								139.33	-168.05	-22.41
12								130.21	-37.84	-4.76
13								121.69	83.85	10.03
14								113.73	197.58	22.59
15								106.29	303.87	33.36
16								99.34	403.21	42.68
17								92.84	496.05	50.81
18								86.76	582.81	57.94
19								81.09	663.90	64.23
20								75.78	739.68	69.82
21								70.83	810.51	74.80
22	5.5	660.00	135.02	131.75	155.72	422.49	237.51	53.61	864.12	78.12
23								50.10	914.22	81.10
24								46.82	961.04	83.79
25								43.76	1004.80	86.22
26								40.90	1045.70	88.42
27								38.22	1083.92	90.42
28								35.72	1119.64	92.18
29	5.0	600.00	135.02	127.50	155.72	419.24	180.76	25.40	1145.04	93.26
30								23.75	1168.79	94.19
31								22.19	1190.98	95.04
32								20.74	1211.72	95.81
33								19.38	1231.10	96.52
34								18.12	1249.22	97.18
35								16.93	1266.15	97.79
36	4.5	540.00	135.02	123.25	155.72	413.99	126.09	11.03	1277.18	97.98
37								10.31	1287.49	98.15
38								9.63	1297.12	98.32
39								9.00	1206.12	98.60
40								8.42	1314.54	98.60
41								7.86	1322.40	98.73
42								7.35	1329.75	98.85
43	4.0	480.00	135.03	119.00	155.72	409.74	70.26	3.83	1333.58	98.72
44								3.58	1337.16	98.63
45								3.34	1340.50	98.52
46								3.13	1343.63	98.43
47								2.92	1346.55	98.35
48								2.73	1349.28	98.27
49								2.55	1351.83	98.20
50	3.5	420.00	135.02	114.75	155.72	405.49	14.51	0.49	1352.32	97.99

[1]Tabulated according to dollars per acre

The number of years required to repay the initial investment and bring the vineyard into production on an income-sustaining basis is 12 with a 5 ton yield, assuming a 3% discount rate. For each 1% increase in the discount rate, 1 added year was required to pay off the establishment costs, up to 7%. At the 8% rate, 2 years would be required to pay off these costs.

As yields increase, net profits are sooner realized, regardless of discount rate (Table 8).

Table 8. Time required to pay off the initial establishment costs

Discount rate	Average yields in years			
	5 tons	6 tons	7 tons	8 tons
3%	12	11	8	8
4%	13	11	8	8
5%	14	11	8	8
6%	15	12	8	8
7%	16	12	9	8
8%	18	12	9	8

Internal Rate of Return

The internal rate of return measures the cost of obtaining the income stream. The discount rate makes the discounted net returns equal to the cost of obtaining this income stream. This internal rate of return for the grape enterprise would compare to the annual rate of return for the potato or sugar beet enterprises, preferably in a rotation. The formula used to calculate the internal rate of return (7) for the grape enterprise was:

$$I = R \frac{1-(1+i)^{-n}}{i} (1+i)^{-m}$$

Where: I = the initial capital investment,

R = net additional annual return, and

$\frac{1-(1+i)^{-n}}{i} (1+i)^{-m}$ = the discounting factor.[3]

The internal rate of return for the 5 ton yield level was 14% for all discount rates used in the study. At higher yield levels these rates of return were: 6 tons, 23%; 7 tons, 31%; and 8 tons, 36%. The variations of internal rates of return were affected by the optimal age of the vineyard developed using the various discount rates applied to determine optimal age of the vineyards.

The internal rate of return increased as the assumed yield and income levels increased, implying that the grape enterprise would be more sensitive to higher yield levels than to high discount rates on the net income earned. This sensitivity of yield levels also implies sensitivity to price levels.

The internal rates of return were relatively high for all yield levels and discount rates evaluated. Therefore, this enterprise, if successfully grown and marketed in Idaho, could compete with other field crops for agricultural resources. Detail regarding this subject follows later in the report.

[3](1 + i)−m factor was added to account for a 2 year delay between investment and income.

Comparisons with Alternative Crops

The typical rotation found in southwestern Idaho has 3 or 4 years of alfalfa hay or alfalfa seed, a year of potatoes, a year of sugar beets or beans and a year of barley. Alfalfa would be reseeded with the barley crop. The typical cropping program would be divided into 6 or 7 parts with proportional acreages of each crop represented annually. In addition to these cropping systems, peppermint and hops are commonly grown in the area.

Table 9 provides a set of 4 rotations which are commonly used. The data presented in these rotations consists of: yield price, variable costs, fixed costs, total costs, net income and annual rate of return (8).

The budgets were also modified to allow the fixed costs to be comparable to those used in the grape enterprise. This modification consisted of adjusting the interest rates charged on operating capital and loan investment, taxes and water costs.

Rotations which had potatoes in them were the most profitable and earned the highest overall average net profits and rates of return. The average net income per acre of rotation No. 1 — alfalfa hay, potatoes, sugar beets and barley — was $33.56 per acre with an annual rate of return of 15%. Rotation No. 3 — the alfalfa hay, sugar beets, beans and barley rotation — had an average profit of $12.15 per acre and an annual rate of return of 6%. Rotation No. 2 — alfalfa seed, potatoes, sugar beets and barley — had an annual average net income of $65.51 per acre and an annual return of 26%. Rotation No. 4 — alfalfa seed, sugar beets, beans and barley — had an average net return of $47.11 and an average rate of return of 21%.

The profit for each crop enterprise and its annual rate of return were estimated and shown in this table. The range of these 2 variables was large. Having the poorest financial return was the barley enterprise which had a loss of $20.77 per acre and an annual rate of return of minus 13%. The highest profit and rate of return was earned by the potato enterprise with a net income per acre of $181.62 and an annual rate of return of 50%.

Another crop that grapes would compete with in southwestern Idaho is hops, a perennial crop similar to grapes. Although requiring different growing conditions, hops and grapes may be somewhat complementary under other conditions. In the present analysis the assumption is that these 2 enterprises are competitive.

The same budgetary model evaluated the hops and grape enterprises (5). Production data costs were modified to fit southwestern Idaho yield and growing conditions, and the cost data were adjusted to the same land values and interest on investment costs used for the grape enterprise. A 7% discount rate was assumed in the analysis.

The data used and the budget model are shown in Table 10. The yield levels assumed were 1,200 lb. the first year and 1,800 lb. per acre each year thereafter. The gross income was $900 the first year and $1,350 the second and succeeding years. The price per pound for hops was $0.75. The optimal life of the hopyard was estimated to be 16 years and average internal rate of return 30%.

Using the 7% discount rate to provide consistency in comparison, annual rates of return for the 4 rotations vary from 6 to 26%. Internal rate of return for grapes varied from 14%, with an

Table 9. Estimated costs, income, and annual rate of return for 4 rotations commonly used in Idaho (6)

Rotation No. 1	Alfalfa hay	Alfalfa hay	Alfalfa hay	Irish potatoes	Sugar beets	Malting barley	Per Acre averages
Yield	6 tons	6 tons	6 tons	310 cuts	25 tons	2.75 tons	---
Price/amt	$ 26.90	$ 26.90	$ 26.90	$ 1.75	$ 15.60	$ 50.00	---
Gross income	161.40	161.40	161.40	542.50	390.00	137.50	$259.03
Variable costs	56.34	56.34	56.34	241.51	187.14	38.90	106.10
Fixed costs	119.37	119.37	119.37	119.37	119.37	119.37	119.37
Total costs	175.71	175.71	175.71	360.88	306.51	158.27	225.47
Net income	-14.31	-14.31	-14.31	181.62	84.49	-20.77	33.56
Rate of return	-8%	-8%	-8%	-50%	27%	-13%	15%

Rotation No. 2	Alfalfa seed	Alfalfa seed	Alfalfa seed	Alfalfa seed	Irish potatoes	Sugar beets	Malting barley	Per acre averages
Yield	750 lb.	750 lb.	750 lb.	750 lb.	310 cuts	25 tons	2.75 tons	---
Price/amt	$ .38	$ .38	$ .38	$ .38	$ 1.75	$ 15.60	$ 50.00	---
Gross income	285.00	285.00	285.00	285.00	542.50	390.00	137.50	$315.71
Variable costs	112.06	112.06	112.06	112.06	241.51	187.20	38.90	130.84
Fixed costs	119.37	119.37	119.37	119.37	119.37	119.37	119.37	119.37
Total costs	231.43	231.43	231.43	231.43	360.88	6.51	158.27	250.20
Net income	53.57	53.57	53.57	53.57	181.62	84.49	-20.77	65.51
Rate of return	23%	23%	23%	23%	50%	27%	-13%	26%

Rotation No. 3	Alfalfa hay	Alfalfa hay	Alfalfa hay	Sugar beets	Dry field beans	Malting barley	Per acre averages
Yield	6 tons	6 tons	6 tons	25 tons	25 cuts	2.75 tons	---
Price/amt	$ 26.90	$ 26.90	$ 26.90	$ 15.60	$ 9.00	$ 50.00	---
Gross income	161.40	161.40	161.40	390.00	225.00	137.50	$ 6.17
Variable costs	56.34	56.34	56.34	187.14	52.85	38.90	74.65
Fixed costs	119.37	119.37	119.37	119.37	119.37	119.37	119.37
Total costs	175.71	175.71	175.71	306.51	172.22	158.27	194.02
Net income	-14.31	-14.31	-14.31	84.49	52.78	-20.77	12.15
Rate of return	-8%	-8%	-8%	27%	31%	-13%	6%

Rotation No. 4	Alfalfa seed	Alfalfa seed	Alfalfa seed	Alfalfa seed	Sugar beets	Dry field beans	Malting barley	Per acre averages
Yield	750 lb.	750 lb.	750 lb.	750 lb.	25 tons	25 cuts	2.75 tons	---
Price/Unit	$ .38	$ .38	$ .38	$ .38	$ 15.60	$ 9.00	$ 50.00	---
Gross/ income	285.00	285.00	285.00	285.00	390.00	225.00	137.50	$270.36
Variable costs	112.06	112.06	112.06	112.06	187.14	52.85	38.90	103.88
Fixed costs	119.37	119.37	119.37	119.37	119.37	119.37	119.37	119.37
Total costs	231.43	231.43	231.43	231.43	306.51	172.22	158.27	223.24
Net income	53.57	53.57	53.57	53.57	84.49	52.78	-20.77	47.11
Rate of return	23%	23%	23%	23%	27%	31%	-13%	21%

Table 10. Estimated yields, income costs and optimal economic life of hops in southwestern Idaho.

Age	Yield (cuts)	Gross income ($)	Pre-harvest costs ($)	Harvest costs ($)	Overhead costs ($)	Total costs ($)	Net return ($)	Present value of net return ($)	Accum. present value of net return ($)	Amort. accum. present value of net return ($)
1	12	900	310.78	179.21	1219.99	1709.98	-809.98	-756.99	-756.99	-809.98
2	18	1350	310.78	203.25	439.04	953.07	396.93	346.69	-410.30	-226.93
3	18	1350	310.78	203.46	439.04	953.28	396.72	323.84	-86.46	-32.95
4	18	1350	310.78	197.99	439.04	947.81	402.19	306.83	220.37	65.06
5	18	1350	310.78	197.99	439.04	947.81	402.19	286.76	507.13	123.68
6	18	1350	310.78	197.99	439.04	947.81	402.19	268.00	775.13	162.62
7	18	1350	310.78	197.99	439.04	947.81	402.19	250.46	1025.59	190.30
8	18	1350	310.78	197.99	439.04	947.81	402.19	234.08	1259.67	210.95
9	18	1350	310.78	197.99	439.04	947.81	402.19	218.76	1478.43	226.92
10	18	1350	310.78	197.99	439.04	947.81	402.19	204.45	1683.88	239.75
11	16	1200	310.78	197.99	439.04	947.81	252.19	119.81	1808.69	240.54
12	16	1200	310.78	197.99	439.04	947.81	252.19	111.98	1915.67	241.19
13	16	1200	310.78	197.99	439.04	947.81	252.19	104.65	2020.32	241.73
14	16	1200	310.78	197.99	439.04	947.81	252.19	97.80	2118.12	242.20
15	16	1200	310.78	197.99	439.04	947.81	252.19	91.41	2209.53	242.60
16	14	1200	310.78	197.99	439.04	947.81	102.19	34.62	2244.15	237.56

expected average 5 ton yield, to 36%, with an expected average yield of 8 tons per acre. Hops had an average internal rate of return of 30%.

The net income from annual field crops varied from $12.15 per acre to $65.51 per acre. The average discounted net income for grapes varied from $15.31 to $125.65 per acre between 5 and 8 ton yield levels. Hops also had the largest average discounted net income per acre of $164.27.

The grape enterprise also would compete for farm resources of land, labor, capital and management. Grape yield levels from 5 to 8 tons of the internal rate of return compare favorably with those of field crops. Regarding hops, grapes do not compete effectively with the prices and yields assumed in this study.

Assuming there are no special conditions like shortages of labor or capital, internal rate of return specifies that another enterprise would have to gain a higher rate of return than grapes, given specific conditions, to be a viable alternative.

Grapes would compete favorably with the typical crops grown in the area over a wide range of yield. Both climatic conditions and management obviously will have an important impact on the success of any vineyard enterprise in Idaho.

Risk and Uncertainty

Important variables affecting the degree of risk and uncertainty associated with the grape enterprise are climate and price consistency.

Considering climate, there are always the risks of losing a crop in a spring or fall frost and the possibility of losing the vineyard completely because of winterkill. If the vineyard is completely winterkilled, then the grower must decide whether or not to begin anew or change to another enterprise.

Crop Loss

The impact of climate on grape production necessitates looking at the impact of losing a crop periodically. To determine the impact of occasional crop loss on the grape enterprise, a 7 year period was arbitrarily selected and the 7% discount rate was assumed, primarily for consistency and comparison with the other enterprises in the analysis.

At the 7% discount rate the vineyard averaging 5 tons per acre would not survive economically. At the 6 ton yield level, a crop loss every 7 years would extend the optimal life of the vineyard from 43 to 50 years and the internal rate of return would decline from 23 to 14%. At the 7 ton average yield level, the impact of the crop loss would extend the optimal life from 43 to 50 years and lower the internal rate of return from 30 to 22%. At 8 tons per acre the optimal life would extend from 50 to 57 years and lower the internal rate of return from 36 to 29%.

A complete crop loss every 7 years and the assumption of a constant price of $120 per ton of grapes has these effects:

The crop loss represents a cost which must be borne by the grape enterprise. At the lower yield level of 5 tons per acre under the assumption of a $120 per ton for grapes and a 7% discount rate, grapes were not a viable enterprise. At the 6 ton

per acre yield level under the same assumption, the enterprise is marginal; the length of optimal life increased 7 years and the internal rate of return declined 9%. At 7 to 8 tons per acre grapes are competitive relative to other crops grown in southwestern Idaho.

Because of the nature of this analysis, based on estimated yield, some caution must be used in interpreting these results as errors could exist in either direction. Conservative analysis indicates any vineyard which could average 6 or more tons per acre would be an economically viable enterprise.

Winterkill of Grapes

Winterkill is a more serious problem as recovery can only be accomplished by replanting the vineyard. The ability to successfully replant a vineyard depends upon the frequency of winterkill, weather and the period of time required to pay back the initial investment and operating costs of the vineyard.

Low yielding vineyards would have considerable problems with winterkilling of vines. Therefore, if the winter weather is severe enough to average a winterkill more often than once every 10 years, the grape enterprise is in trouble. If the frequency of a winterkill is greater than 10 years, then the grape enterprise could survive.

These conclusions suggest the need to develop more complete data on the ability of grape plants to survive Idaho climatic conditions, particularly when discussing the possibility of producing the vinifera varieties.

Price Impacts

Price assumed in this study was $120 per ton, received by Idaho growers for the French Seibel varieties and an approximation of prices received by Concord grape producers in recent years. The price simplified the analysis and allowed for determination of the competitive positions of American, French hybrid and vinifera grape varieties. The major factor in comparing these varieties was yield, not price.

The break-even prices shown in Table 11 were developed by determining the net income difference between yield levels with this formula:

$$Ep = \left(\frac{Y1 - Y2}{N}\right) + K;$$

Where: Ep = break-even price
Y1 = net income for yield level
Y2 = net income for yield level 2
N = the tons of grapes for the base yield level used comparison
K = $120 per ton

When the break-even price between the 4 and 8 ton yield level was desired, the equation formulation was:

$$Ep = \left(\frac{550 - 74}{4}\right) + 120 = \$240/\text{ton}$$

When the break-even price between the 8 ton and the 4 ton per acre yield levels was desired, the equation formulation was:

$$Ep = \left(\frac{74 - 550}{8}\right) - 120 = \$60/\text{ton}$$

Break-even prices were developed to measure the impact a changing price level could have on the competitive position of the grape enterprise. This impact was measured in increasing and decreasing price levels to determine the sensitivity of the grape enterprise to changes in price level.

To assume that Idaho growers would receive these prices for their grapes in the next several years is questionable. If a successful wine grape industry were to develop and operate in Idaho for several years, Idaho grape producers might receive prices similar to those received by California growers. Supply and demand, growing conditions and the development of marketing outlets are some of the factors which affect the prices received for grapes. Potential Idaho grape growers need to keep careful watch on these factors as they consider the development of a grape enterprise.

Considering the potential effects of price variability of the grape enterprise, the assumptions are:

1. French wine grapes, vinifera varieties, were relatively low yielding (4 to 5 tons per acre).
2. French hybrid, Seibel varieties, were in the medium yield range (6 to 7 tons per acre).
3. American grapes, Concord variety, have high yields (8 tons per acre).

Sensitivity of the grape enterprise to price changes was determined by calculating break-even prices for each variety. The break-even price required for net expected income of a vineyard — assumed an average annual yield of 4 tons per acre to be the same level as for a vineyard which averages 8 tons per acre annually — is $240 per ton. This would not appear to be an unrealistic price for a winery to pay for many vinifera varieties due to current prices; future prices are another problem. Observing the change from 5 to 6 tons per acre in average annual yield, the price increased only $24. The price required to raise the net income of a 5 ton vineyard to that earned by a 6 ton vineyard was $144 per ton.

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