

BUILDING THE FUTURE OF THE WASHINGTON STATE GRAPE and WINE INDUSTRY THROUGH RESEARCH

FINAL REPORT of the RESEARCH TASK FORCE

1.0 INTRODUCTION

This document describes the current research needs for the Washington State grape and wine industry. This needs assessment was completed by a special task force consisting of all elements of the juice grape, wine grape and processing community.

The economic value of the wine and grape industry in Washington State is estimated to exceed three billion dollars per year. Nationally, the economic value from Washington State wine and grape production is nearly five billion dollars per year. Tax revenues to the State are nearly 145 million dollars per year. If National growth goals for the wine and grape industry are met (tripling industry value by 2020), the economic value could approach \$10 billion per year and tax revenues could approach \$500 million per year.

Growth in the industry is closely related to the State's soils, water, climate, the entrepreneurial spirit of its citizens, and the research, which shows how these resources can be utilized. Without this underlying research it is doubtful that the wine industry would have developed. Continued growth will be enhanced by additional research in high payoff areas.

In January 2006, a task force was formed to identify critical research needs. Paul Champoux, Chairman of the Washington Association of Wine Grape Growers, invited representatives of the Washington Wine Commission, the Washington State Grape Society, the Concord Research Council, the Washington Wine Institute, the Washington Association of Wine Grape Growers, as well as WSU researchers and educators plus "at-large" industry members as participants of this task force.

The Research Task Force (RTF) met every month for nearly 18 months. This document presents their findings.

2.0 BACKGROUND – Washington State

2.1 History

In the 1960's Walt Clore and Charles Nagel received funds for wine research from the Washington Wine and Grape Growers Council and various state and federal sources. After Clore's and Nagel's retirements, funds to support wine research dried up and it wasn't until the late 1970's that an informal industry group called the Washington Wine Society (made up of Wade Wolfe, Bob Betz, Walt Clore, Max Benitz, Mike Wallace and others) decided to approach the Washington legislature for research funding.

In 1981, Senator Max Benitz sponsored legislation that provided for research funding through a ½ cent per liter tax on all Washington wine sales, collected by Washington State Liquor Control Board and sent to WSU and UW. The legislation also identified an industry oversight committee made up of representatives of the Washington Wine Society. The Society was later renamed Wine Advisory Board and between 1982 and 1998 the WAB was made up of 10-12 interested and informed industry volunteer members internally selected.

After concerns of governance and structure, the WAB sought affiliation and in 1998 the group was formalized as a subcommittee of the Washington Wine Commission and the name changed to Wine Advisory Committee (WAC).

Currently, the Wine Advisory Committee (WAC) provides recommendations to WSU for the expenditure of State wine/grape related research funding. As a subcommittee of the

Washington Wine Commission, all State sponsored wine and wine grape research is overseen by the Wine Advisory Committee. Five members are appointed by WAWGG (viticultural) and the Washington Wine Technical Group (enological) appoints five. WAC is chaired by a Wine Commission appointment. Administrative support is contracted from Vicky Scharlau through the Wine Commission.

The Committee meets on a calendar schedule to set research priorities, call for research proposals (primarily from WSU with a few from ARS), review proposals as well as status of ongoing research and finally make funding recommendations to WSU.

Funding includes \$160,000 (depends on wine volume sales) created by original legislation and \$525,000 per biennium as a line item in WSU budget (and shrinking) added circa 1998 by the Washington legislature

These two sources provide about \$400,000 per year for research with other sources available to researchers including:

- Northwest Center for Small Fruits Research
- WA State Commission on Pesticide Registration
- American Vineyard Foundation
- Viticulture Consortium West
- Federal grants

Juice grape research is overseen by the Washington State Concord Grape Research Council, which is made up of juice processor representatives and is funded by a self-assessment on juice grapes processed in the amount of approximately \$100,000 per year.

2.2 Research Successes: The following lists some of the benefits of the past research funding:

- Mildew biology & control: Dr. Gary Grove has identified the over-wintering source of WA's powdery mildew and developed models and cost effective control programs.
- Insect biology & control: Dr. David James work has provided the basis for a sustainable pest control program by expanding our knowledge of the biology of major grape insect pests, the beneficial insects that control them and the impact of various pesticides on the beneficials' health.
- Leafroll virus and its spread: Several researchers have contributed to our knowledge about the prevalence and spread of grape leafroll virus by mealy bugs and programs for its control
- Managing stuck fermentations: Dr. Charles Edwards has contributed to our knowledge about the interaction between yeast fermentations and lactic acid bacteria and the nutritional requirements for healthy yeast fermentations.
- Impact of cultural practices on grape cold hardiness and wine quality: Drs. Sara Spayd and Robert Wample cooperated on several research projects over 20 years that investigated the impact of irrigation, nitrogen fertilization and crop load on cold hardiness and wine quality.
- Deficit irrigation: Drs. Bob Evans and Robert Wample developed the basis for current deficit irrigation strategies to optimize wine quality through long term experiments at IAREC and Ste. Michelle.
- Grape cold hardiness: Dr. Markus Keller and his predecessors developed a program for monitoring grape bud and cane cold hardiness and communicating to growers for protective actions.

3.0 BACKGROUND – the national situation

On August 28 and 29, 2003, twenty leaders and key stakeholders from the California grape and wine industry and the University of California at Davis Department of Viticulture and Enology met to address a growing crisis in research funding, and to develop a process for establishing research priorities that would mutually benefit the wine industry and academic and research organizations.

This eventually led to the National Grape and Wine Initiative (NGWI). This was set up to be an industry-driven partnership with academic and government representatives, designed to focus emphasis on research and extension as a means to strengthen the competitiveness of America's grape and grape product industries. All segments of the grape industry are represented and engaged in taking responsibility for the future of the industry:

These NGWI Theme Committees have developed a set of action steps for both the short and long term. Below is a list of the five theme areas and a brief description of the kinds of topics addressed under each theme. Additional details can be found in appendix 1.

1.) Understanding and Improving Quality

- 1.1 Understand the relationship between the components of grape and grape products and their sensory quality attributes (quality targets).
- 1.2 To deliver grape and grape products according to specifications (Clean Plant Material).

2.) Consumer Insights, Nutrition and Community.

- 2.1 Identify the nutritional components and health effects of consuming grapes and grape products.
- 2.3 Understand consumer insights in the development and production of more targeted grape and grape products to secure increased market share.

3.) Processing and Production Efficiency

- 3.1. To improve and optimize vineyard efficiency
- 3.2 Optimize vineyard production systems for cost, quality and the environment.
- 3.3 Optimize the efficiency of grape processing facilities for cost, quality and the environment.

4.) Sustainable Practices.

- 4.1 Manage in a sustainable manner the waste streams of grape and grape product processing/packaging facilities.
- 4.2. To manage in a sustainable manner the nutrient/mineral cycle and soil health and quality in the vineyard.
- 4.3 Maximize the productivity and efficiency of our financial and human resources through skills training and technology.
- 4.4 To reduce the energy use of the growers and processors throughout the grape and grape product industry.
- 4.5 To understand and enhance the vineyard ecosystem and the interaction of the grape industry with community to contribute to improved quality of life in rural communities.
- 4.6 Promote and enhance vineyard sustainability through development and optimization of integrated pest/pathogen management practices.

5.) Extension/Education.

- 5.1 Communicate fundamental knowledge and production principals.
- 5.2 Facilitate adoption of best management practices.
- 5.3 Develop and implement new education and communication tools.

4.0 THE WASHINGTON STATE RESEARCH TASK FORCE

The approach taken by the Task force (see section 1.0) was to first list virtually every subject that could affect wine and juice production and quality. Every item was ranked according to its importance to achieving the central goal of tripling the economic value of the wine and juice industry by 2020. The result of the ranking identified thirteen tasks describe below.

Initially, the subject scope included research, extension, and market elements, but prioritization focused only on research because of time constraints. A complete listing of the items considered is provided in appendix 2.

4.1 RESEARCH TASK DESCRIPTIONS

- **Task 1, Viticulture Research Priority-Vineyard development**

Develop predictive model to ID locations for premium vineyard development

Task Definition-Jim Holmes

Background:

Industry expansion goals require additional acres to become productive within the next twenty years. To capture the competitive high-ground, the new plantings must be at locations which produce outstanding wines. Other states have developed methods to identify optimum vineyard locations. These methods need to be improved and applied to Washington state conditions.

Tie-In to National Priority List (NGWI)-

This subject matter is not specifically identified for action under NGWI. Broad applicability across the entire nation suggests that NGWI theme committee should consider adding this effort to the action plan.

Scope of Work:

Satellite imagery systems like Google Earth will be integrated with soil maps, climate data, wine quality data, and relevant wine industry data using “Geographic Information Systems (GIS)” technology. Vineyard performance information from Washington, Idaho and Canada’s Okanogan, and Oregon’s Willamette valleys will also be included to assist in evaluating site potential. The output will be a user friendly computerized map which shows, in detail (10 foot resolution), new locations in Washington which are likely to produce excellent wines. The map will specify grape varieties which should be successful, irrigation requirements and availability, tourism potential, as well as disadvantages and risks, such as water availability, salinity potential, and climate change impacts. The task will produce an internet interface for these maps and related information.

This work is expected to reveal numerous new areas throughout the state where a broadened wine industry will thrive.

Estimated Cost:

System conceptual design \$50,000.

Development of GIS system \$500,000

Web and GIS system site maintenance, 50,000/year

Schedule:

Year one: Complete concept design

Year two to three, Complete GIS system

Task Leader:

This task will be lead by the Center for Precision Agriculture at IAREC. Most work will be conducted by subcontract to organizations, which have appropriate experience.

• **Task 2, Viticulture Research Priority-Plant improvement**

Quality evaluation of varieties, clones, and rootstocks new to WA viticulture

Task Definition-Wade Wolfe

Background:

Industry expansion goals require that significant new grape acreage becomes productive within the next 20 years. To remain competitive, many of these acres will be planted to varieties, clones and potentially on rootstocks with which the industry has had limited or no previous experience. In addition, much of this plant material will not be available as certified stock in sufficient quantities to meet these development goals. Trials must be established to evaluate these new selections to determine which have the most potential for high quality and commercial yields and a process must be in place for rapid buildup of certified stock once the most promising selections are identified.

Tie-In to National Priority List (NGWI)

This task is part of Item 1.2

Scope of Work:

Promising grape selections will be identified by industry representatives and made available as virus and crown gall certified material for trials and commercial propagation through the Northwest Grape Foundation Service. Experimental trials will be established in appropriate locations representing the state's primary growing regions to evaluate fruit & wine quality and horticultural suitability. The results of these trials will be communicated to industry members through scientific publications, extension bulletins, industry meetings and on university and industry websites. The most promising selections will be built up to commercial volumes through cooperative programs between WSU and private Washington State certified nurseries. This work is expected to identify numerous new varieties, clones and rootstocks that can be utilized in existing and emerging growing regions within Washington State.

Estimated Cost:

- Plant importation & certification: 100 selections @ \$2000/variety plus an additional \$50,000/year for five years for fast track indexing, DNA typing and expansion of new materials for trials = **\$450,000**
- Establish 2 cultivar field trials: 2 cultivar trials each requiring 5 acres land (10 acres @ \$5000), 50 cultivars @ 100 vines/cultivar (10,000 vines @ \$2/vine) and development costs @ \$12,000/acre = **\$190,000**
- Maintain & evaluate field trials for 7 years: Vineyard maintenance @ \$2500/acre/year plus horticultural evaluation (\$6000/trial/year) = **\$259,000**
- Satellite Trials: 20 cooperator variety and/or clonal trials each involving no more than 20 selections: 40,000 vines @ \$2/vine plus horticultural evaluation (\$6000/year/trial) = \$80,000 + 840,000 = **\$920,000**
- Fruit Analytical Evaluation: Equipment: \$40,000 (one time purchase), one full time technician for 7 years (\$60,000/year) plus supplies (\$33,000/year) = **\$691,000**
- **TOTAL COST: \$2,510,000**

Schedule:

- Year one: Complete concept design
- Year two to five: Select, import & build up plant material
- Year six to eight: Establish field trails
- Year nine to sixteen: Evaluate field trials

Task Leader:

This task will be led by WSU Department of Horticulture and Landscape Architecture with Dr. Markus Keller as project leader with appropriate cooperators to complete objectives.

• Task 3, Viticulture Research Priority-Water management

Develop an irrigation scheduling program to optimize wine and juice quality and production

Task Definition-Russ Smithyman

Background-

Annual rainfall varies from 8 inches in Eastern Washington (predominate grape growing region) to 48 inches in Western Washington. Additionally, maximum summer temperatures frequently exceed 90°F in the state’s warmer regions that often increase the possibility for periods of water deficit stress. Hence, an understanding of plant water relations and soil water management is essential to successfully produce consistent yields of high-quality grapes. The introduction of grapevines into new rainfall limited growing regions, has led to an increasing focus on irrigation to maintain or increase vine productivity and fruit quality. Furthermore, increased competition for this increasingly scarce resource will impose greater efficiency in irrigation management practices. Deciding when and how much to irrigate requires a thorough understanding of the factors that contribute to vine water status. Determining the effects of various water management strategies on grapevine development and productivity is essential to facilitate the growth of the Washington grape industry.

Tie-In to National Priority List (NGWI)

This work is covered under items 1.2.3, 3.2.1, and 3.1.

Scope of work-

Recent research suggests that efficient irrigation scheduling depends upon the variety grown, vineyard site, and desired end-use of the grapes (e.g. wine style, or juice). Hence, field trials for determination of efficient irrigation scheduling strategies will need to utilize multiple vineyard sites and varieties. Analytical analysis of fruit from these trials will determine the influence amount and timing of irrigation has on the production of fruit quality components. Making and evaluating wines from the different trials will be critical to determine the impact on end-product quality. Examination of different irrigation strategies with additional viticultural practices is needed to determine the most efficient practices for production of quality fruit. This task will also involve evaluation of, more efficient technology for weather prediction, soil moisture monitoring, and measuring vine stress response. Finally, methods will need to be devised to avoid or cope with potential increases in salinity in arid eastern Washington.

Estimated Cost:

Investigate influence of irrigation on fruit quality components. **\$500,000**

- Several specific research projects from existing trials
- Analysis from future irrigation trials

Establish and implement irrigation field trials within major grape production regions. **\$1,000,000**

- 4 to 5 field trials for 7 years

Develop new technology for irrigation scheduling. **\$500,000**

- Evaluation of current technology
- Development of new technology

Schedule:

Year 1-7 Investigate influence of irrigation on fruit quality components from existing trials.

Year 1-7 Establish and implement irrigation field trials within major grape production regions.

Year 1-7 Develop new technology for irrigation scheduling.

Task Leader: Russell Smithyman

- **Task 4, Viticulture Research Priority-Pest and disease management**

Management of viruses that impact fruit quality and vine health

Task Definition-Mike Means

Background-

Grapevines are susceptible to many debilitating diseases and pests. Over fifty viruses have been documented in grapevines. Grapevine leafroll (GLD), Rugose Wood (RW) and grapevine fanleaf are considered to be the major diseases of grapevines with worldwide distribution. Currently GLD is recognized as the major viral disease problem affecting the sustainability of wine grape industry in the State.

Vineyard pests include powdery mildew, mite of various types, cutworms, and mealybugs, and others. While these are largely under control at present, pest evolution will continue to threaten productivity and quality for the foreseeable future.

Tie-In to National Priority List (NGWI)

This work is part of items 3.1.1, 4.5.2, and 4.6.1

Scope of work

The extent that pests and diseases harm vineyard production and quality will be continually assessed to create a basis for targeted research. Methods to control or eliminate target pests and diseases will be identified and tested. This will include the development of risk assessment models and economic thresholds, and comparison of conventional and sustainable alternative control measures. Control methodologies include clarification of propagation vectors and development of counter measures. Development of user-friendly diagnostics and robust sampling strategies for pest and disease management is also part of this task.

Estimated Cost: \$400,000/year

Schedule: Continuous

Task Leader: To be determined

WSU Department of Plant Pathology & Entomology

- **Task 5, Viticulture Research Priority-Mechanization**

Mechanize vineyard operations to optimize profitability, quality, and sustainability

Task Definition-Dick Boushey

Background

The Washington wine industry has grown rapidly in the last twenty years. Currently there are approximately 31,000 acres of wine grapes and over 500 wineries in the state. Juice grape acreage is stable at about 26,000 acres. Historically the grape growing area has had a reliable steady workforce that has been a contributing factor to the success of Washington's grape-related industries. A substantial reduction in this traditional workforce is expected to occur over the next few years. If the Washington wine and grape juice industries are to remain viable, they must systematically control and reduce manpower while delivering ever increasing fruit quality to wineries and juice processors. This can be achieved only by a transition from the use of extensive manual labor to efficient mechanization

Tie-In to National Priority List (NGWI)

This work is covered in 3.2.1 and 4.3.

Scope

This task will test new vineyard equipment for its potential to replace labor intensive activities while maintaining or improving grape quality. In addition, innovative vineyard designs, canopy management, and remote sensing and imaging will be evaluated. The vineyard equipment industry is developing

innovative machinery for virtually all vineyard activities including leafing, suckering, pruning, sorting, cluster thinning hedging and harvesting. In addition, utilization of computers, sensors and robotics is advancing rapidly. Some of these concepts will be successful; some will be failures. The primary output of this task will be to provide guidance to the grower concerning utilization of new equipment.

Estimated Costs: \$350,000 per year

Schedule: Ten year duration

Task Leader:

WSU Center for Precision Agriculture

• **Task 6, Viticulture Research Priority-Plant health and nutrition**

Develop nutrient standards to optimize juice/wine quality, yield, and plant health

Task Definition-Paul Champoux

Background-

Wine quality throughout the world is continually improving. Conditions in Washington State are such that excellent wine can be made using conventional methods. However, in order to remain competitive, we need to continually improve our product. Vine nutrition and health are key elements needed sustain yields and improve quality. Little consensus exists on optimal nutrition for wine and juice grapes, and no well founded nutrition standards exist outside of Europe. Development of such standards appropriate for Washington will assist in advancing our competitive position.

Tie-In to National Priority List (NGWI)

This task is covered in item 3.2.1 and 4.2.1

Scope of work-

This task will develop nutritional standards for grape vines which lead to optimal yield and wine and juice quality. This work will also develop nutrition management procedures for application of natural and artificial materials. Included in this work will be clarification of physiological effects and interactions with water management schemes. Methods for nutrient sampling will also be examined and sampling standards will be developed.

Estimated Cost:

Seven years at \$100,000 per year for several specific research projects including extension work - with results to growers

Schedule: 7 Yrs

Year 1- Initiate, design and start projects

Year 2-7 Perform critical tests and provide results to growers.

Task Leader:

WSU Department of Crop and Soil science

• **Task 7, Processing Research Priority-Primary processing (wine and juice)**

Optimizing receiving practices and resultant quality from harvest to pressing

Task Definition-Kendall Mix

Background-

Wine and juice quality often depend on processing equipment and methods. Improvements are being developed and offered to our industry at a rapid rate. Some of these will be successful; others will not. Advances in processing equipment need to be evaluated to assess its impact on quality to determine whether these mechanical systems are really an improvement on previous methods.

Tie-In to National Priority List (NGWI)-

This task is generally covered by Item 3; however, nothing in NWGI directly addresses this task.

Scope of work-

The difference between hand and machine harvesting and sorting will be determined using state-of-the-art mechanical harvesters and sorting practices. Sorting methods of interest will include hand versus mechanical, cluster versus berry, removal of MOG, infected clusters, jacks, shot berries, and poorly colored berries. In addition evaluations will be conducted on the relative merits of gravity feed systems, mechanical conveyors, press types, and related items. The primary output for this task will be guidance to the winemaker concerning the attributes various kinds of winemaking equipment..

Estimated Cost: \$500,000 per year **Schedule:** Seven year project lifetime to begin as soon as possible

Task Leader:

WSU Viticulture & Entomology team

• Task 8, Enology Research Priority-Phenolic management

Evaluate processing and fermentation practices to manage phenolics from vineyard to bottle

Task Definition-Kay Simon

Task Title: Identify necessary phenolic information for viticulturists & winemakers to make the best quality wines during unprecedented expansion of the Washington wine industry (i.e. 60,000 acres over the next 20 years).

Background: The family of chemical compounds known collectively as Phenolics has been shown to have high impact on various quality parameters in wines. In recent years, research work performed in the U.S. and elsewhere in the wine world has begun to direct winemakers in the real-time analysis of phenolics. Dr. James Harbertson has undertaken survey work to create a Washington-specific data base for phenolics. The next logical step is to determine where & how viticulturists and winemakers might impact wine quality via manipulation of phenolic constituents either in the grapes or resultant wine. An economic assessment of the various viticultural & winemaking parameters which might be shown to have quality impacts would be meaningful and one obvious outcome useful to industry.

Tie-In to National Priority List (NGWI)

This task is generally covered by Item 3; however, nothing in NWGI directly addresses this task.

Scope of Work: This effort will determine how viticulture or winemaking parameters effect wine character. Survey work to clarify statistically meaningful differences in phenolic content, will be used to focus research work. This effort will take two separate paths which:

1. Utilize cooperative vineyard management and winemaking participants to perform the work,
2. Build and utilize an experimental winery capable of performing meaningful and commercial/industry standard winemaking procedures.

Vineyard variables and specific winemaking techniques which significantly alter phenolic content will be evaluated. Examples include canopy management, irrigation scheduling, crop loads, extended maceration, pressing techniques, saignee among others. This task also ties in with tasks #2, 3, 5, 6 and 7.

Estimated Cost:

Path #1 \$90,000 annually for lab & personnel; \$12,000 annually for sensory work: \$60,000 for 2 grad students.

Path #2:

Year 1: Development of a laboratory version of a high performance winery, \$5M for building construction, equipment procurement and installation.

Year 2-8: Experimental Winery operations, work planning, evaluations, etc, \$300,000/year. 8-year project duration.

Schedule:

Year 1: Identify cooperating vineyards & wineries for extensive phenolics study in WA and/or design and build experimental winery at WSU Prosser; identify cooperative vineyards for phenolics study. Complete experimental design.

Year 2: Implement vineyard parameters & controls for phenolics study.
Make wines from 2 AVAs and replicates of vineyard treatments.

Years 3-5: Continue phenolics study to collect data from 4 vintages. Publish results and report to industry about successes in managing phenolics in the vineyard and/or winery.

Proposed Task Leader:

WSU team will include James Harbertson, Markus Keller, Carolyn Ross and Karen Ringer.

• Task 9, Enology Research Priority-Microbiology

Managing microorganisms to maximize wine quality

Task Definition-Bruce Watson

Background- The Washington wine industry regularly incurs losses of wine quality and profitability from spoilage of product by a variety of micro organisms at various stages of wine production. These organisms include Brettanomyces, Acetobacter, film yeasts, Lactobacilli, etc. While such issues are shared by all wine producing areas around the world, there are some regional factors that can be addressed. In addition, opportunities currently exist to reduce microbiological spoilage by better education of wine production personnel within the industry.

Tie-In to National Priority List (NGWI)

This task is covered in item 3.3.1 and 3.3.2.

Scope of work- Interactions between the vineyard site and growing conditions (irrigation, fertilization, spray regimen and canopy management) with populations of wine micro flora will be clarified. Vineyard factors undoubtedly affect the populations of organisms found on the grapes prior to harvest and also the growth of inoculated or wild populations of yeast and lactic bacteria during and after the primary fermentation will be identified. Investigation of these interactions in Washington vineyards and wineries will provide insights on how to minimize sluggish, stuck or otherwise problematic alcoholic or M-L fermentations. As other damaging micro flora or bacterial spoilage become important, this task will seek to develop practical counter measures for use in the winery.

This task will include an extension element to translate research results to the wine industry.

Estimated Cost: Research personnel: \$100,000 per year, 20,000 per year research activities.
Extension Microbiologist (50% position): \$60,000 per year, (is it possible for WSU to fill a position at the 50% level?).

Schedule:

This should be an ongoing program with inflation adjusted increases anticipated.

Proposed Task Leader:

Dr. C. Edwards WSU Department of Food Science and Nutrition

• **Task 10, Enology Research Priority-Stabilization/clarification**

Improving clarification/stabilization/fining methods in the winery

Task Definition-Joy Andersen

Background-

Many stabilization and clarification methods currently employed by the industry are antiquated. Though many of these methods are tried and true, seeking out alternative technologies, methods, and materials is desirable to assure our competitive edge.

Tie-In to National Priority List (NGWI)

This task is generally covered by Item 3; however, nothing in NWGI directly addresses this task.

Scope of work-

Conduct an assessment of new filtration technologies, and develop additional methods, which reduce or remove undesirable components, tartrate stabilize, heat stabilize, and enhance wine quality. Research alternative natural fining materials that would enhance cost efficiency, wine quality, and address environmental concerns.

This work is expected to improve wine quality and cost efficiencies while enhancing sustainable practices.

Estimated Cost-

Assessment of filtration technologies: \$10,000

Development of new filtration technology: \$250,000

Research alternative finings: \$100,000

Schedule-

Year one: Assess filtration technologies, research alternative finings

Year two to three: Develop new filtration technology, research alternative finings

Proposed Task Leader:

WSU Viticulture and Enology team

• **Task 11, Enology Research Priority-Product quality/sensory measurement**

Develop objective standards for grape, juice and wine quality assessment

Task Definition- IAREC/Pullman viticulture and enology team

Background-

Modern chemical analytical methods and sensory techniques are necessary to identify and quantify the components of grapes and wine that impact key sensory quality attributes. The development and use of new tools will provide a platform for quality evaluation of experiments in viticulture, breeding, plant physiology, and enology as well as aid growers and winemakers in evaluating their production practices. New methods will help improve the objectivity and accuracy of quality measurement. There also is a need for education and information transfer that will improve the ability of producers to assess fruit quality in the vineyard and juice and wine quality during processing.

Tie-In to National Priority List (NGWI)-

This task is covered under items 1.1.1 and 1.1.4

Scope of work-

Develop and use modern tools to identify and quantify key quality impact components.

Define range, variability, interactions, and sensory thresholds and impact of quality components within and across grape cultivars and their products. Identify impact color and flavor compounds and develop objective quality indices. Correlate standard measurement techniques with impact quality attributes. Develop/adapt new direct and indirect technology and/or methods to measure fruit and product composition.

Compile database on fruit and resultant product composition.

Improve monitoring techniques for grape development (including field evaluation). Generate standard protocol(s) for sampling, measurement, and interpretation of fruit quality and its correlation with juice and wine quality.

Estimated Cost:

Startup money to purchase analytical equipment: \$750,000

Seven years at \$250,000 per year for method development and implementation (specific research and extension projects).

Schedule:

Year 1-5: Compile existing methods and use to investigate key quality impact components.

Year 1-7: Develop and implement new technology and methods for quality assessment.

Year 3-7: Generate and implement standard sampling and measurement protocols.

Proposed Task Leader:

WSU Department of Food Science and Human Nutrition.

• Task 12, Technology Transfer, Education, Implementation

Develop specific deliverables for each research project as well as the identified technology needs of the wine and grape industry for outcome based projects.

Task Definition- WSU, community colleges and industry organizations

Bruce, Mercy, Jim, Kerry, Vicky,

Via call or email.....

Adopted, innovative,

4.2 COST AND SCHEDULE SUMMARY

The research work described in the foregoing will cost about two million dollars per year over the life of the effort excluding the Research Winery defined in Task 8. First and second year startup cost may approach 3.3-million per year, but will depend on time phasing of the various task elements. Average cost for the first five years will be about 2.6-million per year. Yearly costs will taper off to about one-million dollars per year by the tenth year of the program. Residual research work conducted after ten years would cost about 600,000 dollars.

The research winery is a special case. This is a major addition to the IAREC campus at a total cost of five-million dollars. The proposed facility plays an important role in all tasks. Evaluations of wine made from grapes produced by the various research tasks will provide the key measure of the applicability of research results to improvements in the wine industry. Completion of this project will be a major step in upgrading the WSU wine and grape program to world class status.

4.3 IMPLEMENTATION

Acquisition of funding at the required level will require a strong leader to interface effectively with potential funding agencies. Essentially, a full time advocate will be needed in the early going. Once funding is obtained, leadership can be directed at coordinating and evaluating the research efforts and at renewing objectives as new needs emerge.

NGWI WORK ELEMENTS

1.) Understanding and Improving Quality

This theme area concentrates on research to assist industry in growing, harvesting and producing the highest quality grapes and grape products. The current focus is on modern analytical methods that identify quality and sensory attributes in wine and other grape products and to understand mechanisms that control these components. As part of this effort, the group plans to develop a national sensory training network and a center for chemical testing. In addition, work is being done to establish a national center to provide Clean Plant Materials for growers.

1.1 Understand the relationship between the components of grape and grape products and their sensory quality attributes (quality targets).

1.1.1 Using modern analytical and sensory techniques and quantify the sensory, nutritional and chemical components of grapes and grape products that impact key quality attributes, measure grape maturation, predict grape product quality throughout the production process, and discover the mechanisms that control these components

1.1.2 Develop and implement a national sensory training network.

1.1.3 Create a national center (service) for chemical testing of grape and grape products that provide a uniform application of analytical methods, data collection and data management.

1.1.4 Determine the mechanisms that control the biochemical synthesis of grape quality components.

1.2 To deliver grape and grape products according to specifications (Clean Plant Material).

1.2.1 Establish a national network to provide growers with a broad range of disease-free grape varieties, rootstocks and clonal materials which have been evaluated for regional suitability and quality attributes – Acquisition, Clean-Up, Evaluation.

1.2.2 Preserve and utilize national grape germplasm stocks to develop and expand commercial accessions that meet regional industry cost and quality requirements, and eliminate production hurdles relating to pests/diseases and environmental stress.

1.2.3 Understand the effects of viticulture and environmental factors on grape and grape product quality.

2.) Consumer Insights, Nutrition and Community

This theme area concentrates on research to explore the health benefits of grapes and grape products. The current focus is on compiling all known nutritional research and developing strategies to obtain funding from the National Institutes of Health for a major study on health attributes of grapes and grape products. In addition, the group is working to provide industry with communications tools from existing research to promote the health benefits of grapes and grape products.

2.1 Identify the nutritional components and health effects of consuming grapes and grape products.

2.1.1 Characterize and quantify the nutritional components, phytonutrients and health effects of consuming grapes and grape products.

2.1.2 Work with NIH to conduct a major research study on the most promising health and nutritional benefit identified as being associated with grapes and grape products.

2.2 Advance consumer's education of the health, nutritional and disease preventing aspects of grapes and grape products.

2.2.1 Identify, prioritize and communicate data and facts that are most relevant to consumers and health organizations in terms of the disease preventing attributes of grapes and grape products.

2.3 Understand consumer insights in the development and production of more targeted grape and grape products to secure increased market share.

2.3.1 Identify most consumer critical nutritional impacts of grape and grape products to be utilized by the grape industry in the development of new varieties and products.

3.) Processing and Production Efficiency

This area concentrates on research to enhance existing technologies for improved vineyard and production systems that are cost effective and efficient. The current focus is on vineyard design; trellis and training systems; mechanization; crop load and canopy management; yield estimation; and irrigation and fertilization requirements. In addition, the group is seeking improvements in HAACP management tools for processing facilities.

3.1. To improve and optimize vineyard efficiency

3.1.1 Create, evaluate and adopt cutting edge technologies to improve and enhance vineyard production efficiencies. Key applications include the reduction of vineyard yield and fruit quality variability, the improvement of irrigation and fertilization application uniformity and efficiency and the rapid and spacial detection of vineyard pests and diseases.

3.2 Optimize vineyard production systems for cost, quality and the environment.

3.2.1 Design and evaluate vineyard production systems for maximum production efficiency. Key variables include vineyard design, training and trellis systems, mechanization methods, canopy management practices, yield estimation and crop load management, irrigation and fertilization requirements.

3.2.2 Create, evaluate and adopt economically viable and current available technologies for small to large vineyards.

3.3 Optimize the efficiency of grape processing facilities for cost, quality and the environment.

3.3.1 Implement current best practices and develop innovative processes to eliminate the impact of spoilage and negative microflora through improved cleaning and sanitation procedures for grape and grape product processing facilities.

3.3.2 Better understand and optimize the positive influence of fermentive microorganisms throughout grape production and processing operations.

3.3.3 Develop and extend HAACP management tools for grape processing facilities.

4.) Sustainable Practices

This area concentrates on research to improve farming and processing practices that are environmentally-friendly and sustainable. The current focus is on enhanced systems for managing waste streams and run-off from both vineyards and processing facilities. The group is also working towards improvements in energy conservation, integrated pest and pathogen management and maximization of productivity with respect to financial and human resources.

4.1 Manage in a sustainable manner the waste streams of grape and grape product processing/packaging facilities.

4.1.1 Develop and apply technology to the grape products industry to reduce cost, reduce waste and/or convert it to energy, recover byproducts of value and increase quality.

4.1.2 Develop research strategies for address salt, BOD, total nitrogen load and water usage in grape processing operations.

4.1.3 Preserve and enhance water quality by developing research-based management guidelines to reduce the potential for runoff and/or leaching of nitrogen fertilizer and pesticide residues into surface and ground water.

4.2. To manage in a sustainable manner the nutrient/mineral cycle and soil health and quality in the vineyard. ,

4.2.1 Increase understanding and provide improved tools and technologies for determining influence and impact of different nutrient inputs and soil microbial behavior and population dynamics on the preservation or improvement of soil quality, vine health, yield and grape quality attributes.

4.3 Maximize the productivity and efficiency of our financial and human resources through skills training and technology.

4.3.1 Develop more affordable efficient and sustainable commercial practices for managing labor and energy resource inputs including the pursuit of innovative alternative technologies and approaches.

4.4 To reduce the energy use of the growers and processors throughout the grape and grape product industry.

4.4.1 Develop more sustainable affordable and efficient energy use practices in the growing, processing and packaging (and delivery) of our products.

4.5 To understand and enhance the vineyard ecosystem and the interaction of the grape industry with community to contribute to improved quality of life in rural communities.

4.5.1 Understand and enhance the agro ecosystem and interaction of industry with the local community to contribute to the improved quality of life and well-being of the neighborhood, enhance worker safety and satisfaction and assist the industry in becoming the employer-of-choice within competitive job market.

4.5.2 Decrease pesticide use and environmental risks as a result of better pest monitoring, improved application technologies and advanced management practices.

4.6 Promote and enhance vineyard sustainability through development and optimization of integrated pest/pathogen management practices.

4.6.1 Improve understanding of vine and pest/pathogen interactions in order to develop new and innovative detection and control methods that reduce costs and environmental impacts.

5.) Extension/Education

This theme area concentrates on ensuring industry members are aware of and have access to findings from grape and grape products research. The current focus is on assembling and expanding the collection of existing educational materials on viticulture, winemaking and grape processing. The group is also working to facilitate adoption of best management practices in a number of areas and on expanding communications tools to improve access to research for industry members.

5.1 Communicate fundamental knowledge and production principals.

5.1.1 (Outreach) Assemble collection of existing viticulture educational materials for producers.

5.1.2 (Outreach) Assemble collection of existing winemaking and grape processing educational materials for new producers.

5.1.3 (Outreach) Expand educational curricula in viticulture, enology and grape processing.

5.1.4 (Quality) Prepare regional recommendations for adapted grape cultivars.

5.1.5 (Quality) Increase funded proposals addressing critical knowledge gaps in mechanisms that control synthesis of grape quality components.

5.2 Facilitate adoption of best management practices.

5.2.1 (Sustainability) Develop integrated programs of multimedia educational activities and field demonstrations to encourage use of best management practices.

5.3 Develop and implement new education and communication tools.

5.3.1 (Outreach) Utilize Internet technology for rapid and efficient communication of knowledge.

5.3.2 Develop interactive learning modules.

5.3.3 Utilize emerging media technology to deliver educational materials.

COMPLETE LIST OF CANDIDATE RESEARCH AREAS

1. Research

Processing

 Grape Juice

 Quality

 -Color extraction

 -Acidity

 -Juice Extraction

 -Stabilization

 -Freshness

 -Clarification

 -Packaging

Processing

 Enology

 -Primary processing

 Crush equipment

 Receiving practices

 Stemmer/crusher

 Direct to press

 Quality assessment

 Pressing

 Juice treatment

 pH and alcohol balance

 -Fermentation management

 -Cap management

 Frequency and methods of pumpovers/punchdowns

 Oxygen management

 Time (skin contact)

 Phenolic management

 -Microbiology

 yeast and bacteria selection and improvement and inoculation methods

 temperature

 undesirable organisms

 nutrient requirements

 -Chemistry

 quality parameters

 developing QA testing procedures (for fermentation by-products or

 additions) to meet emerging requirements

 new developments

 -Sanitation

 TCA

 New methods

 Materials

 Barrels

 -Aging

 Oak

- Closures
- MOX (micro oxygenation)
- Restoration (VA and alcohol)
- Packaging
 - New technology
 - Closures
 - Traceability
- Stabilization /Clarification
 - Fining agents
 - New technology
- Process water management
 - BOD
 - Methods
- Waste management
 - Pomace
 - Packaging
 - Filtration materials
 - Methods of each
- Wine quality/Sensory measurement
 - Improve methods
 - ID flavor active components
 - Develop objective standards for wine quality assessment
- Vineyard micro flora impact on wine quality
- Impact of viruses on wine quality (like leafroll on reds)

1. Research

Viticulture-*what in viticulture do we need to raise the bar by three?*

-Vineyard Development (*what do we need?*)

-Site selection

Develop a predictive vineyard site model.

How do you pick the best site the first time? How do you get the quality characteristics you need from a specific site? Site affects to grape quality. Performance indicators. Perhaps two models: one for site and one for plants?

-Site preparation

Soil amendments

Cropping history

Soil depths

Soil characteristics

Pests

Water holding capacity

Nutrient characteristics

Cover crops

-Plant selection

Develop a predictive model for plant selection.

-Vine/Plant preparation

Create a clean plant source

Vine and row spacing

Orientation

Training-do you do first or second year, winter or other risks of the options?

Grow tubes

Trellising

Grafting

-Irrigation

Availability of water
Water quality
Measurement
Timing
Systems

-Plant Improvement

-Availability

-Hygiene

Improve techniques to detect and eliminate
Unknown pathogens

-Genetic

Varieties, clones and rootstocks
Chemical genomics
GMO's

-Vineyard Optimization (*what do we need?*)

-Canopy Mgmt.

Pruning

Cordon suckering

Hedging

Leaf removal

Shoot positioning

Trellising

Shoot removal

Irrigation timing

-Crop load Mgmt.

Affects of load on quality

Crop estimation

Timing of thinning

Pruning

Irrigation effects

Weather events impacts

Carryover effects

-Floor management

Cover crops

Suckering

Compost

Weeds

Tilling/mechanical

-Grafting

Height

Methodology

Winter kill

Economics

-Water Mgmt.

Scheduling

Monitoring

Quantity

Nutrient interaction

Quality

Salinity

Drought

- Pest and Disease Mgmt.
 - Mildew
 - Botrytis
 - Bunch rot
 - Rots....
 - Pests
 - Vertebrates
 - Mites
 - Insects
 - Nematodes
 - Beneficials
 - Impacts of emerging diseases and pests
 - Shrivel
 - Asian Lady Beetle

- Plant health & nutrition
 - Nutrient deficiencies
 - Nitrogen
 - Macro and micro nutrients
 - Rates and timing
 - Methods
 - Fertigation
 - Sampling
 - Foliar
 - Developing nutrient standards

- Evaluation of “naturalistic” systems
 - Biodynamic
 - Sustainability
 - Organic
 - IPM
 - Conventional

- Harvest (*what do we need?*)
 - Maturity Assessment
 - What is ripe?
 - Sampling
 - Timing
 - Methods
 - hand or machine?
 - MOG
 - Additions (So₂, etc.)
- Mechanization (*what do we need?*)
 - Replacement for hand picking
 - Robotics
 - Pruning
 - Canopy management
 - Harvest
 - Planting
 - Thinning

1. Research

- Sales & Marketing

- Match varieties to future marketing needs

- Product development
 - Styles of wines
 - Varieties
 - breeding
 - New product
- Market Development
 - Consumer research
 - New markets
 - Expand current markets

2. Extension/Adoption

Viticulture (Grower/Producer)

- Transfer current knowledge
 - Certificate program
 - Website
- New findings
 - Certificate program
 - Website
- Information feedback to researchers

2. Extension/Adoption

Processing (Winery/Processor, Manufacturing)

- Transfer current knowledge
 - Certificate program
 - Website
- New findings
 - Certificate program
 - Website
- Information feedback to researchers

2. Extension/Adoption

Consumer

3. Education (Higher and Continuing Education)

Higher

- 2 year-Community Colleges w/Specialty
- 4 year-WSU, etc.
- Post

3. Education (Higher and Continuing Education)

Continuing

- Non-credentialed
- Certificated
- Workshops/Seminars
 - Trade Societies/Groups (WAWGG, WSGS, etc.)