



STATE OF OHIO
DEPARTMENT OF ADMINISTRATIVE SERVICES
GENERAL SERVICES DIVISION
OFFICE OF PROCUREMENT SERVICES
4200 SURFACE ROAD, COLUMBUS, OH 43228-1395

MANDATORY USE CONTRACT FOR: OHIO GRAPE INDUSTRIES EXTENSION AND RESEARCH PROGRAM

CONTRACT NUMBER: CSP900113

EFFECTIVE DATES: 07/01/12 TO 07/31/14
* Renewal through 06/30/17

The Department of Administrative Services has accepted Proposals submitted in response to Request for Proposal (RFP) No. CSP900113 that opened on March 2, 2012. The evaluation of the Proposal responses has been completed. The Offeror listed herein has been determined to be the highest ranking Offeror and has been awarded a Contract for the services listed. The respective Proposal response including, Contract Terms & Conditions, any Proposal amendment, special Contract Terms & Conditions, specifications, pricing schedules and any attachments incorporated by reference and accepted by DAS become a part of this Services Contract.

This Requirements Contract is effective beginning and ending on the dates noted above unless, prior to the expiration date, the Contract is renewed, terminated, or cancelled in accordance with the Contract Terms and Conditions.

This Requirements Contract is available to the Ohio Department of Agriculture as applicable.

The agency is eligible to make purchases of the contracted services in any amount and at any time as determined by the agency. The State makes no representation or guarantee that department will purchase the volume of services as advertised in the Request for Proposal.

Questions regarding this and/or the Services Contract may be directed to:

Therese Gallego, CPPB
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This Requirements Contract and any Amendments thereto are available from the DAS Web site at the following address:

www.ohio.gov/procure

*Indicates renewal effective 07/01/16.

Mutually Agreed Upon Exceptions to Standard Terms and Conditions.

1. [Page 30, Paragraph 16] Declaration Regarding Material Assistance/Non-assistance to a Terrorist Organization (DMA): As a state institution of higher education as defined in section 3345.011 of the Revised Code, the Declaration Regarding Material Assistance/Non-assistance to a Terrorist Organization (DMA) provisions in Attachment Two: Requirements of Proposal do not apply to Contractor and is hereby deleted.
2. [Page 30, Paragraph 18] Banning the Expenditure of Public Funds on Offshore Services. The provisions under Banning the Expenditure of Public Funds on Offshore Services shall be deleted as redundant because similar provisions are contained on Page 35 and shall remain.
3. [Page 35] Subcontracting. The second paragraph under Subcontracting on [Page 32] shall be amended to read as follows: The State's approval of the use of subcontractors does not mean that the State will pay for them. The Contractor will be solely responsible for payment of its subcontractor and any claims of subcontractors for any failure of the Contractor or any of its other subcontractors to meet the performance schedule or performance specifications for the Project in a timely and professional manner. The Contractor will hold the State harmless against any such claims.
4. [Page 36, Paragraph 2] Insurance: Numbered paragraph 2 shall be deleted and replaced with the following:

Contractor shall maintain policies of general liability insurance and property and casualty insurance during the performance of the Agreement. Insurance information shall be found at: <http://www.marsh.com/moi?client=1945>.
5. [Page 36] State Personnel. This paragraph shall be amended to read as follows: During the term of this Contract and for one (1) year after completion of the Project, the Contractor's Food, Agricultural and Environmental Sciences Department will not hire or otherwise contract for the services of any state employee involved with the Project.
6. [Pages 37 and 38] Suspension and Termination. Paragraph 5 of this section shall be amended to read as follows: If the State terminates this Contract for cause, it will be entitled to cover for the Project by using another Contractor on such commercially reasonable terms as it and the covering contractor may agree.
7. [Page 38] Suspension and Termination. Paragraph 11 of this section shall be amended to read as follows: Any default by the Contractor or one of its subcontractors will be treated as a default by the Contractor and all of its subcontractors. The Contractor will be solely responsible for satisfying any claims of its subcontractors for any suspension or termination. Each subcontractor will hold the State harmless for any damage caused to them from a suspension or termination. They will look solely to the Contractor for any compensation to which they may be entitled.
8. [Pages 38 and 39] Contract Remedies. The provisions under Contract Remedies shall be deleted.
9. [Page 41] Confidentiality. Paragraph 3 shall be amended to read:

The Contractor will not be liable for any unintentional disclosure of Confidential Information that results despite the Contractor's exercise of at least the same degree of care as it normally takes to safeguard its own secrets.
10. [Pages 41 to 43] Handling of the State's Data. The following sentence shall be added after the last paragraph of this section on page 43: Contractor will exercise at least the same degree of care as it normally takes to safeguard its own data.
11. [Page 43] Ownership of Deliverables. The first sentence of Paragraph 1 shall read as follows: With the exception of any discoveries, inventions or patents for which Contractor retains all rights and interests pursuant to Section 3345.14 of the Revised Code, all deliverables produced by the Contractor and covered by this Contract, including any software modifications, and documentation, shall be owned by the State, with all rights, title, and interest in all intellectual property that come into existence through the Contractor's custom work being assigned to the State.
12. [Page 43] License in Commercial Material: The fourth paragraph under this section shall be deleted and replaced with the following: Contractor retains all rights and interest in any discoveries, inventions or patents under Section 3345.14 of the Ohio Revised Code.
13. [Page 43] License in Commercial Material. The fifth paragraph shall read:

Except for Commercial Software, if the Commercial Material consists of trade secrets, then the State will treat the material as confidential to the extent permitted by the Public Records Act, Revised Code Section 149.43.

14. [Page 45] General Warranties. Paragraph 1 shall be amended to read:

The Contractor represents that the recommendations, guidance, and performance of the Contractor under this Contract will: (1) Be in accordance with sound professional standards and the requirements of this Contract and without any material defects; (2) Unless otherwise provided in the RFP, be the work solely of the Contractor; and (3) No Deliverable will knowingly infringe on the intellectual property rights of any third party.

15. [Pages 45 and 46] General Warranties; Software Warranty; Equipment Warranty; General Exclusion of Warranties. The word "warrants" found in any paragraph of these sections shall be changed to "represents" and the word "warranties" shall be changed to "representations."

16. [Page 46] Indemnity. As a state institution of higher education as defined in section 3345.011 of the Revised Code, the Indemnity provisions in Attachment Three, General Terms and Conditions, Part Four: Representations, Warranties, and Liabilities do not apply to Contractor and are hereby deleted.

17. [Page 46] Limitations of Liability. The second numbered paragraph shall be deleted.

Clarifications to Proposal Accepted by DAS and AGR

1. *The original request was for 2.75 FTE (25% Dami, 100% Kinney, 50% grad student, and 100% (2x 50%) undergraduates) for 7 proposed projects. Following funding, staffing plan was adjusted to 1 FTE (25% Dami, 40% Kinney, and 35% undergraduate students) for the 6 recommended projects in FY13.
2. Dave Scurlock and Todd Steiner shall be Co-PM's on the extension part of this RFP. With this structure in place, Dave Scurlock will be able to manage the Viticulture Extension component while Todd Steiner will continue to manage the Enology Extension component. Under "Viticulture Extension" Dr. Mike Ellis will be in charge of extension activities related to Plant Pathology, Dr. Roger Williams will be in charge of extension material from Entomology and Dr. Imed Dami will help collaborate with Dave Scurlock on disseminating critical information in Viticulture to the industry. Dr. Gary Gao will still be in charge of the extension and outreach activities from OSU South Centers located in Piketon, Ohio. He will also lead the winegrape cultivar demonstration vineyard at OSU South Centers.
3. Dr. Clay Sneller or the acting Chair or Associate Chair of the Department of Horticulture and Crop Science shall serve as the overall Principal Investigator of this RFP covering all components in both Research and Extension.
4. There shall be 100 site visits to vineyards per year, not 200 site visits as noted on page 165 of the submitted proposal.
5. Regarding Entomology research, the Brown Marmorated Stink Bug (BMSB) is included in the proposal and will be made a priority. Contractor is keeping in contact with colleges in neighboring states and sharing information concerning this pest. It's presence in Ohio vineyards is being monitored and we will be evaluating control measures when numbers within the vineyard environment become adequate for replicated studies.
6. Regarding the Support Requirements on page 207 of the proposal: For item 1, this is acceptable with the following provisions:
 - a. If the conference is held, and
 - b. If supplemental funding is approved by the OGIC.
7. Regarding the Cost Summary, page 64: Item 4.b. (Large screen of the best germ plasm for sensitivity to 2, 4-D and dicamba. Test 20 most promising and currently used varieties in Ohio) is not needed. OGIC Review Panel requests more producer outreach and education on this subject. OGIC Review Panel wishes to see coordination with extension services for other crops to make other growers aware of the impact their choices can make on the grape growers. Per the Contractor, the Weed Science program will directly provide communication and extension work based on results of this project as well as all previous work done to better understand herbicide damage in vineyards. Through collaboration with extension specialists, workshops will be held to educate growers on this subject. In the past row crop farmers have also attended these extension activities to learn about this issue, and would be welcome in the future to attend as well in order to better communicate key issues to all parties. The Contractor will be able to answer any direct questions we receive through email or phone based on the results of this work.

*Indicates change 08/24/12.

MUTUALLY AGREED-UPON NEW PROJECTS FOR FY14

1. Expansion of Spotted Wing Drosophila (SWD) Monitoring and Management:
SWD has a very high probability of turning into a major threat to the grape industry in Ohio. A systematic monitoring of SWD in Ohio vineyards is needed. Traps need to be placed in many vineyards throughout Ohio. These traps need to be monitored on a weekly basis. Dave Scurlock and Dr. Gary Gao will be trained in 2013 in identifying SWDs, especially the females SWDs. Contractor will purchase additional traps, sample vials, and other supplies and recruit grape growers to help the Contractor monitor SWDs. A SWD distribution map in Ohio vineyards will be developed in cooperation with Dr. Celeste Welty. Management strategies will be developed with the help of Dr. Welty and consultation of entomologists from neighboring states.
2. Optimization of mobile detector deployment strategies for 2,4-D and dicamba drift
Goal and Objectives of Research:
To optimize a low-cost 2,4-D/dicamba detection system for use in vineyards. The intent is to have this system deployable by the time 2,4-D and dicamba tolerant crops are available to farmers.

Scope of Project:

The release of 2,4-D and dicamba tolerant corn, soybean, and cotton is imminent, beginning with 2,4-D tolerant corn in 2014. Grain farmers will embrace these crops because they provide a new tool for controlling glyphosate-resistant weeds. Currently Roundup Ready crops are planted on nearly 90% of Ohio's soybean and corn fields. Agronomists predict that once 2,4-D and dicamba tolerant crops are available their adoption will be similar. This means that the use of 2,4-D and dicamba in the state is likely to increase by a factor of 20 compared to present. 2,4-D and dicamba are 400- and 75-fold more toxic than glyphosate to broadleaf crop plants. OGIC funded research conducted at OARDC over the past three years demonstrated that simulated-drift of 2,4-D with concentrations equivalent to 1/300th of the dose (1X-dose) to be used in a single application to corn or soybean severely injured grapes with maximum damage occurring when drift coincides with bloom. A concentration of 1/30th of the 1X dose killed vines. Even with advanced drift reduction technology in place, the increased use of these herbicides adjacent to sensitive crops and wild areas will be such that plant injury resulting from off-site movement is inevitable and almost certainly will exceed current levels (estimated at approximately 300 incidents per year in Ohio).

Drift incidents often lead to financial loss and the need for compensation. An inability to detect drift compounds in damaged crops is one factor that complicates settlement in such cases. 2,4-D and dicamba are hormonal herbicides of the auxin mimic class, and it is very difficult to reproducibly and accurately detect residues of these herbicides from above ground plant tissues if they are not collected within three days (72 hours) of the drift event. Contractor's goal is to solve this problem and allow for longer-term residue detection through deployment of a proprietary, low-cost (OSU-University of Maryland, College Park joint Patent Application) detection system that grape- and other sensitive crop-growers can deploy in their fields. The specific objectives of this proposal are:

- A. to calibrate performance of the detector unit in field conditions and correlate measured herbicide levels with herbicide-induced injury;
- B. optimize mobile detector deployment strategies to maximize accuracy of 2,4-D/dicamba drift detection;
- C. inform grape growers about the detector technology and make the detector available on a cost-recovery basis; and
- D. develop and publish protocols and fact sheets allowing grape growers to deploy mobile sensor technology in areas at high risk of 2,4-D/dicamba drift events.

This detector consists of a fiber matrix stretched across a support frame. Multiple units are easily constructed and deployable in a field setting. The experiments in this study will not be conventional herbicide drift studies. Instead the work is designed to identify the optimal configuration for mobile sensor deployment to maximize 2,4-D/dicamba detection, and will also continue our ongoing research to correlate levels of herbicide quantified from detectors with herbicide-induced damage on sensitive crops. To minimize the cost of the research tomato will be used as a surrogate for grape. Tomato and grape have similar sensitivity to 2,4-D and dicamba. Briefly, a field on OARDC campus will be planted with winter wheat to provide ground cover. Staked tomato (extremely sensitive to 2,4-D) will be propagated as potted plants in the greenhouse in advance of the field experiment and will be placed strategically throughout the field as living sentinel collectors of herbicide drift. There will be five replications of tomato across the field, and tomatoes will be deployed in a grid pattern at 0, 10, 20, 30, 40, 50, and 100 feet from the edge of the sprayed area (a 100-foot swath immediately downwind of the field and perpendicular to the direction of wheat seeding). The sprayer will be operated in both directions (back and forth) to increase the drift load downwind, and this procedure will be repeated three times with new tomato plants and detectors placed in the field each run. Herbicide deposition detectors will be placed in each tomato pot at the tomato canopy height mounted at 45° from horizontal, facing the prevailing wind. From previous research we know that fiber detector measurements at plant canopy height match initial dislodgeable residues present on plant materials (A. Murphy, unpublished data). Therefore, they will accurately reflect the amount of drift that causes specific levels of damage on the respective tomato plants. Unsprayed control plants at the same stage of growth will be used for all comparisons described. In order to correlate observed levels of herbicide present in/on plant tissues/sensors with observed drift, non-potted sensors ("sentinel sensors") will also be placed in line with the potted sensors in the vector of the prevailing wind. These sensors will allow more precise determination of the total range of herbicide drift. For efficiency, a hierarchical methodology will be utilized to quantitate herbicide levels present on deployed sensors starting

with sensors closest to the application site. Based on results from the initial studies we will determine the number and placement of sensors, in a grid pattern, needed to provide reliable results.

Detectors deployed in drift experiments will be harvested and shipped to the Blakeslee laboratory at OSU, stored and analyzed for herbicide concentration as the plants with which they were deployed begin to show herbicide damage. Measurements will begin with detectors/plants closest to the site of application, and will move outward. 2,4-D and dicamba residues will be solvent-extracted from mobile detectors and quantified using current state of the art liquid chromatography dual mass spectrometry methods developed in the Murphy lab (Kubes et al., 2011) and currently deployed in the Blakeslee laboratory. These methods have been extensively tested for the ability to detect auxinic herbicides, and have limits of detection as low as 100 ng/mL (0.001 ppm) for 2,4-D and 1 pg/mL (0.000001 ppm) for MCPP. Preliminary testing indicates that these methodologies allow quantification of herbicide depositions in the 100 pmol/cm² range from mobile detectors. Finally, to support data from the above studies on the efficacy of the mobile detection system, select samples will be subjected to multiple additional forms of confirmatory analysis in the Blakeslee laboratory, including gas chromatography-mass spectroscopy, and capillary electrophoresis/diode array detection.

Potential outcomes and significance of outcomes:

The above studies will result in the development of a clear, easy-to-follow protocol for the deployment of mobile sensors designed to detect 2,4-D and dicamba drift. This system will provide grape growers the means to collect hard data on drift events which may result in crop damage. Once deployed by growers the hard data generated by this system will provide will be instrumental in achieving favorable settlements. Additionally, knowledge that this system is generally deployed in fields of sensitive crops could be a potential deterrent to applicators who would consider applying pesticides during weather conditions conducive to drift or applying drift/volatilization prone formulations of herbicides.

Length of Project: April-December 2014.

3. Effect of tannin addition on Cabernet Franc and Chambourcin wine quality
4. Effect of hyperoxidation on Riesling and Pinot Gris wine quality.
5. The Effects of Oxygen Management on Terpene and Ester Levels in White Wines

Objective:

The proposed research aims to critically evaluate the effects of oxygen introduction (intentional or unintentional) at various stages of white wine production on color, volatile flavor constituents and to determine these effects on the sensory characteristics of finished wines. By conducting both laboratory-scale and cellar research-scale experiments, we hope to identify specific practices/parameters like hyperoxidation that minimize oxidative degradation, increase storage life and improve product quality.

The program will include, but not be limited to distinguishing chemical differences in control and hyperoxidated musts. Oxygen levels will be measured throughout the entire winemaking process by the use of the NomaSense Trace Unit recently purchased by OGIC for the OARDC Enology Program. This device works on Oxo-Luminescence NomaSense® technology which allows for the nondestructive analysis of oxygen in bottled wine. The manipulation of SO₂ and O₂ levels will also be explored before the bottling of the wine. Along with hyperoxidative treatments, the effects of storage temperatures are also of interest for white wines. The chemical compositions of the three wines will be studied after treatment of three different temperatures (50oF, 70oF, and 90oF). The volatile compounds will be analyzed on the GC-MS purchased from OGIC. The second year of research will incorporate quantitative descriptive analysis of wine quality by a trained sensory evaluation panel.

Deliverables:

- A. Laboratory-Scale Research (FY14): Information characterizing the effects of hyperoxidation treatment variables (e.g., time of exposure, duration of exposure, oxygen levels, temperature) on the color and volatile profiles of Riesling wines.
 - B. Cellar-Scale Research (FY14): Information characterizing the effects of a standard hyperoxidation treatment on the color and volatile profiles of Riesling wines at critical stages of production and after storage at three temperatures (50oF, 70oF, and 90oF).
 - C. Laboratory-Scale Research (FY15): Information characterizing the effects of SO₂ addition at vinification steps prior to bottling and the effects of O₂ addition pre- and post-bottling (representing unintended O₂ exposure) on the color and volatile profiles of Riesling wines
 - D. Cellar-Scale Research (FY15): Information relating the effects of an optimized hyperoxidation/storage treatment combination on the color and volatile profiles of Riesling, Vidal, and Traminette wines and the effects of these characteristics on wine quality as perceived by a trained sensory panel.
6. Varietal wine production for extension presentations and functions.

*MUTUALLY AGREED-UPON PROJECTS FOR FY15

1. Viticulture: Progress on Current Projects and Future Plans for FY 15 (1 July 2014- 30 June 2015)

The polar vortex has provided an ideal opportunity to evaluate the impact of the different cultural practices on winter damage. Thus, the information will be valuable to Ohio growers. All varieties from the currently funded projects by OGC were evaluated for winter damage. Due to the frequent freeze events, the Contractor evaluated some varieties more than once. The Contractor also evaluated cane damage which is not typical. The data collected on bud and cane damage helped determine the type of pruning to use this spring. All vines were pruned according to the extent of damage and pruning weights were recorded on all varieties in both locations. With the exception of Best Viticulture Practices (BVP) project, it is anticipated that all remaining projects will be terminated at the end of the fiscal year.

- A. Development and Evaluation of Crown Gall-Free (*Agrobacterium vitis*) Riesling, Chardonnay, and Cabernet franc Grapevines (Kingsville and Wooster):
Principal Investigators: Imed Dami, Diane Kinney
Collaborators: Greg Johns, Yvonne Woodworth, Part-time students

This winter, canes were sampled from each variety in both locations to determine percent bud damage. In March, canes were hedged back to 5-bud spurs. In April, vines were hedged back to the cordon due to high percentage of bud death. The Contractor will also evaluate and record the extent of cordon and trunk damage. Of significant importance, the Contractor will evaluate crown gall incidence during the summer. This trial will answer the question whether clean vines (free from *Agrobacterium vitis*) have less winter injury than standard nursery vines; and whether clean vines recover quicker than non-clean nursery vines.

- B. Evaluation of Different Training Systems for Cabernet Franc (Kingsville):
Principal Investigators: Imed Dami, Diane Kinney
Collaborators: Greg Johns, Yvonne Woodworth, Part-time students

Vines were pruned in April down to the cordon. Vines will be maintained and trained according to the specific system. This summer, additional data will be collected to assess trunk damage to evaluate differences among training systems. Even though there will be a significant crop loss, the Contractor will collect yields (if any) to see if there are differences among the training systems.

- C. Evaluation of Vinifera Winegrape Varieties (Kingsville and Wooster):
Principal Investigators: Imed Dami, Diane Kinney, Todd Steiner
Collaborators: Shouxin Li, Greg Johns, Yvonne Woodworth, Part-time students

The block in Wooster was pruned back to 5-bud spurs in late March. During spring, vines were hedged back to the cordon due to high bud damage. Varieties that sustained >80% cane damage were further pruned as follows: 2/4 vines per panel, trunks were cut 10" above the graft union. The remaining 2 will be left intact. This includes all but Gamay noir, Kerner, Pinot noir precoce, Regent, and Siegerrebe in Kingsville. Varieties that were pruned back in Wooster include Arneis, Dolcetto, Durif, Malbec, Merlot, SB7 and SB14. The Contractor will also evaluate and record the extent of cordon and trunk damage. Of significant importance, the Contractor will evaluate crown gall incidence during the summer.

- D. Clonal Evaluation of Cabernet Franc (Kingsville):
Principal Investigators: Imed Dami, Diane Kinney
Collaborators: Greg Johns, Yvonne Woodworth, Part-time students

Vines were pruned back to the cordon in April. Since this plot is located at AARS in Kingsville, Greg Johns, Yvonne Woodworth, and part-time staff will maintain this plot. The Contractor will evaluate and record the extent of cordon and trunk damage. Of significant importance, the Contractor will evaluate crown gall incidence during the summer. After this freeze, we may identify one or more clones that are more cold-hardy than the industry standard clone #1.

- E. Winter Protection of Grapes Using Abscisic Acid (ABA): Principal Investigator: Imed Dami, Shouxin Li
Collaborators: Greg Johns, Yvonne Woodworth, and Matt Meineke (M Cellars)

Vines were pruned back to the cordon in Pinot gris at AARS in Kingsville. Of the chardonnay grown at M Cellars in Geneva, 2 of the 4 vines/panel were pruned to 5-bud spurs and the remaining 2 vines/panel were pruned completely down to the cordon. Despite the extensive damage to buds, the Contractor will evaluate the cordon and trunk damage and see if ABA improved trunk hardiness. The Contractor will evaluate whole vine damage this summer. This is Shouxin Li's project and she will complete it this fall. If ABA proves effective it would provide growers owning small to medium size vineyards with a cost-effective alternative to protect their vines from cold injury vs. installing expensive wind machines.

- F. Best Viticulture Practices (Kingsville and Wooster):
Principal Investigators: Imed Dami, Thomas Todaro
Collaborators: Greg Johns, Yvonne Woodworth, Todd Steiner

Vines were pruned back to the cordon in Pinot gris at AARS in Kingsville and in Cabernet franc in Wooster research vineyards during April. Thomas Todaro, graduate student, is working on this project. The first-year findings were presented by Dami at the Winter Grape School in March. Part of this project will be to develop video clips for educational purposes. Dami and Todaro will produce new videos in 2014. Thomas will also analyze the 2013 berry samples (currently frozen) for flavor compounds. He will also be involved with the sensory evaluation of the different treatments from the 2013 wines made by Steiner. A cost analysis of the different treatments will be developed. Due to vine damage and crop loss, the Contractor will not be able to repeat the experiment in 2014.

2. Viticulture: New Projects for FY 15 {July 1, 2014 – June 30, 2015}

- A. Cordon and Trunk Management Trial:
Principal Investigators: Imed Dami, Diane Kinney, Thomas Todaro
Collaborators: Greg Johns, Yvonne Woodworth, Part-time students

Since most vinifera varieties sustained nearly 100% bud damage, it is likely many also sustained cordon and trunk damage. However, the Contractor will not know until spring when growth resumes. Managing damaged trunks is one of the most difficult decisions growers face with many questions: is the trunk dead? Is it alive? Is it only injured and if so will it recover? When to cut it and how much? Do I do double prune trunks, etc? The Contractor proposes to set up a trial that will address all those questions. The goal is to have answers to those questions at the end of the trial. Findings will be useful to growers during the season and will be utilized in the future in case this event occurs again.

Trunk management: The trial will be set up at the OSU research vineyards and collaborating commercial vineyards. Trunks will be cut (or left intact as control) at different heights and different times (before budbreak and after growth resumption in the spring). Vines will be evaluated for winter damage during spring and summer including cordon and trunk damage. Assessment of crown gall will also be recorded. Multiple trips to sites will be required to conduct these tasks. These visits will also provide opportunities to interact with growers and provide them with recommendations as the season progresses. Thus, these trials will serve an outreach purpose as well.

- B. Rootstock and Clonal Evaluation Trial:
Principal Investigators: Imed Dami, Diane Kinney, Thomas Todaro
Collaborators: Greg Johns, Yvonne Woodworth, Part-time students

The effect of rootstock on scion cold hardiness has been debated for years. Research in the 1980's showed no difference among rootstocks when buds were tested in the lab. However, field observations "anecdotally" showed a rootstock effect. The Contractor will take this opportunity (first since 1994) to assess rootstock effect in our research vineyards as well as some commercial vineyards that have multiple rootstocks for the same variety. Vines will be evaluated for winter damage during spring and summer including cordon and trunk damage. Growth resumption and any yield will be recorded for each rootstock.

- C. Pruning Decisions in Hybrids Trial:
Principal Investigators: Imed Dami, Diane Kinney, Thomas Todaro
Collaborators: Greg Johns, Yvonne Woodworth, Part-time students

The OSU Viticulture Program developed and shared new pruning strategies for most grape varieties from research conducted after the 2009 freeze event. The strategies were developed for most varieties that have non-fruitful base buds including vinifera and American varieties. However, many hybrids have fruitful base buds and pruning strategies should be different to account for that. Unlike in 2009, most hybrids have been damaged in 2014. Applying the best pruning method is critical to restore crop production at a minimum cost. The Contractor proposes to conduct pruning methods of the most damaged hybrid varieties as follows: adjusted spur pruning, hedging, and complete cane pruning back to the cordon. The latter would be the most straightforward and easiest to manage and cheapest, but may not be the most appropriate for that specific variety. Pruning methods will be applied this spring. Winter damage will be assessed during spring and summer including cordon and trunk damage. Growth will also be evaluated and yield will be recorded for each pruning type.

- D. Sucker Management Trial:
Principal Investigators: Imed Dami, Diane Kinney, Thomas Todaro
Collaborators: Greg Johns, Yvonne Woodworth, Part-time students

Trunk damage will be more apparent when growth resumes in the spring. One of the signs of trunk damage is vine suckering. Basically, vines throw many suckers at the base of trunks. What is the best way to manage suckers? Do we retain two or more suckers per vine? Do we sucker young vines the same way as older vines? Do we remove more suckers later in the season? Is it economical to train suckers the same year? The Contractor proposes to set up a trial that will address all those questions and the findings will be utilized by growers during the same season and in the future in case this event occurs again. The Contractor will retain different numbers of suckers for young and older vines and will apply different training methods by removing the excess of suckers during the summer and actively train them or not throughout the growing season. In year 2, the Contractor will observe and record how vines recovered from the different treatment and identify the best sucker management method. This trial will be conducted on vinifera since they sustained the most damage.

E. Commercial Vineyards Trials:

Principal Investigators: Imed Dami, Diane Kinney, Thomas Todaro

Collaborators: Greg Johns, Yvonne Woodworth, Gary Gao, Part-time students, and grape growers

In collaboration with commercial vineyards, the Contractor will try to answer all management practices in one trial working with the most important varieties across different regions in Ohio, including hybrid varieties: Vidal Blanc (VL Chambourcin (CHBL Traminette (TRL Valvin Muscat (VML and Frontenac (FR); and vinifera varieties: Riesling (RSL Chardonnay (CH), Cabernet franc (CFL Pinot Noir (PNL Pinot Gris (PGL Cabernet Sauvignon (CSL and Gewurztraminer (GW).

3. Viticulture: Extension Proposal

A. On-Going Extension and Outreach Activities:

Weed Science Extension Plan A. This project addresses the major new risk to the grape industry that will be incumbent with the release of 2,4-D and dicamba tolerant field crops. Outreach will be both to grape growers, but also to commercial pesticide applicators, grain farmers, and their advisors who will be using the new 2,4-D and dicamba tolerant soybean varieties. The first step that will occur in 2013/2014 will be to develop a plan to link findings relative to spray drift risk to major educational programs that train grain farmers and custom applicators. Curriculum development will be in concert with agronomic team members who are a part of this proposal. Program delivery will begin in the winter training season of 2013/2014. Outreach materials will include Powerpoint slide presentations and script, narrative for inclusion in bulletins used by farmers and custom applicators. A fact sheet relative to grape growers will be prepared, as will one specific to custom applicators and private applicators spraying grain.

The Contractor will continue to provide extension deliverables to the Ohio grape and wine industry. The core program deliverables include:

- 1) Ohio Grape & Wine Conference,
- 2) Hands-on workshops with relevant topics,
- 3) OGEN, and
- 4) Extension publications (e.g. Factsheets).

B. New Extension and Outreach Activities:

- 1) Workshops on managing winter-damaged vines: The OSU Grape Team will organize and present workshops at the growers' and research sites during the 2014 growing season and next year.
- 2) Grape and Wine Field Day on August 13, 2014 at the AARS. Dami is co-organizing the event with Greg Johns and will present as well. As a result of the winter damage, the focus of the field day will be to demonstrate vineyard equipment for hilling-up. Dami will present an update on winter damage and demonstrate different ways of managing damaged vines in the research vineyards at AARS.
- 3) Fact sheets on new varieties: Dami and Kinney in collaboration with Todd Steiner will write and produce several fact sheets to profile varieties that are recommended by the Viticulture-Enology Program.
- 4) Midwest Grape Production Guide: This book is the number one resource recommended to grape growers in Ohio. Since its publication in 2005, more than 5,000 copies have been sold. However, the book is due for revision after almost 10 years. Dami will devote time and effort to revise this extremely valuable source for Ohio grape and wine producers. All chapters will be revised and new chapters will be added.
- 5) Program Website: Dami has been working on the content of the new website with the CFAES CommTech Office. Due to the unplanned freeze events and subsequent re-prioritization of research and extension activities since January, the website roll-out has been postponed to a later date this year.

4. Viticulture: Production Proposal

Per the recommendation and support by the OGIC and the Ohio grape and wine industry, the OSU Viticulture-Enology Program has evaluated more than 40 varieties in the past 10 years. Evaluation consisted of recording the viticultural and enological performances and identifying the pros and cons of these varieties grown under Ohio climates. From this project, the Contractor identified more than two dozen varieties that performed well and thus have been recommended. Several educational programs (conferences, workshops, and field days) were presented to discuss these varieties with wine tasting. In order to further promote these varieties, maximize their exposure to growers and wine makers, and encourage their expansion, the Viticulture Program proposes to engage in a partnership with OGIC to promote planting varieties new to Ohio through a cost-share program.

Procedures

Regions and Varieties: During the first phase of the project, the Contractor proposes to identify interested growers from the three (3) main regions in Ohio: north, central, and south. More growers will be solicited from sub- regions in the subsequent phases. To maximize the success of the program and its impact and benefits, different types of grapes will be utilized, i.e. cold hardy and cold sensitive, red and white varieties, long- and short-growing season). A list of selected varieties (subject to update) includes the following:

Cold hardy varieties (survive -15F or lower): Frontenac (R), Marquette (R), Arandell (NY 9S)(R), Frontenac gris (W), laCrescent (W), Aromella [NY 76.0844.24] (W), NY 81.0315.17 (W), NY 84.0101.04 (W).

Cold tender varieties (survive -10F or higher): Gamay noir (R), Regent (R), Syrah (R), Teroldego (R), Arneis (W), Siegerrebe (W), Malvasia (W), Sauvignon blanc (W).

Vine Order and Planting: Once vineyards-wineries are identified, variety selection will be made for each region. Dr. Dami will provide recommendations on the best suited varieties for the region and vineyard. Varieties will be ordered in the fall of 2014 and planting will take place in the spring of 2015. A minimum of 2 varieties (25 vines each) per vineyard will be planted. The number of vines per variety is large enough to produce fruit for small-batch wines. Dave Scurlock will assist with vine delivery to growers and follow- up recommendations on vine establishment and care.

Outcomes and Benefits

- A. Some varieties may perform better in growers' vineyards than in the original research site
- B. Develop niche market of locally-grown and well-adapted varieties
- C. Promote new varieties and wines in sub-regions of existing grape growing regions
- D. Expand grape planting and production by improving variety-site matching
- E. Develop new AVAs in Ohio.
- F. Diversify variety planting to minimize the risks of biological (diseases, insects) and environmental (e.g. winter damage) threats.

5. Weed Science: Improved Weed Control for Winter-Hilled Vines

For vinifera grapes the winter-hilling and removal of the hill in spring complicates weed control. This occurs because of repeater mixing of soil that on one hand degrades herbicide activity and on the other increases weed growth. Further removal of the hill in the spring exposes crop roots that may be directly exposed to spring herbicide applications. Selection of herbicides along with the rates and timing of application are critical considerations within the hilling system.

This project, located at OARDC in Wooster was started in the fall of 2013. Vines were hilled prior to herbicide application. Herbicides applied after hilling were Alion, Chateau, Karmex, Princep, Casoron, and Matrix. Weed control and crop vigor were rated in these plots in spring of 2014. Hills will be removed and one-half of each plot will be sprayed again with identical herbicides to determine if applications that come in direct contact with exposed roots result in crop injury. A second set of "spring-herbicide only" plots (not treated with herbicide in the fall) will be sprayed with the same herbicides once the hill is removed. This will allow a three-way comparison of herbicide applied in the fall, to herbicide application in both fall and spring, to herbicide application in spring only. Yield and pruning weights will be recorded in addition to visual assessments of weed control and crop injury. This experiment will be repeated in 2014/ 2015.

6. Plant Pathology: Sustain Ohio Grapevine Productivity by Surveying Virus and Phytoplasma Disease Damages to Vineyards Across the State.

The goal of the proposed project is to determine for the first time the identities of common viruses and phytoplasmas present in Ohio grapevines, map their distributions across Ohio, and assess the severity of diseases caused by each of the viruses through a comprehensive field survey. Such a survey is needed in Ohio as virus and phytoplasma problems have already been found to cause serious yield losses to wine grapes in other states and areas, including California, Missouri, New York, Pennsylvania, and Virginia. More importantly, the grapevine leafroll disease, caused by Grapevine leafroll-associated viruses (GLRaVs), was recently confirmed in two Ohio vineyards (Han, Ellis, and Qu, Plant Disease, 2014, in press). In addition, the grapevine yellows disease caused by phytoplasmas was also observed in a number of Ohio vineyards by Dr. Dami (unpublished). Finally, the risk of a new disease caused by Grapevine red blotch-associated virus (GRBaV), recently reported in California and New York, also warrants urgent assessment.

7. Enology Production: Status of Dissolved Oxygen in Ohio Table Wines at Various Stages of Vinification with an Emphasis on Bottling

Although dissolved oxygen is favorable at the beginning of fermentation, further aeration produces several adverse effects. Thus, the quality of table wines improves when air exposure is limited. Oxygen levels are especially critical at bottling with importance on shelf life stability and aging potential. Contractor has accomplished both written and preliminary bottling surveys of the industry indicating this as a problem in FY 14. Contractor will continue to place a significant effort on surveying a greater amount of Ohio commercial wineries in regards to oxygen absorption at bottling. Based on individual winery results, bottling line audits and oxygen pickup in the cellar will be performed.

MUTUALLY AGREED UPON PROVISION

It is agreed that any equipment valued over \$500 purchased by the Contractor for use on the specified projects in the Contract is the property of the Ohio Grape Industries Committee.

*MUTUALLY AGREED-UPON PROJECTS FOR FY16

VITICULTURE

1. Managing Grapevines after Successive Winter Injuries

- A. Developing a Training System for Winter-Damaged Grapevines (New). Almost all cold tender varieties sustained die-back (trunk damage) or died in 2014. Recovering vines that produced new growth (canes) were damaged again after the freezing events in February 2015. The responses of vines to back-to-back cold stress events are unknown and dealing with "re-damaged" vines requires special practices in the vineyard. Many vinifera growers are faced with this situation during the 2015 season. The central dilemma is what is good for the vine is not necessarily good for the grower's bottom line and vice versa. It is the purpose of this study to answer the question "how can the grower strike a balance between producing a healthy vine while generating some revenue?" The goal is to provide growers with objective and research-based information that outlines the pros and cons of the different training scenarios.
- B. Trunk Renewal and Sucker Management (Ongoing). In 2014, almost all vinifera grapevines and some hybrids sustained trunk damage or even death across Ohio. Trials of trunk renewal and sucker management were conducted and several of the questions posed in last year's proposal were answered. Results showed the following: 1) "active" sucker training (laying shoots down the fruit wire) is better than "minimum" training (keeping shoots straight and bundled), 2) train as many suckers as the vine produces in order to devigorate the vines and produce less bull growth; 3) bull canes are not desirable for trunk renewal and should be removed when pruning. In 2015, we propose to observe how vines will recover from the different trunk renewal treatments and record yields in year 2. The goal is to identify the best sucker management strategy with the quickest vine recovery and optimum yield and fruit quality. This trial will be conducted on the same vines treated in 2014.
- C. Evaluation of Crown Gall Sensitivity in Grape Varieties and Preventative Management Methods against *Agrobacterium vitis* (Ongoing). In 2014, many growers indicated that they had extensive incidence of crown gall in their vineyards. This disease, caused by a bacterium, *Agrobacterium vitis* (AV), can be deadly and thus causes the highest economic losses among all grape diseases and pests in the vineyard. Unfortunately, there is no "silver" bullet to cure vines from this disease. At the Winter Grape School held in March 2015, we invited the world leader on crown gall research, Dr. Tom Burr, and he indicated that the current best protection methods against this disease involve vineyard practices and biological control using non-tumorigenic strain. There is currently an "on-going" trial on crown gall that compares *Agrobacterium vitis*-free vines with vines treated with non-tumorigenic strain. Both treatments were compared to the "control" consisting of vines purchased from the nursery (note that vines from nurseries are not free from AV). The results are promising thus far, since we found a reduction on crown gall incidence on crown-gall free vines and those treated with F2/5 strain. Contrary to the Kingsville location, vines in Wooster did not sustain trunk damage and all regrew in 2014. Therefore, we plan to evaluate crown gall incidence during the summer of 2015 in Wooster only. In addition to the on-going study, we plan to evaluate crown gall incidence in all varieties used in our trials.
- D. Managing Winter Damage in Commercial Vineyards (On-going): In 2014, Dami initiated multiple trials in nine (9) commercial vineyards representing all grape growing regions in Ohio. Many of the trials provided useful data and served as demonstration plots for growers and FSA representatives at workshops conducted in 2014. However, there were a few challenges encountered while conducting such a large-scale project: 1) some trials were interrupted because some growers stopped tending for their vineyards (e.g. spraying against diseases/insects/weeds) or interfered with the research plots unintentionally; 2) costly travel and labor. Many of the trials required 100+ miles trips bi-weekly to train vines and Dami and his group spent a large portion of last summer on the road; 3) irregular communication which resulted in loss of data (yield, fruit, and pruning data). For those reasons, Dami proposes to scale down and will continue the trials that started last year with fewer growers. The new training system trial (described above) will be established at a new commercial vineyard once a collaborating grower is identified.

*Indicates change 07/01/15.

*MUTUALLY AGREED-UPON PROJECTS FOR FY16 (continued)

2. Evaluation of Performance and Cultural Practices of Promising Winegrape Varieties. Per the recommendation and support by the OGIC and the Ohio grape and wine industry, the OSU Viticulture-Enology Program has evaluated more than 40 varieties in the past 10 years. The majority of recent variety planting in Ohio results from recommendation by the OSU viticulture and enology program. Examples include: Cabernet franc, Pinot gris, Chambourcin, Traminette, Noiret, Marquette, LaCrescent, and Frontenac to list a few. Variety evaluation consisted of recording the viticultural and enological performances and identifying the pros and cons of these varieties grown under Ohio climates. From this project, we identified more than 10 varieties that performed well and thus have been recommended.

In 2014, the evaluation trial in the Wooster site sustained 70% vine loss vs. 20% in Kingsville. So far, we have 3-years' worth of data from the Wooster trial, but only 2 years from Kingsville. The Kingsville plot has many varieties that were planted later than in Wooster thus vines are young and don't have sufficient data to make any recommendations. Furthermore, at recent meetings (Tri-county growers association and AARS advisory committee) in northeast Ohio, most growers ranked variety evaluation as a high research priority. For those reasons, Dami proposes to continue the trial in Kingsville by replacing dead/missing vines (20%). Due to extensive loss (70% dead vines) at the Wooster site, all vines were removed except for one row. Dami proposes to initiate new trials at the Wooster site with the most promising varieties (4 to 6) by planting larger number of vines per variety to conduct research on best practices to grow these varieties in Ohio. For example, Regent is recommended and now grown commercially, but growers do not have information on the best vineyard practices to grow it (e.g. optimum pruning method, optimum crop load, optimum fruit maturity, etc). Additionally, we plan to continue testing new varieties and clones but a smaller scale (~6 varieties instead of 20+).

ENOLOGY

1. Varietal Wine Evaluation (OARDC, AARS and OSU South Center). Vineyards were set up at Wooster, Kingsville (AARS) and OSU South Centers as part of the original NE1020 variety trial collaborative project. Varieties at both Wooster and Kingsville have reached maturity for winemaking trials with a number of varieties being made from the 2011 through 2013 vintage. Varieties from OSU South Centers are considered to comprise more of an extension display vineyard that the OARDC Enology Program may also choose to vinify for the Southern region of the state. Although funding is not available through VCE and NE1020 anymore for this program, the enology program has also been working with Dr. Imed Dami including supplemental funding from SCRI. Unfortunately, similar to after the "Polar Vortex" in not having enough grapes for wine production from the 2014 vintage, the past cold winter conditions received will not yield much in regards to wine production once again for the 2015 vintage. There may only a few varieties that might yield enough grapes for wine production such as those from Regent.

We are expecting to produce wines from the New York and Minnesota selections to observe wine quality coming out two years of less than ideal winter conditions. There will be several other hybrid varieties produced at Wooster, AARS or OSU South Centers that may be produced into wine as well under this section of research. It will be important to keep track of wine quality from these varieties in tasting with members of our industry who may be considering a few of these varieties to replant some Vinifera or hybrid vines that did not make it through the past two winters. It is extremely valuable to have these wines available for use in educational formats in having winemakers taste any observed differences that the treatments may have in these practical studies.

2. Best Viticulture Practices. This project is working in collaboration with Dr. Imed Dami on different cultural practices being implemented in the vineyard involving both Pinot Gris from AARS and Cabernet Franc from Wooster. Treatments consist of applying various cultural practices as follows: 1) Good Quality (commercial standard): five practices are conducted based on commercial practices; 2) Premium quality (best practices): similar to 1) but with more vine management; 3) Fair quality (for bulk wine): fair to poor practices. We have made wine from the 2013 vintage from these varieties in addition to performing some chemical analysis of must and wine with preliminary taste panel results from both a professional and a consumer perspective. Unfortunately, due to the "Polar Vortex" we were not able to produce wine from this study for the 2014 vintage in addition to the 2014/2015 winter conditions being too harsh.
3. Effects of Hyper-oxidation on Terpene and Ester Levels in Riesling. Approximately 75% of Ohio wineries produce white wines from cultivars with fruity or floral varietal characteristics (e.g., 'Vidal', 'Traminette', 'Riesling' and others). The quality of these wines is highly dependent on vintner practices that control the level of oxygen that the wine receives during the winemaking and aging processes. After primary fermentation, exposure to oxygen at any point in these processes is generally considered to have a negative impact on wine, color, aroma, flavor and shelf-life. There is perhaps, one exception to this generality being a process known as hyperoxidation. Using this procedure, the winemaker purposefully introduces high levels of oxygen to recently pressed must/juice in order to initiate enzymatically controlled oxidation cascades' of common phenolic constituents leading to the formation and precipitation of yellow quinones. When these compounds are removed prior to vinification, they are excluded from the finished wine, leading to a product that is arguably more shelf-stable and less harsh or bitter in flavor.

*Indicates change 07/01/15.

*MUTUALLY AGREED-UPON PROJECTS FOR FY16 (continued)

Several research studies indicate hyperoxidation procedures are found to substantially decrease the fruity and floral aromas that white wines typically contain and promote the formation of new, unwanted compounds that are detrimental to wine quality. In contrast, some researchers report white wine stabilization by hyperoxidation of must before alcoholic fermentation to be associated with improved aroma quality in the resulting product. Storage can affect final sensory quality of white wine, by modifying or decreasing characteristic terpenes or ester content and by forming new detrimental flavor constituents leading to reduced quality. The rate of phenolic oxidation seems to increase within wines stored at higher temperatures. Therefore, wines with lower concentrations of phenolic substrates through the process of hyperoxidation may be able to retain these positive aromatic and flavor constituents ultimately leading to longer shelf life stability and aging potential.

Determining the identity and relative concentration aroma compounds via gas chromatography-mass spectroscopy (GC-MS) is essential when evaluating wine flavor characteristics; the analyses are useful to quantify the effects of altered vinification parameters and provide a mechanism to relate vinification techniques to sensory evaluation of flavor quality. Terpenoid and volatile ester compounds play a key role in white wine flavor and scent. However, the effects of unintentional oxygen on the levels of these compounds are poorly documented.

4. Research Studies and Varietal Wine Production for Extension Purposes. Effect of Harvest Temperature and Time on Traminette Wine Quality. Determining the exact time to harvest a specific variety is extremely important and should be based off of factors such as grape chemistry, taste and weather conditions. In light of this important decision, it is also important to consider the temperature at harvest as it relates to the time it takes until processing the grapes in the cellar. Some studies would indicate that the longer the grapes are held prior to processing the more detrimental it is on wine quality attributes. Within the Ohio commercial wine industry, it is common to have a limited staff in the vineyard that might extend holding times after harvest. It is also common that a winery might not have the appropriate funding or facilities to cool the grapes immediately after harvest.

PLANT PATHOLOGY-VIROLOGY

- A. Sustain Ohio Grapevine Productivity by Surveying Virus and Phytoplasma Disease Damages to Vineyards across the State. It is vitally important to ensure the health of Ohio grape industry as it contributes an annual output of at least \$580 million to the state economy and supports over 4,000 full time jobs. Viruses and phytoplasmas are among the most damaging pathogens of grapevines, and their prevalence has been documented in other grape-producing states and countries. However, the scope of virus and phytoplasma problems in Ohio has not been systematically assessed. Our preliminary survey of seven (7) Southern Ohio vineyards during 2012-2014 suggests that viruses are indeed present in some vineyards. We propose to continue the survey in 2015 to discover all disease-causing viruses and phytoplasmas in Ohio vineyards using state-of-art technologies including RNA-Seq and RT-PCR. Results of the survey will offer the much needed guidance for improved intervention aimed at minimizing the losses to Ohio grapevine industry caused by viruses and phytoplasmas.

ENTOMOLOGY

1. Integrated Pest Management System for Insect Pests in Ohio Vineyards. In Ohio we have several species of insects that attack the fruit, shoots, roots, and leaves of cultivated grapes. Many of these pests are indigenous to all vineyards while some are present in specific regions of the state and still others are sporadic pests triggered by varying environmental factors. There are also new invasive species of insects that could pose serious threats to the grape industry in Ohio. The goal of our pest management program is to provide a commercially acceptable level of pest control with minimal economic and environmental impacts. Through these efforts, Ohio growers stand to benefit directly by improving the quality of their fruit and reducing the use of pesticides, resulting in a more environmentally sound program with fewer health concerns for the grower and consumer and reduced costs and improved profitability for their operations.

WEED SCIENCE

1. Improved Weed Control for Winter-Hilled Vines. We continue a grower-driven program conducted at OARDC in Wooster to identify better approaches to weed control. Winter-hilling and removal of the hill in spring complicates weed control because of repeated mixing of soil that degrades herbicide activity while at the same time stimulating weed growth. In addition growers are concerned that removal of the hill in the spring exposes crop roots that may be directly exposed to spring herbicide applications.

*Indicates change 07/01/15.

*MUTUALLY AGREED-UPON PROJECTS FOR FY16 (continued)

HERBICIDE DETECTION

1. Beta-testing of a mobile, field-deployable 2,4-D/dicamba detection system. The release of 2,4-D and dicamba tolerant corn, soybean, and cotton is imminent, beginning with 2,4-D tolerant corn. Grain farmers will embrace these crops because they provide a new method to kill a growing range of glyphosate-resistant weeds. Employment of novel 2,4-D/dicamba resistant crops as a pest-management strategy, however, brings with it a concomitant set of risks that must be ameliorated for this strategy to be employed successfully. Even modest adoption of this technology on 30% of the corn and soybean acreage in the Midwest will result in an increase in potential 2,4-D and dicamba use to six times the current usage. Because these crops will cause a shift in where 2,4-D and dicamba are primarily used from western rangeland and wheat production to the corn belt, the actual increased usage in the Midwest could be much more than a 6X increase. Even with advanced drift reduction technology in place, the increased use of these herbicides adjacent to sensitive crops will be such that crop injury resulting from off-site movement is almost inevitable and has a high probability of exceeding current levels (estimated at 300 incidents/ year in Ohio).

While new formulations of 2,4-D and dicamba can dramatically reduce drift, drift events can still occur and these events often lead to lawsuits. Depending on the concentration of 2,4-D or dicamba in drift that impinges on a crop, effects vary from occasional yield increases, to initial injury with complete recovery, to greatly reduced yield or death. Crops vary in sensitivity, and sensitivity varies with stage of development; drift at or near the time of flowering is often particularly damaging. Detection of drift compounds in the damaged crop is increasingly a deciding factor in such cases. In the case of 2,4-D and of dicamba, herbicides which mimic the plant hormone auxin, it is very difficult to detect residues with reliability and reproducibility using current analytical techniques if above-ground tissues are not collected within two to three days (48-72 h) of the drift event. Unfortunately, evidence of drift damage is usually not visible until the end of this period.

EXTENSION

1. Viticulture
 - A. On-Going Extension and Outreach Activities. Dami and the OSU Winegrape Extension Team will continue to provide extension deliverables to the Ohio grape and wine industry. The "core" program deliverables include: 1) Ohio Grape & Wine Conference, 2) Grape School and hands-on workshops with relevant topics, and 3) technical information in the Team newsletter, OGEN.
 - B. New Extension and Outreach Activities. Dami proposes to continue the following new Extension activities for FY16. Dami and his group in collaboration will deliver these activities with the OSU Winegrape Team.
 - 1) Fact sheets on new varieties: Dami and Kinney in collaboration with Todd Steiner will write and produce several fact sheets to profile varieties that are recommended by the Viticulture-Enology Program.
 - 2) Midwest Grape Production Guide: This book is the number one resource recommended to grape growers in Ohio. Since its publication in 2005, more than 5,000 copies have been sold. However, the book is due for revision after 10 years. Dami will devote time and effort to revise this extremely valuable source for Ohio grape and wine producers. New authors have contributed new chapters and new information. Due to the unplanned freeze events and subsequent re-prioritization of extension activities, the completion of the guide will be postponed to a later date.
 - 3) Program Website: Dami and Kinney in collaboration with the 1inegrape team completed the new website which was rolled-out at the OGWC last February. Diane Kinney will be the primary person working on maintaining and updating the website content. Among the new additions, Dami plans to create a U-tube channel to post educational video clips.
 - C. Vineyard Site Visits. Plan of Action-Visit as many vineyards across Ohio to increase grape and vineyard quality.
 - D. Promote Grape Quality.-Plan of Action is to hold workshops to promote grape quality at different stages of grape development held at grower's vineyards or when appropriate the research sites at Kingsville, Wooster and Piketon will be used.
 - E. Additions to Grape Quality Viticulture Outreach. Provide consultation to growers selected by Dr. Dami to plant Winter Hardy New York and Minnesota grape varieties in 9 commercial vineyards that have wineries across the state. This is collaboration with Dr. Imed Dami and it is dependent on additional funding to purchase vines that are being phased in over 3 seasons. Some vines have been purchased/propagated for this. My responsibility is to help in the grafting process and visit these sites in conjunction with my outreach site visits which will not include additional funding.
 - F. Vineyard Site Identification, Best Grape Varieties for Specific Site Recommendation and Best Vineyard Practices Continue Vineyard Site Evaluations for FY15 for new sites being planned-with the increase in clients wanting to establish vineyards I did request an increase in the travel budget.

*Indicates change 07/01/15.

*MUTUALLY AGREED-UPON PROJECTS FOR FY16 (continued)

- G. Site preparation A Plan of Action is recommended for Site Prep to be done a year in advance of planting to properly take care of any issues such as cover crops, drainage, nutrients or weeds. This will be done for both new and established growers. It is strongly recommended to have any noxious or perennial weeds under control before planting vines to avoid competition.
- H. Early Diagnosis of Problems and Solutions and Control of Diseases. Plan of Action is to scout private vineyards with the grower to detect disease, weeds, nutritional, chemical or insect problems and recommend course of action in collaboration with Dr. Mike Ellis on disease problems even though Dr. Ellis has retired, he is still available for advice and potential on-site visits. Insects was not on the list of priorities in the Strategic Plan but with the occurrence of the 4 new invasive insects (SWD, MALB, BMSB, Spotted lantern fly and old continual pests such as the Grape Berry Moth, Phylloxera, trapping and identification and control of these insects will also be a part of any on sight vineyard visit for early detection and control with recommendations.

2. Viticulture Extension from OSU South Centers.

Comprehensive training of new and existing grapes is of vital importance to the success of wine grape growing in southern Ohio and beyond. Testing of cold hardy grape cultivars for premium wine production, development and demonstration of effective vineyard management practices and improvement of basic understanding of grape and wine quality are also critical to a growing wine grape industry. OSU South Centers is uniquely positioned to conduct both basic and applied research on grape production and deliver a comprehensive grape grower outreach program.

3. Enology

- A. The 2016 Ohio Grape and Wine Conference. The past number of Ohio Grape and Wine Conferences has been viewed as a huge success with record attendance occurring each year. We have once again worked closely with Christy Eckstein at OGIC in Co-coordinating the conference. A very good technical program has been established highlighting excellent out of state featured speakers in addition to OSU/OARDC in state specialists in each grape and wine discipline.

Therefore, we will once again plan to help coordinate 2016 Ohio Grape and Wine Conference. We have already started the process in searching for a potential host site for next year's conference. The enology program will again develop the technical sessions in enology and co-organize the general sessions with key members of the viticulture program being Dave Scurlock, Imed Dami and Dr. Gary Gao. We will also work with the conference organizing committee to help develop the conference format, special events and logistics. With the increased attendance and interest from the Ohio grape and wine industry we are excited to have an opportunity to once again work together in performing the proposed conference.

- B. Participation and Involvement in National and International Meetings. It is extremely vital to both participate and attend professional meetings at national and international venues. These meetings bring exposure to research and extension we are doing in Ohio in addition to collaborating with other researchers in enology on future projects. Attending out of state conferences, also opens eyes to our commercial grape and wine industry in Ohio and the quality wines we are producing today. This is also a good time to learn of new methodology and enology practices. Many contacts can be made at these meetings providing extension opportunities of excellent speakers to present their information at our annual conference, field days or workshops. Although OGIC does not cover out of state travel, they still provide funds allocated toward my salary which I feel compelled to list in this proposal. These opportunities are extremely valuable and will be covered under OARDC enology program funds.
- C. The Ohio Quality Wine Program. The Ohio Quality Wine Program (OQW) has been implemented and running presently since 2007. This program consists of a joint venture involving the Ohio Grape Industries Committee, The Ohio State University/OARDC Viticulture and Enology Program and key members of the commercial grape and wine industry. The OARDC Enology program is pleased with the sensory and chemical evaluation of wines entered into the program. This is an extremely valuable program that was originally created to address 3 objectives being; to provide global respect, consumer recognition regarding wines of distinct quality, planting more grapes in the ground to address the growing number of wineries in Ohio

However, it is important to recognize that the OQW program is realistically still in the early stages and will take some time in continuing to develop this program for the benefit of identifying and marketing the quality wines being produced in Ohio. It is excellent that OGIC has also placed a significant effort on marketing these wines to help in consumer recognition of this important program.

It is our intension to continue working effortlessly with OGIC in the development of this program through coordinating and performing the sensory evaluations and chemical analysis of wines entered into the OQW program for FY 16. Under direction of the OQW subcommittee, we will coordinate four separate OQW sensory evaluations (August, November, March and May) including chemical analysis of wines submitted. In addition, we will continue to provide input on the quality subcommittee as we proceed further into this important program for the Ohio grape and wine industry.

*MUTUALLY AGREED-UPON PROJECTS FOR FY16 (continued)

- D. Post Fermentation Wine Quality Control Workshops. The Post Fermentation Wine Quality Control Workshops have been very successful and greatly appreciated for the past number of years we have performed them for the Ohio wine industry. We have had an average attendance of nearly 20 people at these regional workshops since establishment of this series in 2008. As indicated in the recent FY 14-19 strategic planning meetings, addressing "wine quality" was viewed as the highest priority of all with a score of (4.4) in continuing to be addressed. Therefore, the enology program will continue to offer the Post Fermentation Wine Quality Control Workshops in December and January on a regional setting for the FY 16 proposal period.

The workshops will continue to be done in a relaxed social format with winery personnel participating in discussion of the wines presented with some possible remedies or treatments if required at this stage of vinification. If wines are being analyzed for possible flaws, all possible remedies or treatments will be discussed in a constructive format. These workshops also train winery personnel on sensory evaluation techniques and what to expect in regards to varietal characteristics and blending potential.

- E. Additional Workshops. It is our goal to provide some additional workshops in enology covering several key areas of interest such as but not limited to; laboratory analysis, filtration, new winery setup and a pre-fermentation conference. These types of workshops were included in our "Winemaking Boot camp" series of workshops accomplished in FY 15. The amount of additional workshops will be directly related to the time commitment involved with looking into the possibility of a potential winemaking certificate program initiating in FY 17. It is important to note that a focus of these workshops also are set up to take place at the annual Ohio grape and wine conference taking place in February.

Depending on the content and agenda, implementation of some workshops may be necessary to include a relatively small charge for cost recovery purposes.

- F. Ohio Commercial Tour of the Michigan Grape and Wine Industry. The OARDC enology and viticulture program is excited to offer this unique opportunity once again to the Ohio grape and wine industry. We have offered industry tours to different growing regions both in and out of the country within the past decade. These tours bring great excitement from the tour participants. Michigan is becoming quite known for being a premium wine producing state with a diverse growing regions and varieties. Since they have similar growing conditions and diverse varieties as we have in our industry, there should be much to learn on this trip.

There will be several main objectives of the tour. The first purpose is to provide an educational aspect in regards to both viticulture and cellar practices emphasized in Michigan. A second objective provides a good opportunity to network between the attendees present on the tour in addition to the contacts at each stop. The last objective is to provide some cohesiveness within our growing, grape and wine industry in addition to simply having a good time away from the vineyard or winery.

This tour originally was supposed to take place in FY 15 however due to an additional workshop on sensory evaluation of wines and recognition of wine flaws that was also recommended by OGIC; we postponed this tour to FY 16. This was also accomplished due to some indication from industry members that they may be still working in the vineyard during the first part of June re-planting and trellising from what was lost or being renovated due to the past two severe winters. We desire to make this opportunity available to all even though we are limited on the total number of participants.

The exact locations of the tour have not yet been identified but we are confident that it will provide a wonderful educational and enjoyable experience.

- G. Northeast Ohio Grape Twilight Tour. The enology program is asked each year to present research and extension information at the Northeast Ohio Grape Twilight Tour. This is held in collaboration with Dr. David Marrison in the Northeast region of Ohio where we have a significant number of wineries. It will be especially good to participate in this meeting since Greg Johns will be retired at AARS and desire to show our support from OSU for this event in addition to the vineyards and wineries in the region. In addition to providing research and extension information, we are usually asked to provide an educational tasting of our research projects. This is a good venue to continue providing useful information to the Ohio wine industry which we plan to participate in the August, 2015 Twilight Tour.
- H. Participate in both National and International Wine Competitions. I plan to participate as a judge in several regional, national and international wine competitions throughout FY 16 period. This enables me to stay sharp on sensory evaluation of wines in addition to becoming familiar with new varieties and examining their potential wine quality for the Ohio commercial wine industry. In addition, collaborating with other judges is also beneficial in determining the potential of additional judges to participate as a judge in the Ohio Wine Competition.
- I. Researching a Potential Wine Makers Certification Program. A recent desire from several OGIC research subcommittee members has expressed interest in developing a type of winemaker's certificate program in Ohio. This type of program could vary greatly in the type of certification program being developed and implemented. The overall scope of the program must fit into specifics of the Ohio State University for teaching and certification program ethics. It will take a great effort in looking into what will be the most efficient and optimum type of certification program to develop for the Ohio wine industry.

*MUTUALLY AGREED-UPON PROJECTS FOR FY16 (continued)

Therefore, a significant amount of time will be devoted during FY 16 into evaluating a winemaker's certification program and the best methodology for this to potentially get implemented for FY 17. We will also evaluate other certification programs from institutes of higher education across the country in addition to looking into the staffing of such programs in working efficiently.

- J. On-Site Winery Consultations: Continue Extension Technical Support. Many times the best way to learn respect and trust of the owner's and winemaker's in the Ohio commercial wine industry is to provide a personal on-site consultation. This enables conversation in the winery environment providing a more comfortable, relaxed atmosphere. It also provides us with the opportunity to raise any additional comments, questions or troubleshooting advice based on individual winery situation and layout. There has been a special effort placed by the OARDC Enology Program in this area the past several years which has received some grateful comments from reciprocating wineries receiving this valuable service. In addition, on-site visits are performed for startup wineries in determining the best layout options, organization and technical information for producing premium quality wines. Topics covered during these critical site visits deal directly with wine quality, best practices for wineries, consistent wine quality and early flaw detection to name a few of the highest priorities of the recent research and extension strategic planning sessions. An additional effort will be placed on the availability of utilizing a special piece of equipment to be purchased yet in FY 15 in determining winery sanitation utilizing an ATP Luminometer. A special production project may be designed in the future to evaluate our current industry status regarding winery sanitation efficiency utilizing at a larger pool of wineries. Therefore, we will continue to place an increased emphasis in performing winery site visits in FY 16.
- K. Off-Site Winery Consultations. Since the Ohio wine industry has grown over the past decade to over 200 actively producing wineries, the opportunity does not exist to visit each winery as often as desired. Therefore, many consultations are performed over the phone in providing research and extension information in addition to troubleshooting wine problems if necessary by phone, fax or e-mail. It is our goal to spread the word to all wineries in feeling comfortable to contact us at any time for confidential support in answering questions and ultimately helping improve wine quality. In the winery site visits, winery consultation covering critical winemaking topics with the intent on ultimately improving wine quality has collectively been rated one of the highest priorities and will continue to be a focus area of the enology program for improved efficiency in FY 16.
- L. Provide Chemical Analysis of Commercial Wines. Approximately 14 years ago, we implemented a wine analysis program in collaboration with OGIC in which we provide wine analysis and troubleshooting through the enology lab at no charge to our commercial wine industry. This goes hand in hand with the offsite winery consultations listed above. This effort addresses wine quality and consistency throughout the industry as being a vital part in the production of premium quality wines and positive recognition of the Ohio grape and wine industry. Analyses of wines are followed up with suggested recommendations and troubleshooting if necessary, ultimately to increase wine quality. I believe this is an invaluable service to the Ohio wine industry and has helped many wineries continue to improve their wine quality to a point where they are being recognized in Ohio, national and international wine competitions. It is our intent on continuing to provide chemical analysis and feedback to the Ohio commercial wine industry for those wineries taking advantage of this service.

This service will hopefully be benefited by increased chemical analysis ability in the utilization of a recently purchased spectrophotometer by the OARDC enology program.

We hope to utilize some more enzymatic analysis capabilities in performing increased evaluation abilities and faster turnaround times.

4. Weed Science

Extension Outreach for Weed Management in Grapes. Here we continue to address the major risk to the grape industry that will be incumbent with the release of 2,4-D and dicamba tolerant field crops. Outreach will be both to grape growers, but also to commercial pesticide applicators, grain farmers, and their advisors who will be using the new 2,4-D and dicamba tolerant soybean varieties. Outreach materials included Powerpoint slide presentations and script used by County Agents in Pesticide Education sessions, and narrative for inclusion in bulletins used by farmers and custom applicators. We also completed a new factsheet, designed for distribution to grain growers, on the risks of drift faced by grape growers. This fact sheet is currently in internal review within OSUE and we expect release in the next few weeks. Presentations were made in Ohio (NE Ohio Grape School, and Ohio Grape & Wine Conference) and also at the Virginia Grape & Wine Conference in Charlottesville.

*Indicates change 07/01/15.

MUTUALLY AGREED-UPON PROJECTS FOR FY16 (continued)

PRODUCTION

1. Commercial Expansion of Varieties New to Ohio. In order to promote varieties tested at OSU research vineyards, maximize their exposure to growers and wine makers, and encourage their expansion, the Viticulture Program in partnership with OGIC started a new variety expansion initiative through a cost-share program in 2014. Six collaborating vineyards and wineries from the main grape growing regions (northeast, northwest, central, southeast, and southwest) in Ohio have participated in the first year of this project. Four hybrid and vinifera varieties (Aromella, Malvasia, Sauvignon blanc, and Teroldego) and an advanced selection (NY81) are purchased and will be planted this spring by cooperating growers and vintners. Due to shortage of plant materials from nurseries, many varieties were not available. Furthermore, vines were more expensive than originally budgeted. If it were not for multiple requests (begging!) by Dami for donations, it would not have been possible to order 5 varieties (750 vines ordered). The actual cost was more than double (~\$4,000) the amount requested (\$1,500). Dami proposes to continue this project for FY16 with the following adjustment: 1) increase the minimum number of vines per variety provided to cooperators. Many requested 100+vines instead of the minimum 25-50; 2) increase the requested budget due to vine expenses (grafted and rootstocks) and shipping cost; 3) request to purchase a grafting machine to be able to graft specific varieties and clones that are not available from the nurseries. For example, most varieties of interest (e.g. Gamay noir, Siegerrebe, Arneis) were not available in nurseries. Further, some growers suggested varieties to plant in OSU research vineyards that are not available in the nurseries. Thus having the flexibility to graft our own varieties will be highly desired.

*MUTUALLY AGREED-UPON PROJECTS FOR FY17

EXTENSION

1. Winegrape Extension Team Activities. The team will continue to provide extension deliverables to the Ohio grape and wine industry. The "core" program deliverables include:
 - A. Ohio Grape & Wine Conference
 - B. Grape School, Grape Field Day, and viticulture workshops with relevant topics
 - C. Technical information on the Team website, Buckeye Appellation and newsletter, OGEN.

Additional Extension and Outreach Activities

- B. Fact sheets on new varieties that are recommended by the Viticulture-Enology Program.
 - C. Fact sheet on managing winter damaged vines that includes a summary of the 2-year findings from several trials and observations following the 2014 and 2015 winter events.
 - D. Midwest Grape Production Guide. Currently under major revision with ten new chapters to be added.
 - E. Program Website. Maintain and update. Fruit maturity monitoring will resume in 2016.
2. Viticulture Outreach Activities
 - A. Continue on-site visits with a maximum number of 75 visits for the year.
 - B. Produce a minimum of 12 issues of OGEN
 - C. Continue to update The Grape Exchange as needed by the industry to help facilitate the exchange of equipment, real estate, grape and wine products.
 - D. Design and present workshops to deliver best cultural practices.
 3. OSU South Centers Activities. Comprehensive training of new and existing grape growers is of vital importance to the success of winegrape growing in southern Ohio and beyond. Testing of cold hardy grape cultivars for premium wine production, development and demonstration of effective vineyard management practices and improvement of basic understanding of grape and wine quality are also critical to a growing wine grape industry. OSU South Centers is uniquely positioned to conduct both basic and applied research on wine grape production and deliver a comprehensive grape grower outreach program.

Deliverables

- A. Reach at least 50 growers through site visits, workshops and field days or field nights.
 - B. Add one small vineyard right next to the existing vineyard.
 - C. Keep refining sampling time for more accurate monitoring of nutrient status.
 - D. Gain a better understanding of the effects of cultural practices on photosynthesis, fruit color, and other quality parameters.
4. Enology Extension Activities
 - A. Participation and Involvement in National and International Meetings
 - B. Assist in coordinating the 2017 Ohio Grape and Wine Conference
 - C. Continued participation in the Ohio Quality Wine program
 - D. Present Post Fermentation Wine Quality Control Workshops
 - E. Provide one or two additional workshops on topics of interest

*Indicates addition of FY17 projects effective 07/01/16.

*MUTUALLY AGREED-UPON PROJECTS FOR FY17 (continued)

- F. Present research and extension information at the AARS Field Day and Northeast Ohio Grape Twilight Tour
- G. Ohio Commercial Tour of the Michigan Grape and Wine Industry
- H. Participate in both National and International Wine Competitions
- I. Develop Winemaking 101 Best Practices Fact Sheet / Manuscript
- J. Researching a Potential Wine Makers Certification Program
- K. On-Site Winery Consultations
- L. Off-Site Winery Consultations
- M. Provide Chemical Analysis of Commercial Wines

RESEARCH

VITICULTURE

1. Managing Grapevines after Successive Winter Injuries. The viticulture group conducted trials at research and commercial vineyards to address issues associated with managing grapevines after winter injury due to extreme low temperatures (-4 to -24oF) in 2014. Unfortunately, in February 2015, sub-freezing temperatures (-5 to -33oF) occurred again in vineyards across Ohio and reached critical levels that were damaging to several grape varieties, especially in *Vitis vinifera*. The successive damaging winters were exceptional weather events that grape growers never faced before and thus created unique challenges. Due to back-to-back winter damage, we are not able to conclude how recover (yield) in 2016 vines after the winter damage in 2015. Grapevines require two growing seasons (16 months) to complete a yield cycle. It is the purpose of this proposal to complete the project on managing vines after winter damage with a primary focus on evaluating vine recovery and return to normal vine training and crop production, by accomplishing the following objectives:

- A. Develop and evaluate training systems for winter-damaged grapevines
- B. Evaluate best sucker management for trunk renewal
- C. Develop post-damage management practices for commercial vineyards
- D. Disseminate findings of managing grapevines after winter damage.

The outcome of this study is very valuable to growers as they will be able to select the best vine recovery options for their vineyards based on our findings and recommendations. In the past two years, Dami and his group shared major findings with growers at educational events and via written and electronic publications posted on Buckeye Appellation website (ohiograpeweb.cfaes.ohio-state.edu).

2. Evaluation of Performance and Cultural Practices of Promising Winegrape Varieties. Grape variety evaluation remains a high research priority as indicated by grape and wine producers and supported by OGIC. The OSU Viticulture-Enology Program has evaluated more than 40 varieties in the past 10 years and provided recommendations on successful and widely planted varieties to date including, Pinot gris, Chambourcin, Traminette, Aromella, Noiret, Marquette, LaCrescent, and Frontenac to list a few. Due to severe winter damage to OSU variety trials (70% vine loss in Wooster and 20% in Kingsville), Dami proposes to continue the trial in Kingsville by replacing dead/missing vines. Due to extensive vine loss at the Wooster site, all vines were removed except for one row. Dami proposes to initiate new trials at the Wooster site with the most promising varieties (4 to 6) by planting a larger number of vines per variety to conduct research on best practices to grow these varieties in Ohio. For example, Regent is recommended and now grown commercially, but growers do not have information on the best vineyard practices to grow it (e.g. optimum crop load, optimum fruit maturity). Additionally, we plan to continue testing new varieties and clones but at smaller scale (6-8 varieties instead of 20+). The establishment of these trials will be the first major research planting at OSU since 2008. Therefore, the majority of the viticulture group time and effort will be dedicated toward this project. Further, since this project is tied to the "Variety Expansion Program", Dami and his group will keep supplying vines, as needed, to cooperating growers-vintners in 2016.

Methods:

- A. In fall 2015, we ordered vines from nurseries for planting in the spring of 2016.
- B. When not available, specific varieties were ordered as cuttings to graft in our lab. We purchased a grafting machine and grafted vines in March 2016.
- C. We have ordered varieties with potentially high quality wines and different cold hardiness. Advanced selections (not named yet) will also be provided by research breeders: Dr. Bruce Reish at Cornell University, Dr. Matt Clark at the University of Minnesota, and a private breeder, Mr. Tom Plocher.
- D. In spring 2016, we will replant the variety block in Wooster and replace dead and missing vines and varieties that underperformed in Kingsville.
- E. Since not all vines will be ready this spring (newly grafted in 2016), we will continue planting during the spring of 2017 as well.
- F. Grafting will continue in 2017 to produce missing vines for both the evaluation trial and variety expansion. Grafting will become an integral part of our research, as we need vines on a yearly basis.
- G. In addition to planting and training the newly planted vines in research vineyards in Wooster and Kingsville, Dami's group will maintain hundreds of potted vines grafted this year in the greenhouses.

*Indicates addition of FY17 projects effective 07/01/16.

*MUTUALLY AGREED-UPON PROJECTS FOR FY17 (continued)

PLANT PATHOLOGY

1. **Statewide Distribution of Grapevine Viruses.** Viruses are important pathogens of grapevines that are known to cause decline in vineyard productivities. Thanks to the generous support by OGIC during the last two years, we have visited a total of 28 vineyards spanning all six Ohio wine production regions, collecting a total of 162 grapevine leaf samples. We then extracted RNA from each of the 162 samples, pooled the RNA into one RNA pool, and subjected the pooled RNA to high throughput sequencing (RNA-Seq) to identify all possible viruses in the collected samples. Analysis of RNA-seq data indicated that at least 21 different viruses are present in Ohio vineyards (Table 1). Sequence signatures for at least one new virus are also present in the dataset. It now becomes critical to map these viruses back to their respective field locations so that the scope and prevalence of each of the viruses can be further assessed.

Expected measurable outcomes:

- A. We will obtain the detailed, location-specific information about all 21 viruses listed in Table 1 of OSU FY17 Proposal.
 - B. This information is expected to permit improved control and management of existing virus problems, as well as to facilitate the development of effective standard operation procedures aimed at preventing future introduction of new viral pathogens.
 - C. The knowledge gathered, in combination with the newly established management procedures, will be broadly disseminated to the stakeholders, leading to increased awareness of the damages that can be caused by these pathogens.
2. **Maintaining a Successful Integrated Disease Management Program for Ohio Grape Growers.** Commercial production of grapes in the Midwestern United States utilizes Integrated Pest Management (IPM) programs to protect the crop from injuries due to plant diseases. Successful management of grape diseases requires management actions throughout the growing season. Combining resistance with good cultural practices and an array of pesticides has enabled growers to produce a profitable crop while simultaneously controlling many grape diseases in Ohio. All the research and extension studies in this proposal focus on maintaining and improving upon current IPM recommendations for grape growers in Ohio. It is our intention to build and expand on the breadth of research previously conducted by the Fruit Pathology Program at Ohio State University.

Diseases continue to be one of the major factors limiting grape production in Ohio. Many of the commercial varieties favored by Ohio grape growers are susceptible to many diseases including downy mildew, black rot, and Botrytis bunch rot. We will continue to evaluate experimental and currently available fungicides for control of all the major grape diseases in Ohio. In addition to efficacy, yearly evaluations of registered fungicides allows us to indirectly monitor fungicide resistance development in the endemic pathogen population, shifts in pathogen diversity and the impact of fluctuating environmental conditions on efficacy. As industry develops and markets new chemistries or biocontrol products we will test their efficacy and make comparisons to registered products.

Deliverables

- A. Updated grape fungicide and biocontrol spray program recommendations (i.e. Midwest Grape Production Guide, Midwest Small Fruit and Grape Spray Guide, OSU Extension factsheets) for Ohio growers.
 - B. Support registration and labeling of new materials in Ohio.
 - C. Provide publishable data for a national database (Plant Disease Management Reports) used to prepare quantitative reviews of fungicide efficacy for managing grape diseases.
3. **Create an Extension information/education web portal for Ohio wine grape growers.** Web-based information delivery is not expected to displace traditional methods of information exchange, but to remain relevant in our rapidly changing information society more needs to be done with web-based educational programs and information. We will enhance the Buckeye Appellation website (<http://ohiograpeweb.cfaes.ohio-state.edu>) by adding a page dedicated to grape IPM. This page will include portals for information and resources for diseases, insects, weeds, and pest management. Each portal will be organized in a manner that provides IPM recommendations for organic and conventional grape production, year round IPM programs, and disease, weed, and insect image galleries for easy identification. The page will be developed so that it can be easily converted into a mobile application (long term goal).

An OSU Grape IPM Facebook page will be launched to provide real-time information on upcoming outreach activities (i.e. workshops, trainings, new factsheets etc.), disease outbreaks, insect infestations, weeds problems, new pesticide regulations and other information related to grape IPM. The Facebook platform will bring local, national and international visibility to grape and wine production in Ohio.

*Indicates addition of FY17 projects effective 07/01/16.

*MUTUALLY AGREED-UPON PROJECTS FOR FY17 (continued)

A searchable web-based database will be constructed in three phases. Phase one will be constructed to allow grape growers to compare varieties based on disease resistant profiles, cold hardiness, fruit type and wine attributes. Users will be able to export the information as an Excel file or PDF. An example of a similar database for vegetables was developed by the PI and can be viewed at <http://sites01.lsu.edu/faculty/mivey/recommended-varieties/>. Phase two (year two) will expand on phase one to include registered pesticides for target pests and downloadable pesticide labels. Users will also be able to select multiple varieties for comparison purposes and a one page "variety snapshot" for each variety will be compiled and downloadable. Phase three will convert the database into a mobile application. Completion of phases 2 and 3 will be completed based on future funding opportunities.

An evaluation plan will be implemented to measure impact based on application usage (web statistics) and the relevance of the information as perceived by the growers using the applications (surveys).

Deliverables

- A. A user friendly state of the art web-based information portal for extending grape IPM science-based IPM strategies and technologies.
- B. A Facebook page for grape IPM in Ohio.
- C. A searchable database to quickly identify registered pesticides, disease resistant varieties and wine attributes for grape varieties recommended for wine production in Ohio.

ENTOMOLOGY

As vineyards and wineries continue to grow in number in Ohio we must be mindful of the long-term sustainability of grape production because what we do now will shape the trajectory of our grape industry in the future. In managing insect pests of grapes, our key challenges are: 1) staying up to date on the activity and occurrence of grape pests in Ohio, both old and new; 2) evaluating our management practices to ensure they are still reliable and economically feasible for growers; and 3) balancing our reliance on chemicals with our use of cultural and biological controls to manage vineyard pests. These challenges can be addressed using Integrated Pest Management (IPM), which has the further benefit of minimizing the development of resistance in pests, as well as reducing unintended impacts on the environment and other non-target organisms. This proposal aims to address the 3 above-mentioned challenges with the goal of positioning growers to be proactive in their approach to managing insects, with an eye towards the sustainability and environmental integrity of their vineyard systems.

Expected Results and Deliverables

1. Continued collection of up-to-date information on the status and activity of invasive insects that have potential to threaten Ohio's grape industry (particularly spotted-wing drosophila), as well as identifying the "good" and "bad" (no ugly!) members of the insect community common to Ohio vineyards.
2. Developing a better understanding of insecticide efficacy and residual activity against grape pests so that we can better inform growers in their pesticide application decisions, with emphasis on grape phylloxera and spotted-wing drosophila.
3. Contribution to the annual revision of the "Midwest Small Fruit and Grape Spray Guide."
4. Delivery of research-based information on new technologies and products available for the management of grape insect pests in Ohio via extension presentations, newsletters, and online videos.

WEED SCIENCE

Weed Management of the Vineyard Floor; A Pro-active Approach. Selection of site and knowledge of weed populations are paramount in establishing a new vineyard. While many herbicides are registered to control annual broadleaf weeds and grasses in the vineyard, how and when to use the various options is confusing and worrisome to the grower. Moreover, creeping perennials such as thistle, various vines and woody species, and ground ivy continue to challenge most.

The first step in weed control is to eliminate perennial weeds before planting. This should be done by killing sod with one or more systemic herbicides not later than the autumn before planting vines. It is equally important to then begin the process of establishing a permanent sod ground cover between the rows, bearing in mind that a weed-free strip will usually be required directly under the trellis. Newly planted vines are more likely to be damaged by herbicides than vines that have been established for a year or more. Close examination of the labels of registered herbicides will show that in the year of planting only a few products can be used because of that fact.

*Indicates addition of FY17 projects effective 07/01/16.

*MUTUALLY AGREED-UPON PROJECTS FOR FY17 (continued)

The objective of the proposed research is to establish a multi-year experiment enabling evaluation of six sequential herbicide programs starting immediately after transplanting and continuing through the end of the fifth year when the herbicide Alion can be added to the program. In year 1 the initial six treatments will be one of: Treflan, Surflan, Prowl, Venue, Snapshot, or Roundup. Duration of weed control resulting from each application will be recorded as well as the identity of those weeds surviving treatment. Once weed control drops below 50% bare ground, plots will be retreated with the most appropriate herbicide depending on weeds present (eg Poast for grass escapes). The sequential nature of the treatments can be appreciated by considering that in the fall of the planting and second years, respectively, Chateau and Casoron can be added to the program. Further, in the spring of the second year Matrix can be added in addition to a reapplication of the herbicides used in spring of year 1. In year 3, Zeus Prime XC, Princep and Karmex can be added to the program, and so on through year 5 when Alion can be used for the first time. In addition to weed control, we will also measure vine growth and vigor, fruitfulness, and ground cover establishment. By focusing only on combinations of herbicides already registered for use in grape production we expect the research to position us to make practical recommendations for the best season long weed control with the least possible damage to fruit.

HERBICIDE DETECTION

Beta-testing of a mobile, field-deployable 2,4-D/dicamba detection system. The release of 2,4-D and dicamba tolerant corn, soybean, and cotton is imminent, beginning with 2,4-D tolerant corn. Farmers are expected to rapidly embrace these crops because they provide a new method to kill a growing range of glyphosate-resistant weeds. Employment of 2,4-D/dicamba resistant crops as a pest-management strategy, however, brings with it a set of risks that must be dealt with. Even modest adoption of this technology on 30% of the corn and soybean acreage in the Midwest will result in an increase in potential 2,4-D and dicamba use to six times the current usage. Even with advanced drift reduction technology in place, the increased use of these herbicides adjacent to sensitive crops will be such that crop injury resulting from off-site movement is highly likely, resulting in damage to sensitive crops, particularly grapes.

While new formulations of 2,4-D and dicamba can dramatically reduce drift, drift events can still occur, resulting in damage to vines and loss of yield. Depending on the concentration of 2,4-D or dicamba in a drift event, effects vary from occasional yield increases, to initial injury with complete recovery, to greatly reduced yield or death. The ability to rapidly detect drift compounds in the damaged crop is increasingly a deciding factor in preventing further damage or recovering financial losses in drift cases. In the case of 2,4-D and of dicamba, herbicides which mimic the plant hormone auxin, it is very difficult to detect residues with reliability and reproducibility using current analytical techniques if above-ground tissues are not collected within two to three days (48-72 h) of the drift event. Unfortunately, evidence of drift damage is usually not visible until the end of this period.

Our work has aimed to resolve the problem of longer-term 2,4-D detection by optimizing and beta-testing a proprietary detection system that sensitive crop growers can deploy in their fields. This system can be harvested post-drift, stored in the cold, and analyzed for the presence of 2,4-D after signs of damage become visible on the plant. Our preliminary results (funded in part by OGIC in 2013, 2014, and 2015), demonstrated that the current version of these detectors are able to successfully detect 2,4-D residues and withstand long-term storage.

Deliverables

1. Data determining which "Mark-II" detector matrix is best capable of withstanding exposure to rain, sun, wind, and heat.
2. An estimation of the length of time which the detection system (employing the best matrix composition) can be deployed in the field and still retain detectable 2,4-D residues.
3. A detection system ready for beta field deployment in the 2017 growing season, with OGIC partner vineyards.

ENOLOGY

1. Varietal Wine Evaluation (OARDC, AARS, and OSU South Center). Vineyards were set up at Wooster, Kingsville (AARS), and OSU South Centers as part of the original NE1020 variety trial collaborative project. Varieties at both Wooster and Kingsville have reached maturity for winemaking trials with a number of varieties being made from the 2011 through 2013 vintages. Varieties from OSU South Centers are considered to comprise more of an extension display vineyard that the OARDC Enology Program may also choose to vinify for the Southern region of the state. Although funding is not available through VCE, NE1020, and SCRI anymore, the enology program has also identified the importance of continuing to evaluate new varieties for their ability to grow in Ohio but more specifically related to their wine quality potential. We plan to continue our collaboration with Dr. Imed Dami on several promising and potential new varieties we have identified from these studies. Due to the past two harsh winters, we will be limited on the amount of grapes processed into wine for the 2016 vintage.

We expect to produce wines from the New York and Minnesota selections to continue observing wine quality from these varieties for commercial interest. There will be several other hybrid varieties produced at Wooster, AARS or OSU South Centers that may be produced into wine as well under this section of research. We will keep track of wine quality from these varieties in tasting with members of our industry who may be considering a few of these varieties to replant some Vinifera or hybrid vines that did not make it through the past two winters. It is extremely valuable to have these wines available for use in educational formats in having winemakers taste any observed differences that the treatments may have in these practical studies. The following information below provides a brief overview of the wines vinified for this purpose.

*Indicates addition of FY17 projects effective 07/01/16.

*MUTUALLY AGREED-UPON PROJECTS FOR FY17 (continued)

Deliverables

- A. Produce wine from varieties with high enough yields for evaluation of wine quality attributes
 - B. Taste wines with members of our industry who may be considering a few of these varieties to replant some Vinifera or hybrid vines that did not make it through the winter.
 - C. Provide recommended grape and wine quality fact sheets being disseminated to Ohio grape growers and winemakers
 - D. Addresses "best practices for wineries" in addition to "wine quality" deemed of high importance in the recent research and extension strategic planning process through OGIC.
2. The Effects of Hyperoxidation and Storage Temperatures on the Flavor Profiles and Sensory Qualities of Riesling Wine. Approximately 75% of Ohio wineries produce white wines from cultivars with fruity or floral varietal characteristics (e.g., 'Vidal', 'Traminette', 'Riesling' and others). The quality of these wines is highly dependent on vintner practices that control the level of oxygen that the wine receives during the post fermentation and aging processes. Exposure to oxygen at any point in these processes is generally considered to have a negative impact on wine color, flavor and shelf-life.

However, there may be one exception, a process known as hyperoxidation. Using this technique, the winemaker purposefully introduces high levels of oxygen to recently pressed juice in order to initiate enzymatically controlled oxidation cascades of common phenolic constituents leading to the formation and precipitation of quinones (Moio et al., 2004; Ough, 1985; 1992). When these compounds are removed prior to vinification, they are excluded from the finished wine, leading to a product that is more shelf-stable, less off-colored, with fewer harsh or bitter flavor notes. However, the overall effects of hyperoxidation on wine flavor quality are still in dispute. Some studies indicate that hyperoxidation decreases the fruity and floral flavors that white wines typically contain and promotes the formation of new, unwanted compounds that are detrimental to wine quality (Nagel and Graber, 1988). In contrast, other researchers report that hyperoxidation of juice before alcoholic fermentation is associated with improved flavor, quality, and stability in the resulting product (Moio et al., 2004; Ough, 1992).

Storage can affect final sensory quality of white wine by modifying or decreasing characteristic hydroxycinnamic acids, flavanoids, and ester compounds, and by forming new detrimental flavor constituents leading to a reduction in quality (Kallithraka et al., 2009; Ough, 1985; Recamales et al., 2006). The rate of phenolic oxidation seems to increase within wines stored at higher temperatures (Kallithraka et al., 2009). Therefore, wines with lower concentrations of phenolic substrates through the process of hyperoxidation may be able to retain positive flavor constituents ultimately leading to longer shelf-life stability and aging potential.

Determining the identity and relative concentration of flavor compounds via gas chromatography-mass spectroscopy (GC-MS) is essential when evaluating wine flavor characteristics. The analyses are useful to quantify the effects of altered vinification parameters and provide a mechanism to relate vinification techniques to sensory evaluation of flavor quality. Terpenes, volatile ester compounds, and some low molecular weight phenolic compounds play a key role in white wine flavor and scent (Ferreira et al., 1996). However, the effects of hyperoxidation on the levels of these compounds are poorly documented. We hypothesize that the technique of hyperoxidation may increase the overall shelf-life, decrease flavor intensities initially, and will also reduce the development of oxidized off-flavor volatiles over time compared to control wines, especially at higher temperatures.

We have identified four objectives for verification of our main hypothesis:

- A. Critically evaluate the overall effects of must hyperoxidation on Riesling wine phenolic levels
- B. Examine the effects storage temperatures on the flavor quality and shelf-life of hyperoxidized Riesling wines
- C. Determine the efficacy of different levels of applied oxygen during hyperoxidation of Riesling must samples
- D. Distinguish whether or not the practice of hyperoxidation will improve the consumer acceptance and marketability of Riesling wines

2017 Deliverables

- A. Laboratory-Scale Research (FY17): Volatile flavor compounds will be analyzed using SPME-GC-MS, Phenolic assays, and phenolic compound levels will be analyzed using HPLC-DAD.
- B. Cellar-Scale Research (FY17): Information relating the effects of an optimized hyperoxidation/storage treatment combination and optimal oxygen addition levels on the color and volatile profiles of Riesling wines, the effects of these characteristics on wine quality as perceived by a trained sensory panel, and the attitude of the average consumer of hyperoxidated wines.
- C. Consumer Research (FY17): Focus groups will be formed to determine what Ohio consumers want in white wines and how consumers are likely to react to hyperoxidation and its affects to the quality of white wines.

*Indicates addition of FY17 projects effective 07/01/16.

*MUTUALLY AGREED-UPON PROJECTS FOR FY17 (continued)

3. Lalvigne Study. Lalvigne is a yeast derivative product produced by Lallemard that is sprayed as a foliar application in the vineyard at 5% veraison with a second spray 10 to 12 days later. Lalvigne has been developed with the goal and intension of achieving both phenolic and enological maturity at the same time. This is attractive in a cool climate where growers desire to harvest earlier and avoid extended periods of rain, frost, and cool weather. Lalvigne is reported to help increase aromatic intensity for white wine varieties while also increasing body and mouthfeel in red wines. Currently, this work has been performed on Vinifera varieties with interest on its quality effects on hybrid white and red varieties common to the Midwest and Eastern section. Therefore, we will continue preliminary work on Traminette and Chambourcin vines for the 2016 vintage.

Deliverables

- A. Perform chemical and sensory evaluation trials on both control and Lalvigne treated wine samples.
 - B. Evaluate the effect of Lalvigne sprayed on Traminette and Chambourcin on overall wine quality.
 - C. Taste experimental wines at enology workshops or the annual conference.
 - D. Recommendations based on results will be disseminated to the Ohio commercial grape and wine industry at industry workshops, the annual Ohio Grape and Wine Competition or other extension related publication relating to the effect of Lalvigne on wine quality important factors to consider at harvest.
4. Dissolved Oxygen and Sulfur Dioxide (SO₂) Correlation Study (*continuation with write up of study). A separate study not originally proposed in the production line item was developed based on the results of the dissolved oxygen study/survey during the bottling process of Ohio commercial wineries. This study was designed to determine the influence of free SO₂ at various dissolved oxygen levels and storage intervals on white wine quality. When wine is exposed to extensive aeration, oxidation usually occurs with a decrease in wine quality. The most common oxidation flaw results in a nutty, sherry-like aroma with a brown color. To control wine chemical oxidation, dissolved oxygen should be maintained at a minimum of 10 ppm at the time of bottling. In addition, it is essential to add adequate amounts of free SO₂ to obtain 10 ppm free SO₂ throughout bottle storage. Sulfur dioxide is a powerful anti-oxidant and consumes 4 ppm of dissolved oxygen per 1 ppm free SO₂. For this reason, most SO₂ amounts are increased to extreme levels to compensate for high dissolved oxygen levels. The consequence of this is undesirable sensory attributes such as, pungent odor and bleaching of color. Also, some recent studies indicate that higher levels of SO₂ may diminish the ratings for delicate varietal fruit and various other positive sensory attributes in aroma.

Deliverables

- A. Analyze the data to observe if simply adding additional amounts of sulfur dioxide based on oxygen content is an acceptable practice as related to sensory evaluation results.
 - B. Try to correlate if there is a limit to the amount of oxygen and sulfur dioxide addition according to sensory evaluation over time.
 - C. Results will be disseminated at future OARDC enology workshops, the Ohio Grape and Wine Conference in addition to the annual report to OGIC.
5. Research Studies and Varietal Wine Production for Extension Purposes. Several small scale enology studies will also be performed specifically for the educational benefit of Ohio commercial winemakers. These studies are mainly focused on extension related activities with the purpose of directly observing the results through tasting wines in an educational setting. Results and tastings will be performed at various workshops, wine making forums, site visits or conferences. Although not listed below, other small scale studies under this focus may evaluate specific yeast or bacterial strains in addition to other potential cellar treatments of potentially enhancing wine quality for a particular variety.

*Indicates addition of FY17 projects effective 07/01/16.

COST SUMMARY

Ohio Grape Industries Extension and Research Program
 CSP900113

UNSPSC CATEGORY CODE: 93141905, 70141705

OAKS ITEM NUMBER: 11942

Description	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost
1. Extension Services					
Extension Services	\$ 172,716.00	\$ 189,593.00	\$ 203,427.00	\$ 202,779.00	\$ *209,784.00
Category Total	\$ 172,716.00	\$ 189,593.00	\$ 203,427.00	\$ 202,779.00	\$ *209,784.00
2. Viticulture Research					
1. Viticulture	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost
a. Evaluation of Crown Gall-Free grapevines	\$ 9,012.00	\$ 9,192.00	\$ 3,132.00	\$ 0.00	\$ 0.00
b. Evaluation of training systems for Cabernet Franc	\$ 10,014.00	\$ 10,215.00	\$ 3,132.00	\$ 0.00	\$ 0.00
c. Winegrape variety evaluation – Ne 1020 Project	\$ 10,000.00	\$ 12,700.00	\$ 3,132.00	\$ 0.00	\$ 0.00
d. Winegrape variety selection evaluation with improved cold hardiness	\$ 7,010.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
e. Clonal evaluation of Cabernet Franc.	\$ 9,012.00	\$ 9,192.00	\$ 3,132.00	\$ 0.00	\$ 0.00
f. Rootstock Evaluation for Traminette and Chardonel	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
g. Winter protection of grapes using ABA	\$ 15,000.00	\$ 15,300.00	\$ 0.00	\$ 0.00	\$ 0.00
h. Implementing Best Viticulture Practices		\$ 15,000.00	\$ 3,132.00	\$ 0.00	\$ 0.00
Managing Vines after Winter Injury	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost
a. Cordon and Trunk Management			\$ 9,397.00	\$ 0.00	\$ 0.00
b. Rootstock and Clonal Evaluation			\$ 9,397.00	\$ 0.00	\$ 0.00
c. Pruning Decisions in Hybrids			\$ 9,397.00	\$ 0.00	\$ 0.00
d. Sucker Management			\$ 9,397.00	\$ 0.00	\$ 0.00
e. Commercial Vineyards Trials			\$ 9,397.00	\$ 0.00	\$ 0.00

*Indicates updated FY17 costs and re-pagination effective 07/01/16.

f. Developing a Training System for Winter-Damaged Grapevines				\$ 12,631.00	\$ 0.00
g. Trunk Renewal and Sucker Management				\$ 12,631.00	\$ 0.00
h. Evaluation of Crown Gall Sensitivity in Grape Varieties				\$ 12,631.00	\$ 0.00
i. Managing Winter Damage in Commercial Vineyards				\$ 12,631.00	\$ 0.00
j. Evaluation of Performance and Cultural Practices of Promising Winegrapes				\$ 12,631.00	\$ 0.00
*FY17 Projects					\$ *61,471.00
Viticulture Total	\$ 60,048.00	\$ 71,599.00	\$ 62,465.00	\$ 63,155.00	\$ *61,471.00
2. Plant Pathology	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost
a. Evaluation of currently available and experimental fungicides	\$ 3,023.80	\$ 3,106.60	\$ 0.00	\$ 0.00	
b. Collect infected grape canes and document pycnidia formation and sporulation	\$ 3,023.80	\$ 3,106.60	\$ 0.00	\$ 0.00	
c. Determine the conditions required for sporulation of P.viticola on infected grape canes and develop a predictive model	\$ 3,023.80	\$ 3,106.60	\$ 0.00	\$ 0.00	
d. Determine the effects of dormant applications of a potential substitute for Liquid Lime Sulfur (Sulfurix) on the development of Phomopsis cane and leaf spot and other grape diseases in Ohio, and the effects of dormant applications of phosphorous acid on control of grape diseases.	\$ 3,023.80	\$ 3,106.60	\$ 0.00	\$ 0.00	
e. Determine the efficacy of a new biological control agent and soil amendments of compost for control of grape crown gall.	\$ 3,023.80	\$ 3,106.60	\$ 0.00	\$ 0.00	
f. Sustain Ohio grapevine productivity by surveying virus and phytoplasma disease damages to vineyards across the state.			\$ 23,033.00	\$ 0.00	
g. Identify Disease-Causing Viruses and Phytoplasmas in Ohio				\$ 12,000.00	
h. Determine Statewide Distribution of Identified Pathogens				\$ 8,000.00	

*Indicates addition of FY17 costs and re-pagination effective 07/01/16.

i. Assess Grape Production Losses Caused by these Pathogens				\$ 3,033.00	
*j. Statewide Distribution of Grapevine Viruses					\$ *11,636.00
*k. Maintaining a Successful Integrated Disease Management Program for Ohio Grape Growers					\$ *11,030.00
*l. Create a web portal for Ohio wine grape growers					\$ *7,005.00
Plant Pathology Total	\$ 15,119.00	\$ 15,533.00	\$ 23,033.00	\$ 23,033.00	\$ *29,671.00
3. Entomology Section to be awarded after 08/01/12.	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost
a. Develop more effective scouting protocols and pest management strategies to control invasive pests in Ohio vineyards, including but not limited to Multi-Colored Lady Asian Beetle, Marmorated Stink Bug, Spotted Wing Drisophila and European Berry Moth.	\$ 14,608.00	\$ 20,214.00	\$ 20,214.00	\$ 0.00	
b. Evaluate Movento for control of grape scale.	\$ 4,804.00	\$ 2,000.00	\$ 2,000.00	\$ 0.00	
c. Evaluate Movento and leverage for annual and long term control of grape phylloxera.	\$ 4,804.00	\$ 2,000.00	\$ 2,000.00	\$ 0.00	
d. Statewide systematic monitoring of Spotted Wing Drosophila (SWD), comprehensive training of growers in SED monitoring and identification, and insecticide efficacy studies of SWD.	\$ 0.00	\$ 5,000.00	\$ 5,000.00	\$ 0.00	
e. Monitoring and Managing Invasive Pests in Ohio Vineyards				\$ 13,000.00	
f. Evaluating Admire Pro, Movento and Leverage for Control of Grape Phylloxera				\$ 6,000.00	
g. Monitoring and Management of Japanese Beetles				\$ 3,000.00	
h. Grower Outreach and Consultation				\$ 1,714.00	
i. Midwest Small Fruit and Spray Guide Development				\$ 500.00	

*Indicates addition of FY17 costs and re-pagination effective 07/01/16.

*j. Informing Management Strategies for the Good, Bad and Ugly Insects in Ohio Vineyards					\$ 23,651.00
Entomology Total	\$ 24,216.00	\$ 29,214.00	\$ 29,214.00	\$ 24,214.00	\$ 23,651.00
4. Weed Science	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost
a. Continue development of new and improved herbicides, alternative weed control techniques and weed management systems that will provide more efficient, cost effective and environmentally sound weed control in Ohio vineyards.	\$ 5,700.00	\$ 5,700.00	\$ 0.00	\$ 0.00	
b. Optimization of mobile detector deployment strategies for 2,4-D and dicamba drift.	\$ 0.00	\$ 6,500.00	\$ 6,500.00	\$ 0.00	
c. Improved weed control for winter-hilled vines			\$ 5,700.00	\$ 5,800.00	
*d. Weed Management of the Vineyard Floor					\$ 5,696.00
Weed Science Total	\$ 5,700.00	\$ 12,200.00	\$ 12,200.00	\$ 5,800.00	\$ 5,696.00
5. Herbicide Detection	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	
a. Complete Weather Optimization of 2,4-D/dicamba Detection System				\$ 7,700.00	
b. Beta Field Deployment Trials of the 2,4-D Detection System in Vineyards				\$ 9,800.00	
*c. Beta-testing of a mobile, field-deployable 2,4-D/dicamba detection system					\$ 16,600.00
Herbicide Detection Total				\$ 17,500.00	\$ 16,600.00
Category Total	\$ 105,083.00	\$ 128,546.00	\$ 127,092.00	\$ 133,702.00	\$ *137,089.00
3. Enology Research					
1. Enology research focused on producing premium quality wine in Ohio:	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost
a. Identify vinification practices in determining optimum procedures of enhancing varietal character.	\$ 13,037.00	\$ 9,567.40	\$ 7,729.00	\$ 0.00	
b. Investigation of new yeast and bacteria strains in producing higher quality and more complex wines.	\$ 6,520.00	\$ 7,653.40	\$ 0.00	\$ 0.00	

*Indicates correction of Category Total amount effective 07/01/16.

c. Emphasis on aromatic volatile research by optimizing the GC/MS.			\$ 0.00	\$ 0.00	
d. Investigation of new techniques of controlling both chemical and microbial wine stability.	\$ 8,691.00	\$ 0.00	\$ 0.00	\$ 0.00	
e. Effect of tannin addition on Cabernet Franc and Chambourcin wine quality		\$ 13,085.40	\$ 0.00	\$ 0.00	
f. Effect of hyperoxidation on Riesling and Pinot Gris wine quality.		\$ 4,894.40	\$ 0.00	\$ 0.00	
g. Effect of oxygen management on terpene and ester levels in white wines		\$ 15,810.00	\$ 24,734.00	\$ 0.00	
h. Best Viticultural Practices		\$ 5,930.00	\$ 10,821.00	\$ 7,480.00	
i. Varietal Wine Evaluation (OARDC, AARS and OSU South Center)				\$ 10,472.00	
j. Effects of Hyper-oxidation on Terpene and Ester Levels in Riesling				\$ 23,935.00	
k. Research Studies and Varietal Wine Production for Extension Purposes				\$ 17,813.00	
Enology Research for Premium Quality Wine	\$ 28,248.00	\$ 48,874.00	\$ 43,284.00	\$ 59,700.00	
2. Collaborative Enology research focused on enhancing both grape and wine quality for Ohio:	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost
a. Evaluate cultural practices in the vineyard that optimize vine performance and fruit quality for wine quality enhancement.	\$	\$	\$ 0.00	\$ 0.00	
b. Evaluate clones and rootstocks of existing and newly introduced varieties for enhancing wine quality (e.g. Cabernet franc, Riesling, Gamay noir, etc.)	\$	\$	\$ 0.00	\$ 0.00	
c. Evaluate newly released varieties and advanced selections for grape and wine quality in Ohio. Varietal wine production for extension presentations and functions.	\$ 6,519.00	\$ 7,653.40	\$ 18,551.00	\$ 0.00	
d. Develop standards of fruit maturity for varieties in Ohio in the production of premium wine.	\$ 4,345.00	\$ 0.00	\$ 0.00	\$ 0.00	
e. Work with other disciplines involving Entomology, Plant Pathology and Weed Ecology on possible studies effecting wine quality	\$	\$	\$ 0.00	\$ 0.00	
Enology Research to Enhance Grape and Wine Quality	\$ 10,864.00	\$ 0.00	\$ 0.00	\$ 0.00	

*Indicates re-pagination effective 07/01/16.

*FY17 Projects					\$ *71,833.00
Category Total	\$ 39,112.00	\$ 64,594.00	\$ 61,835.00	\$ 59,700.00	\$ *71,833.00
Commercial Expansion of New Varieties to Ohio			\$ 1,500.00	\$ 2,800.00	
Grand Total	\$ 316,911.00	\$ 382,733.00	\$ 393,854.00	\$ 398,981.00	\$ *418,706.00

*Indicates addition of FY17 costs and re-pagination effective 07/01/16.

All costs must be in U.S. Dollars.

The State will not be responsible for any costs not identified.

There will be no additional reimbursement for travel or other related expenses.

CONTRACTOR INDEX

CONTRACTOR AND TERMS:

*BID CONTRACT NO.: CSP900113-1



678 (address 48)
The Ohio State University
Office of Sponsored Programs
1960 Kenny Road
Columbus, OH 43210-1063

TERMS: Net 30

CONTRACTOR'S CONTACT:

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*Indicates re-pagination effective 07/01/15.

SUMMARY OF AMENDMENTS

Amendment Number	Effective Date	Description
11	07/01/16	To correct Category Total amount on page 27.
10	07/01/16	To renew the contract for an additional twelve (12) months, effective July 1, 2016 through June 30, 2017, add the FY17 approved projects, update the Cost Summary, update the Administrative Contact and re-paginate the document.
9	07/01/15	To renew the contract for an additional twelve (12) months, effective July 1, 2015 through June 30, 2016, change the Administrative/Fiscal Contact and update the Cost Summary for FY16.
8	10/27/14	To change the expiration date of the contract and to add the mutually agreed-upon provision regarding equipment.
7	08/01/14	Issued to renew the contract for an additional twelve (12) months, effective August 1, 2014 through July 31, 2015. In addition, this amendment is issued to include budgeted projects for FY15 for this contract; and, an update to the Contractor's contact.
6	07/01/14	To renew the contract for an additional twelve (12) months, effective July 1, 2014 through June 30, 2015.
5	07/19/13	To add new projects, update the budget amounts with FY14 funding and re-paginate the document.
4	08/24/12	To correct the FY13 totals for Viticulture Research and Grand Total and to correct the OAKS vendor address code.
3	08/08/12	To add the Entomology costs and include these costs in the Grand Total amounts.
2	07/13/12	To correct Weed Science and Grand Total amounts for Years 1 and 2.
1	07/06/12	To correct Grand Total amount in Year 1 and Plant Pathology Total, Viticulture Research Category Total and Grand Total amounts in Year 2.