Pennsylvania Wine Market & Research Promotion Program

Final Report

A financial status report and a project performance report will be required on a semi-annual basis. October and April reports are due. A final report may serve as the last semi-annual report due 30 days after completion of the contract. Grantees shall monitor performance to ensure that time schedules are being met and projected goals by time periods are being accomplished. Please submit reports to: RA-AGCommodities@pa.gov.

SECTION 1 – SUMMARY INFORMATION

Date of Report: June 7, 2021

Contract/PO#: 63019431 Fiscal Year: 2020-2021 Round of Grant: (i.e. Round 1, Round 2, etc) 4

Title of Paper: Does delaying budburst reduce the risk of frost damage while maintaining grape and wine quality? Comparing the effectiveness of pruning time and Amigo application

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Progress Report: ☐ October ☐ April ☒ Final

Area of Focus: ☒ Research ☐ Marketing

SECTION 2 –OBJECTIVES | TIMELINES | OUTCOMES | BUDGET

(A comparison of actual accomplishments to the objectives for that period?)

The goal of our 3-year study was to provide Pennsylvania grape growers and wine producers with recommendations and best practices to decrease the risk of spring freeze damage and subsequent crop losses while maintaining grape and wine quality. We evaluated the effectiveness of traditional and novel methods to shift grapevine budburst later in the spring, when temperatures are warmer, and the likelihood of a sub-freezing event has diminished. Two well-replicated field trials were conducted during this funding cycle. The first trial was established at the commercial vineyard on a white (Riesling) and red (Lemberger) vinifera varieties. The two methods to delay budburst were: a vegetable oil-based adjuvant (Amigo®) applied to dormant buds at 8% and 10% (v/v) and late pruning applied when apical buds/shoots had one to two leaves unfolded. The second field trial was conducted on a promising cold-hardy hybrid, Marquette, at the Penn State Horticulture Research farm. Marquette can produce high quality wines and withstand extremely low winter temperatures (e.g., -40 ºC) but it is susceptible to spring freeze damage because of its early budburst. At this site, we tested the efficacy of novel sprayable products (Frostshield developed by Ohio State University and ABA analog® synthesized by ABAzyne Bioscience Inc.). This experiment is an ongoing collaborative effort with Virginia Tech and Ohio State Universities and the University of Saskatchewan, Canada. At both sites methods to delay budburst were compared to control vines (no frost avoidance practice). Our **objectives** were to **1:** Compare the effectiveness of delay bud burst practices and evaluate their effects on grape production, finished wine quality and sensory perception in both red and white grapevine varieties; **2:** Elucidate the mechanism of action of Amigo oil through an examination of bud respiration and potential phytotoxic effects; and **3:** Assess the impact of delay budburst practices on cold acclimation and deacclimation of primary buds and maximum bud cold hardiness, and linking those parameters to carbohydrate reserve storage.

Timeline: October 17, 2020, to April 7, 2021.

Obj1.Wine chemical (volatile and non-volatile) analysis for the Lemeberger and Riesling wines was completed. This was the last measurement left for the first field trial conducted on the two vinifera varieties. At the second site (Marquette vineyard) pruning weight was collected for all the experimental vines to assess the effects of delay budburst and spring freeze damage (occurred in 2020) on seasonal vegetative growth.

Obj 3: Marquette canes were collected two times during the dormant season to evaluate potential negative effects of delay budburst and spring freeze damage (occurred in 2020) on vine ability to survive low winter temperatures. Bud freeze tolerance was measured during vine acclimation (November 2020) and maximum cold hardiness (January 2021) using Differential Thermal Analysis (DTA). Bud samples were also used to quantify non-structural carbohydrates (soluble sugars) associated to bud freeze tolerance.

All objectives: All data collected during the 2020 field season were statistically analyzed.

Outcomes

First trial (vinifera varieties): Overall, we found that all treatments, both novel (chemical products) and traditional (late pruning) methods, were able to delay budburst, but to a different extent. Among the treatments tested on the vinifera varieties, late pruning was the most effective in delay budburst and reducing spring freeze damage on Lemberger (data included in previous reports). Neither delay budburst treatment had negative effects on yield or wine chemistry (Table 1).

Second trial (Marquette): Among the novel products tested on Marquette vines, ABA was the most promising product; vines treated with ABA had the lowest spring freeze damage, highest yield at harvest, and greater

crop load (Ravaz index; Table 2). In addition, none of the delayed budburst treatments influence soluble sugar storage in the buds or bud freeze tolerance during the following dormant season (Table 2).

Results of the project were presented at the two online extension meetings to over 300 attendees, which were mainly grape and wine producers in the Mid-Atlantic regions (New Jersey Agriculture Convention and Eastern Viticulture and Enology Forum). A publication summarizing the main finding from the first trial established at commercial vinifera vineyard was accepted for publication ("*Delaying Budbreak to Reduce Freeze damage: Seasonal Vine Performance and Wine Composition in Two V. vinifera Cultivars*") by the American Journal of Enology and Viticulture. A second manuscript is in draft form. This article will review the correlations between seasonal weather conditions, shift in grapevine phenology, and wine chemistry and sensory perception across our 3-year project. The data included in these two manuscripts will be the basis of two extension articles for Pennsylvania stakeholders, including actionable plans for growers to implement. Data collection is still ongoing at the Marquette site because multiple years of data are needed to draw any conclusion and provide recommendation to growers.

Budget: Financial reporting is provided by the Department of Research Accounting at PSU in accordance with the terms of the grant agreement.

SECTION 3 – SCOPE OF WORK

(Reasons why established objectives were not met, if applicable?)

NA

SECTION 4 – DELAYS/RISKS

(Reasons for any problems, delays, or adverse conditions which will affect attainment of overall program objectives, prevent meeting time schedules or objectives, or preclude the attainment of particular objectives during established time periods. This disclosure shall be accomplished by a statement of the action taken or planned to resolve the situation?)

There have been no major problems with data collection or analysis and no effect on the overall progress of the program objectives. However, laboratory work took longer than anticipated because of COVID-19 safety regulations and travel to meetings and conferences was eliminated, resulting in unspent funds.

SECTION 5 – SPECIAL NOTES

(What objectives and timetables are established for the next reporting period? Etc.)

NA, this is a final report.

Table 1. Treatments effect on wine anthocyanin and tannin concentration of Lemberger. Control treatment = no frost avoidance practice was applied on these vines.

Treatment	Tannin (mg/L)	Total anthocyanins (mg/L)	Monomeric anthocyanins (mg/L)
Control	258.0	264.3	247.0
Amigo 8%	256.0	254.7	237.7
Amigo 10%	238.0	277.0	261.0
Late pruning	243.3	308.0	291.0
p-value	NS[z]	NS	NS

[z] NS: Not statistically significant

Table 2. Treatment effects on Marquette yield, prunign weight and Ravaz index (crop load). Control treatment = no frost avoidance practice was applied on these vines.

Treatment	Yield (tons/acre)	Pruning weight (kg/ vine)	Ravaz index (Yield/ prunign wt.)
Control	6.0 b[z]	1.56	6.20 a
ABA	**8.1 a**	1.27	**9.71 b**
Amigo 10%	5.8 b	1.57	6.10 a
Frostshield	6.4 b	1.50	6.57 a
p-value	0.004	NS[y]	0.028

[z] Within the same column, mean values followed by different letters are statistically significant.

[y] NS: Not statistically significant

Table 3. Treatment effects on Marquette bud freeze tolerance and bud soluble sugars. Bud freeze tolerance is expressed as the low temperature (LT50) required to kill 50% of the buds. Control treatment = no frost avoidance practice was applied on these vines.

	Bud freeze tolerance LT50 (°F)		Total soluble sugars (mg/g)
Treatment	**November 2020**	**January 2021**	**January 2021**
Control	-4.9	-10.1	35.7
ABA	-6.0	-12.1	41.8
Amigo 10%	-5.3	-9.4	33.9
Frostshield	-5.3	-10.6	36.9
p-value	NS[z]	NS	NS

[z] NS: Not statistically significant