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#: 63019428 Fiscal Year: 2020-2021 Round of Grant: (i.e. Round 1, Round 2, etc) 4

Title of Paper: Evaluating the impact of under-trellis groundcover practices on winegrape production profitability and sustainability

Organization: The Pennsylvania State University

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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 primary goal of this multi-year project is to implement weed control practices in vineyards that reduce herbicide use while increasing the profitability of growing premium quality grapes in Pennsylvania. With that goal in mind, the **objectives** for this funding cycle were to **1:** Assess the effects of annual and perennial cover crops planted directly under the trellis on vine vegetative growth, productivity, fruit quality, disease incidence, winter hardiness, and weed suppression; and **2:** Determine consumer awareness and interest in buying and consuming wines produced with both herbicides and under-trellis cover crops.

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

Objective 1. During this reporting period we conducted laboratory analysis for two under-trellis cover crops field trials. These trials were established to assess the performance of several under-trellis cover crops and determined their impact on vine nutrient and water status, production, fruit maturity, vegetative growth and cold hardiness. At one experimental site three cover crop species were established beneath own-rooted Marquette (site a). At the other site (site b) we used Noiret vines growing with either under-trellis red fescue (*Festuca rubra*) or bare soil and grafted on two rootstocks with different vigor potential (Riparia and 101-14Mgt). Laboratory analysis included juice chemistry (soluble sugars, titratable acidity, pH) and yeast assimilable nitrogen (YAN). We also processed fruit samples for fruit carbon isotopic composition analysis, which is an indicator of vine water status. This data will help us understand if cover crops and/or rootstocks affected vine water status during a relative dry season (i.e., 2020). We also processed and analyzed plant tissue samples for nutrient analysis. During the dormant season we collected pruning weight and bud cold hardiness (or freeze tolerance) data to assess the effects under-trellis cover crop on vine vegetative growth and vine's ability to survive cold winter temperatures. All data collected during the 2020 growing season were statistically analyzed during the reporting period.
Objective 2. Consumer data collected during an internet survey conducted in 2019 was further analyzed. Data were examined to determine what marketing strategies would best appeal to segments of participants who would be "likely" to buy wine made from grapes grown in a vineyard with cover crops planted below the vines. A classification model was used to create 12 segments, of which seven consisted of "likely buyers."

Outcomes:

Objective 1

- Site a: Perennial and annual cover crop species were compared at the Marquette experimental site. Overall, both perennial mixes suppressed weeds more effectively than annual species. Neither cover crop selection affected vegetative growth, yield, fruit composition, or bud freeze tolerance of the vines. Although not directly quantified, planting perennial grasses under top-cordon trained vines was a less labor-intensive weed suppression practice than multiple seasonal herbicide applications. Therefore, we had extended the use of under-trellis perennial grasses to an adjacent block of Marquette vines, where it will be used as a standard management practice.
- Site b: One of our objectives was to assess if either perennial grasses or rootstocks could be used as a vigor-control strategy for highly vegetative hybrid cultivars. In 2020, regardless of the rootstock used (Riparia or 101-14), vines growing with under-trellis red fescue had lower pruning weight (Table 1). The reduction in vegetative growth was likely caused by nitrogen competition because leaf petiole nitrogen concentration was lower in vines growing with under-trellis fescue than those on bare soil (control) (Table 2). Instead, vine water status was more affected by rootstock than cover crop: our δ13C analysis indicated that vines grafted on 101-14 had higher water status than those grafted on Riparia (Table 2); in other words, they were less prone to water deficit. Vines growing with under-trellis fescue also had higher bud freeze tolerance or cold

hardiness in January, which might be an indirect positive effect of their lower vegetative growth. Neither cover crops or rootstocks had negative effects on fruit chemistry or YAN at either site (Table 2 for site b).

- Taken together, these results show that red fescue planted under young vines at a site with high vigor potential beneficially reduced vine growth and, indirectly, improve bud freeze tolerance without negative effects on fruit composition. However, adoption of under-trellis cover crops requires a careful analysis of the site (soil and weather conditions), grape cultivar, and cover crop species to maximize cover crop benefits without compromising vine health. Furthermore, growers need to be prepared to implement a flexible management plan, e.g., conduct an annual leaf/ petiole nutrient analysis and be ready to apply nutrient additions or remove cover crops if competition between cover crops and vines is excessive.
- During the reporting period results were presented at the University of Massachusetts (seminar series) and were published in a peer-reviewed journal (https://doi.org/10.1016/j.agee.2021.107362). A second manuscript, which reviews practical consideration for farm adoption of under-trellis cover crops, has been submitted for publication and it is currently under review.

Objective 2

While a $1.00 bottle surcharge, added to the base bottle price of $17.99, was deemed to be enough to cover labor and other costs associated with planting cover crops, the researchers were able to identify three segments which would pay even more than $18.99. Over half of the participants in each group would be willing to pay $20.99 for the bottle of wine, which could be a motivating factor for growers to consider implementing this sustainable strategy. Researchers were also able to identify the top three statements that were "important" to most participants in the three segments. These statements, which could be used to promote the sustainably produced wine, were: a) the grower bases pesticide application on the presence to pests on grapes and leaves; b) cover crops are used in the vineyard to control weeds, improve soil structure, and reduce erosion; and c) grape leaves are removed from vines to increase air circulation in an attempt to reduce fungicide applications. A manuscript has been submitted to a peer-reviewed journal, and the researchers are waiting for a decision regarding publication. In addition, data will be the basis of extension articles for Pennsylvania stakeholders, which will include actionable plans for growers to implement.

Budget: Financial reporting on this project 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. Pruning weight, Ravaz index (crop load), and fruit composition parameters (soluble sugars, pH, titratable acidity, YAN) at harvest 2020 for Noiret vines (site b) growing with under-trellis red fescue or on bare soil (control) and grafted on 101-14Mgt or Riparia.

Treatment	Pruning weight (kg/ vine)	Ravax index (yield/ pruning weight)	Soluble sugars (Brix)	pH	Titratable acidity (g/L)	YAN (mg/L)
Control/101-14	1.9	2.1	19.16	3.62	6.90	268 a[y]
Red fescue/101-14	1.5	2.6	19.53	3.72	6.63	282 a
Control /Riparia	1.8	2.4	19.71	3.57	7.86	213 b
Red fescue/ Riparia	1.5	3.0	19.41	3.60	7.85	204 b
P-cover crop	<0.001	0.008	NS[z]	0.041	NS	NS
P-rootstock	NS	0.002	NS	0.050	NS	0.051

[z] NS: Not statistically significant

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

Table 2. Leaf petiole macronutrient concentrations at veraison, berry water status (via δ13C) at harvest, and bud freeze tolerance expressed as the low temperature (LT10) required to kill 10% of the buds in January for Noiret vines (site b) growing with under-trellis red fescue or on bare soil (control) and grafted on 101-14Mgt or Riparia.

	Leaf petiole			Fruit	Bud
Treatment	**Nitrogen (%)**	**Phosphorus (%)**	**Potassium (%)**	**$\delta^{13}C$ [z] (‰)**	**Freeze tolerance LT10 (°F)**
Control/101-14	0.78 a[y]	0.17	2.17	-29.0 a	-7.5 b
Red fescue/101-14	**0.60 b**	0.18	2.42	-29.1 a	**-8.4 a**
Control /Riparia	0.78 a	0.15	2.15	**-28.2 b**	-6.6 b
Red fescue/ Riparia	**0.62 b**	0.16	2.41	**-28.2 b**	**-9.5 a**
P-cover crop	<0.01	NS[x]	0.02	NS	0.016
P-rootstock	NS	NS	NS	<0.001	0.141

[z] More negative δ13C values indicate higher water status (i.e., no stress).

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

[x] NS: Not statistically significant