# NYWGF RESEARCH - FINAL REPORT

**Funding for fiscal year:** April 1, 2024 – March 31, 2025

## SECTION 1:

**Project title:** Evaluating Osmotic Protectant, Glycine Betaine, as a Multifaceted Approach to Enhance Grapevine Stress Tolerance and Productivity

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**New Research** ☒ **Continued Research** ☐

**Amount Funded** **$** 26,276.00

## SECTION 2:

**Project Summary Impact Statement:** Grape growers face the risk each season in their vineyards withstanding injury and loss of production from biotic and abiotic stresses whose severity is dependent on the current season's weather conditions. Frost, disease, water availability, and extreme temperatures are just a few of the challenges grapevines face with climate change. The Lake Erie Grape region experienced frost/freeze events and damage in vineyards for the last five growing seasons, with 2024 requiring a disaster declaration in the Lake Erie Grape Region do to approximately 16,000 acres of early bud-breaking grape cultivars with 70% damage. The average Concord yield across the Lake Erie Grape belt in 2023 was 9.3 tons/acre and 2024 is projected to be 1-2 tons/acre. The Finger Lakes Grape Region experienced a frost/freeze event in the spring of 2023 that damaged crop potential. Glycine Betaine (GB), an osmotic protectant, and other products use methods existing in nature for the prevention of plant diseases and pests and may improve plant productivity and vitality without releasing undesirable pesticide residues into the environment. Through foliar applications, this bio-stimulation product improves plant resistance to stress, but also stimulates natural processes to improve crop yield and quality.

**Objectives:**

1. In research/commercial vineyards, determine the relationship of foliar applied GB and other products on overall grapevine production using viticulture measurements.
2. Determine the relationship of reduced disease infection levels in *Vitis Vinifera* Cultivars
3. Test frost protection response on grapevines in the Lake Erie, Finger Lakes, Long Island, and Hudson Valley grape growing regions.
4. Determine if there is a cold hardiness response with the application of GB.

**Materials & Methods:**
The outlined objectives reflect a comprehensive research plan focused on understanding the impact of foliar applied Glycine Betaine on grapevine health and exploring its potential benefits in various aspects of viticulture.

1. **Relationship of Foliar Applied Glycine Betaine on Grapevine:**
    - Conduct research in both research and commercial vineyards to evaluate the effects of timely foliar applied Glycine Betaine.
    - Utilize viticulture measurements to assess grapevine health, considering parameters such as yield, juice quality, and overall plant vigor.
    - Collect data over multiple seasons to account for variations in weather conditions and to observe any long-term effects.
2. **Relationship of Reduced Grapevine/Cluster Infection Levels in Different Grape Cultivars:**
    - Investigate the impact of Glycine Betaine on reducing grapevine/cluster infections in different grape varieties, including *Vitis Labrusca*, *Vitis Vinifera*, and Hybrid Cultivars.
    - Employ testing methods to quantify and compare infection levels in treated and untreated vines.
    - Analyze the data to identify potential variations in the effectiveness of Glycine Betaine across different grape cultivars.
3. **Testing Frost Protection Strategies with Glycine Betaine:**
    - Focus on frost protection strategies using Glycine Betaine in specific grape growing regions, namely Lake Erie, Long Island, and the Hudson Valley.
    - Implement controlled experiments under frost conditions and assess the efficacy of Glycine Betaine in mitigating frost damage.
    - Consider variables such as application timing, concentration, and frequency to optimize frost protection strategies.
4. **Bud Hardiness Response with Glycine Betaine Application:**
    - Investigate the impact of Glycine Betaine on bud cold hardiness, especially in the context of frost/freeze events.
    - Conduct controlled experiments to assess the response of grape buds to Glycine Betaine application in terms of cold tolerance and recovery after frost events.
    - Monitor bud survival rates and potential improvements in overall vine resilience once a month during the dormant season.

<u>Glycine Betaine Spring Spray Schedule</u>
*Goal*: to reduce frost damage, lower freezing point of vines.

1. At the 4”-6” shoots length, foliar apply 2lbs/acre onto plant tissue until saturation point of runoff. Spray three panels of each cultivar with panel buffer in between treatment panels minimum of 24 vines per spray. If spraying Concord, typically 3 vines per panel would require 8 panels of sprayed vines with buffer vines in between panels. This will need to be duplicated for the Spring + Mid-Season combination treatment (Spring_Spray and Spring_Veraison).
2. In the threat of Spring frost event ~2-7 days prior to frost event, (if any) foliar apply 2lbs/acre of Glycine Betaine product onto green plant tissue until point of saturation runoff. Spray same type of set up as Spring Spray setup, but

different set of vines (Frost_Spray).

Mid-Season Veraison Spray – At veraison

1. Foliar apply 2 lbs/acre of GB on canopy until saturation and runoff to target later season expansion of berries to see if it fruit growth, fruit color, and relative cracking of berry cuticle. Spray three panels of each cultivar with panel buffer in between treatment panels minimum of 24 vines per spray. If spraying Concord, typically 3 vines per panel would require 8 panels of Sprayed vines with buffer vines in between panels.
2. Spray the Spring_Veraison vines from the Spring for the Spring + Veraison combination treatment (Veraison_Spray and Spring_Veraison).
3. Collect petioles from the Spring Sprayed vines and the Control Vines for tissue analysis.

Harvest Collection

1. Collect three 100 berry samples from each treatment and control for final berry weight and juice analysis.
2. Collect yield from each treatment and control for comparison.

Fall Glycine Betaine Spray Schedule

*Goal*- to induce cold hardiness, reduce budbreak frost damage.

1. After harvest, approximately 2-4 weeks prior to estimated dormancy, apply 2lbs/acre of Glycine Betaine product to canopy until saturation and runoff. Spray three panels of each cultivar with panel buffer in between treatment panels, minimum of 24 vines per spray. If spraying Concord, typically 3 vines per panel would require 8 panels of sprayed vines with buffer vines in between panels.

Cold Hardiness Monitoring – Dormant Season

1. Collect two canes per treatment replicate bud number 3-7 per treatment replicate for Differential Thermal Analysis of Lethal Thermal Exotherms to assess cold hardiness.
2. Collect three replicates of Pruning weights for each treatment of Spring, Spring+Veraison, and Frost if applicable.

This research aims to address three different seasonal concerns. One set focuses on Spring alone, one set on Veraison, one set Fall, and one set a combination of Spring and Veraison.

In executing these objectives, it is crucial to design well-controlled experiments, gather comprehensive data, and analyze results rigorously.

**Results/Outcomes/Next Steps:**

**Objectives:**

1. In research/commercial vineyards, determine the relationship of foliar applied Glycine Betaine (GB) and other products on overall grapevine production using viticulture measurements.
   After one year of research across viticultural areas in New York State, the results are inconclusive. The trial in the Hudson Valley did have greater yields with vines sprayed with Glycine Betaine over the control in both Gamay Noir and Riesling. The stakeholder collaborator in Long Island began harvest before final yield could be recorded in the Chardonnay. In the Finger Lakes Region, the GB sprayed Riesling produced lower yields compared to the control, and GB sprayed Cayuga White had higher yields compared to the control. In the Lake Erie Region, all of the control vines had a higher yield than the Glycine Betaine sprayed vines.
2. Determine the relationship of reduced disease infection levels in *Vitis Vinifera* Cultivars
   In the Hudson Valley trial, the Gamay Noir GB clusters had .05% more disease incidence over the control and Riesling GB clusters had .03% less disease incidence over the control vine clusters. In the Lake Erie region, the Chardonnay GB sprayed vines had considerably more disease control over the control vines with only 11.78% disease compared to the 58.25% in the control. In the Finger Lakes, the Cayuga White GB sprayed clusters had 38% disease rating, and the control had 32%.
3. Test frost protection response on grapevines in the Lake Erie, Finger Lakes, Long Island, and Hudson Valley grape growing regions.
   The Lake Erie regional was the only region to get a frost protection spray on 36 hours before a frost. After the frost, the vines' primary and secondary shoots were counted. The largest difference as between the Concord primary shoots with 37.6 in the control and 31.13 in the GB sprayed vines.
4. Determine if there is a cold hardiness response with the application of GB.
   After one year of research across viticultural areas in New York State, the results for cold hardiness are inconclusive. Concord and Chardonnay GB sprayed vines were hardier two of the three runs compared to the control vines, and Marquette and Riesling control vine buds were more cold hardy every run over the GB sprayed vines. The Gamay Noir GB sprayed vines were more cold hardy every run compared to the control vines.

**Technology Transfer Plan:** After at least two consecutive growing seasons of data collection, the results will be communicated in extension publications.

**Attachments:** relevant charts and graphs, photos etc.

| Grape Growing Region | Cultivar | Average Cluster count | Average Yield/vine (lbs) | Average Berry Weight (g) | Average Brix | Average Disease Incidents | Average Jan Cold Hardiness LTE50 |
|---|---|---|---|---|---|---|---|
| Long Island | Chardonnay GB | | | | | | |
| | T 1 4-6" + prebloom | | | 1.84 | 20.1 | | |
| | T 2 4-6" + veraison | 80 | 3.18 | 1.81 | 20.4 | 8.10% | |
| | Treatment 3 - cluster | 80 | 3.5 | | | 12.90% | |
| | T 5 Control | 80 | 3.3 | 1.75 | 20 | 7.50% | |
| Hudson Valley | Gamay Noir GB | 69.7 | 16.79 | 2.04 | 21.13 | 13.1% | -13.9 |
| | Gamay Noir Control | 60.1 | 15.03 | 1.99 | 20.62 | 13.1% | -12.93 |
| | Riesling GB | 53.58 | 11.1 | 1.62 | 19.43 | 9.7% | -12.85 |
| | Riesling Control | 43.75 | 10.77 | 1.65 | 18.43 | 12.6% | -13.00 |
| Lake Erie | Concord GB | 50.3 | 8.39 | 3.66 | 19 | | -17.56 |
| | Concord Control | 65 | 10.9 | 2.9 | 17.9 | | -16.01 |
| | Marquette GB | 17.87 | 7.73 | 1.38 | 19.1 | | -17.35 |
| | Marquette Control | 17.04 | 9.22 | 1.57 | 19.9 | | -19.31 |
| | Chardonnay GB | 17.97 | 1.88 | 1.2 | 18.9 | 11.79% | -11.88 |
| | Chardonnay Control | 18.44 | 3.74 | 2 | 18.9 | 58.25% | -10.41 |
| Finger Lakes | Cayuga White GB | 40.25 | 6.06 | | 16.97 | 38% | |
| | Cayuga White Control | 35.9 | 5.26 | | 17.75 | 32% | |
| | Riesling GB | 13.67 | 6.72 | | | | |
| | Riesling Control | 13.43 | 7.55 | | | | |

| Sprayed 36 hours before April 24/25th Frost Event | May 5,2025 | | | | |
|---|---|---|---|---|---|
| **Lake Erie** | Treatment | Average Primary/vine Alive | Average Field Score/Vine | Average Secondary/Vine Alive | Average Field Score/Vine |
| | Concord GB | 31.13 | 6.93 | 40.95 | 6.44 |
| | Concord Control | 37.16 | 6.765 | 39.66 | 6.33 |
| | Marquette GB | 15.81 | 6.32 | 21.43 | 5.37 |
| | Marquette Control | 14.54 | 6.35 | 23.25 | 5.42 |
| | Chardonnay GB | 17 | 6.025 | 10.8 | 5.12 |
| | Chardonnay Control | 16.57 | 6.116 | 11.33 | 5.176 |

Determine if there is a cold hardiness response with the application of Glycine Betaine.

| Cultivar | Date | Ave LTE50 Control °F | Ave LTE50 GB °F | Ave LTE50 Kelp °F | Ave LTE50 GB+Kelp °F |
|---|---|---|---|---|---|
| Concord | 11/11/24 | -2.14 | -2.59 | -2.57 | -2.15 |
| | 12/11/24 | -10.77 | -9.62 | -11.09 | -10.96 |
| | 1/13/25 | -16.01 | -17.56 | -16.98 | -15.73 |
| Marquette | 11/11/24 | -3.56 | -0.86 | -1.93 | -1.75 |
| | 12/11/24 | -14.69 | -12.92 | -11.67 | -10.42 |
| | 1/13/25 | -19.31 | -17.35 | -17.50 | -17.24 |
| Chardonnay | 11/11/24 | 0.32 | 3.16 | 0.73 | 1.64 |
| | 12/11/24 | -9.40 | -8.56 | -7.84 | -9.76 |
| | 1/13/25 | -10.41 | -11.88 | -11.02 | -11.08 |
| Rieslinlg | 12/23/24 | -11.67 | -11.21 | | |
| | 1/6/25 | -10.87 | -10.54 | | |
| | 2/3/25 | -13.00 | -12.85 | | |
| Gamay | 12/23/24 | -12.34 | -13.47 | | |
| | 1/6/25 | -11.01 | -12.43 | | |
| | 2/3/25 | -12.93 | -13.90 | | |

**SECTION 3:** Considering the regional differences in grape growing conditions, this research can provide valuable insights into the potential benefits and limitations of using Glycine Betaine in diverse viticultural settings. Enhancing the content of glycine betaine in general and during stress conditions is seen as a suitable strategy to address at least one aspect of the stress factors affecting plant cells and could be a potential approach for enhancing stress tolerance in grapevines. This will lead to increased profitability by limiting crop loss from abiotic stresses and disease complexes. This approach aligns with the growing emphasis on environmentally friendly and sustainable agricultural practices,

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**Importance of research to the NY wine industry:** Grape growers face the risk each season in their vineyards withstanding injury and loss of production from biotic and abiotic stresses whose severity is dependent on the current season's weather conditions. Glycine Betaine (GB), an osmotic protectant, and other products use methods existing in nature for the prevention of plant diseases and pests and may improve plant productivity and vitality without releasing undesirable pesticide residues into the environment. Through foliar applications, this bio-stimulation product improves plant resistance to stress, but also stimulates natural processes to improve crop yield and quality. It is necessary to investigate whether exogenous sprayed Glycine Betaine can improve grapevine resilience to extreme cold weather events.

**Project Results/next steps:** Due to the lack of consistent results, we plan to repeat the trial, but double the amount of glycine betaine in each spray period.