NGWB GRANT FINAL REPORT

Contract Number: 18-13-258

Contact Information:

Max McFarland

Mac’s Creek Vineyards & Winery

43315 Rd 757

Lexington, NE 68850

(308) 324-0440

[max@macscreekvineyards.com](mailto:max@macscreekvineyards.com)

Issue of Interest:

The wine industry is burgeoning in the state of Nebraska. As such, agriculture practices must be scrutinized closely to assure the industry is sustainable while minimizing the environmental impact but maximizing the quality of the fruit used to make the wines. This study investigated the feasibility of eliminating or reducing the chemical usage on the fruit to control fruit diseases using the application of ozone technology. This will strengthen the sustainability of the industry, enhance the quality of the fruit, and protect the health of consumers. The project was designed to:

1. Determine the amount of ozone needed to kill common fruit diseases
2. Enhance fruit quality while strengthening the plant’s natural immunity system (eliciting resveratrol) to internally become more resistant to disease.

Approach to Problem

Research on the effectiveness of spraying ozone on grape vines for the purpose of disease control was conducted. Multiple grape cultivars were selected across two vineyard sites (Frontenac, Brianna, Edelweiss, Marechal Foch, deChaunac, LaCrescent – at Mac’s Creek in central Nebraska; St. Croix, Vignole, Lacrosse – at James Arthur Vineyards in Eastern Nebraska). Each cultivar was divided into three groups:

1. The Control Group did not receive spray treatment of any kind.
2. Treatment Group A received only ozone spray treatment every 10 days to two weeks at Mac’s Creek; every week to 10 days at James Arthur Vineyards.
3. Treatment Group B received only pesticide spray (same schedule as ozone spray application to Group A).

Three samples (1lb-2lbs) were collected from each group for each cultivar upon normal harvest times and each sample was frozen immediately.

Goals/Achievement of Goals:

1. Improve the post-harvest preservation of specialty crops (grapes) through ozone-elicited induction of a phenolic-linked antioxidant protective system.
2. Enhance the nutritional quality of grapes through ozone elicited phenolic bioactive enrichment for human health benefits targeting early stages of Type 2 diabetes.
3. Evaluate the potential of phenolic bio-actives of grapes and improve glucose metabolism.
4. To determine what diseases are susceptible to being controlled by ozone spray and what level of concentration would be necessary to kill the disease. Initially, it was proposed that ozone testing be done in a plant pathology lab, under laboratory controls. This was to be conducted by the plant pathology lab at North Dakota State University. However, it was later determined by that lab that such analysis would not be possible at this time. Therefore, this component of the project was not conducted at this time.

Results, Conclusions, Lessons Learned:

Since the beginning of this line of ozone research, questions from within the industry have been raised regarding the possible effect of ozone treatment on the quality of the fruit being treated. This component was designed to conduct in-depth analysis of the fruit quality by a fruit analysis laboratory at North Dakota State University (NDSU). This analysis has been completed on 35 fruit samples (comparing fruit sprayed with ozone, fruit sprayed with chemical pesticides and fruit not sprayed at all – see above cultivars). Additionally, fruit samples from ozone treated orchard fruit (apples) and tomatoes were analyzed (from separate research studies ongoing concurrently with this study). A preliminary report has been provided by NDSU indicating:

“Overall the results showed very high phenolic-linked bioactive functionality in all grape cultivars and had potential for the management of early stage type 2 diabetes and its associated human health complications (potential to mitigate oxidative stress. Ozone and chemical treatments significantly increased total phenolic content, antioxidant activity and associated health benefits relevant to early stages of type 2 diabetes management” (Sarkar & Shetty, 2015).

Progress Achieved According to Outcome Measures:

Potential Impact

1. Should ozone prove to effectively control disease, the grower could eliminate or reduce a substantial portion of their chemical spray program. This economic impact could increase the competitiveness of the industry.
2. Problems of disease control, the build-up of chemical resistance, chemical residual in the soil and garden, not being able to spray at or during harvest could be minimized or eliminated.
3. Improved safety and image of safety for the consumer could significantly impact the marketing/sales of Nebraska specialty crops.
4. Improved food product safety for the consumer could directly also significantly impact the marketing/sales of the Nebraska specialty crop.

Benefits to the ecology could be as positive and significant. These benefits are multi-faceted.

1. Reduced build-up of disease resistance to chemicals. The build-up of disease resistance to currently used chemicals is a major problem today in production agriculture. Even with recommended alternating use of chemicals, resistance to herbicides, fungicides and insecticides develops. The use of ozone will not result in any such known resistance build-up.
2. Reduced usage of toxic chemicals.
3. Reduced chemical residual build-up in soil and/or water supply and increased consumer and product safety.

Benefits to Nebraska specialty crop producers could also be multifaceted and include the following:

1. Move more closely to organic production. With the elimination or reduction of the use of chemicals in the production of the food product the producer will move more closely to an “organic” method of production.
2. Safer raw product. The industry has done a good job of training/informing producers such that hopefully all products being used are labeled for usage with grapes and the application of the products are within safety and legal parameters. However, even with these safeguards in place, the continued and increased usage of these practices is resulting in the ever-increasing concern that these chemicals are potentially harmful to the environment and consumers.
3. Flexibility for disease control at the time of harvest. Each on the pesticides use recommend “harvest intervals”, which is the amount of time the grower must wait after application until the tomatoes can be safely harvested. When the disease pressure is heavy, this restricts the pesticides available for use, and/or can result in tomatoes that are sprayed and must be left hanging until the harvest interval has passed which can result in poor tomato quality. Using ozone could mean that spraying for disease control can be done immediately prior to harvest with no harvest interval being necessary.

Multiple studies across the past three years have consistently indicated efficacy when using ozone spraying to control certain diseases with grapes, tomatoes and orchard fruits (McFarland & McFarland, 2012,2013,2014). Additionally, effectiveness also resulted in a significant reduction, and in multiple studies, elimination of the usage of chemical pesticides to control such disease. Moreover, this study and the preliminary results from the lab analysis provided by NDSU, appear to answer the question regarding the effect of ozone upon the fruit quality. That is, this preliminary analysis has found no adverse effect on fruit quality. Quite the contrary, enhancement of fruit quality has been reported.

These results potentially could have a profound effect on the Nebraska grape and wine industry in the long-term (see Potential Impact above).

One must keep in mind that these results are preliminary at best. Continued research, both in terms of ozone usage for disease control and resultant fruit quality, is critical.

Financial Report:

A total of $27,000 has been budgeted for this project. To date, $17,000 has been expended, including Equipment Rental ($5,000); Consultant fee ($2,000) and NDSU Fruit Quality Lab analysis fee ($10,000). Invoices for this amount have been submitted to the Nebraska Department of Agriculture and have been processed for reimbursement. The remaining funding ($10,000) will not be expended as this was earmarked for the analysis that was proposed to be conducted by the NDSU Plant Pathology Lab. As described above, this analysis was not possible at this time and this component of the proposal was cancelled.