NGWB GRANT FINAL REPORT

2012-2013

Contract Number

18-13-194

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Issue of Interest

This study investigated the feasibility of eliminating/reducing chemical usage in disease control via the usage of ozone technology, thereby enhancing sustainability, reducing environmental carbon footprint, enhancing the positive image of the Nebraska industry and protecting the consumer. Ozone technology and engineering have reached levels which enable commercial application in vineyards to be researched. Therefore, the purpose of this project is to evaluate the efficacy of using ozone to reduce usage of pesticides to control disease on grape vines.

Approach to Problem

Sample: Three cultivars were initially selected for study. As the study was in the beginning stages (one spraying applied), on May 19, 2012, Mac's Creek Vineyards incurred severe damage to the grape vines/grape crop as the result of a catastrophic hail storm. Adjustments to the design were made and the researchers were able to continue the project using only two cultivars, those being Edelweiss and Marechal Foch. Three groups of vines were identified within each of the two cultivars; Control Group (no treatment); Treatment Group #1 (Tx1) (received chemical/pesticide spray); and Treatment Group #2 (Tx2) (received ozone spray). Sample groups were systematically selected by row blocks, i.e., three rows for each group with the Control Group in between the two Treatment Groups. This was done to minimize drift/overlap between Tx1 and Tx2. Sample vines which were evaluated were selected from the two outside most rows, again to minimize any drift overlap.

Procedures: Tx1 groups were sprayed with chemical pesticide sprays in accordance with the vineyard's normal and customary practices (i.e., sprayed approximately every 10 days beginning in May; 25 gallons/acre rate of application using an air blast mist sprayer. Pesticides were alternated with no pesticide being used twice in a row. Normal spray schedules were adhered to. Six sprayings at approximately 10 day intervals:

5/17 - Pencozeb/Rally/Danitol

6/2 - Abound/Danitol

6/16 - Captan/Rally/Sevin

6/24 - Abound/Mustang Max

7/8 - Captan/Rally/Mustang Max

7/18 - Abound/Seven

Ozone spraying was done in the exact same manner i.e., same day as pesticide spraying, same equipment and identical rate of application. Seven sprayings were applied.

Vines were evaluated using a 5-point scale (1=no observable disease, 3= moderate disease pressure; 5= near lethal disease pressure). Presence of insect(s) and type of insect(s) were recorded. A research assistant (who remained blind to group assignment of vines) was trained to rate disease pressure. Approximately 10% of the vines were randomly selected for independent evaluation by the research consultant for reliability checks. Adequate inter-rater agreement was maintained r>.95. Vines were evaluated weekly and to date, a total of 12 weeks of data are reported.

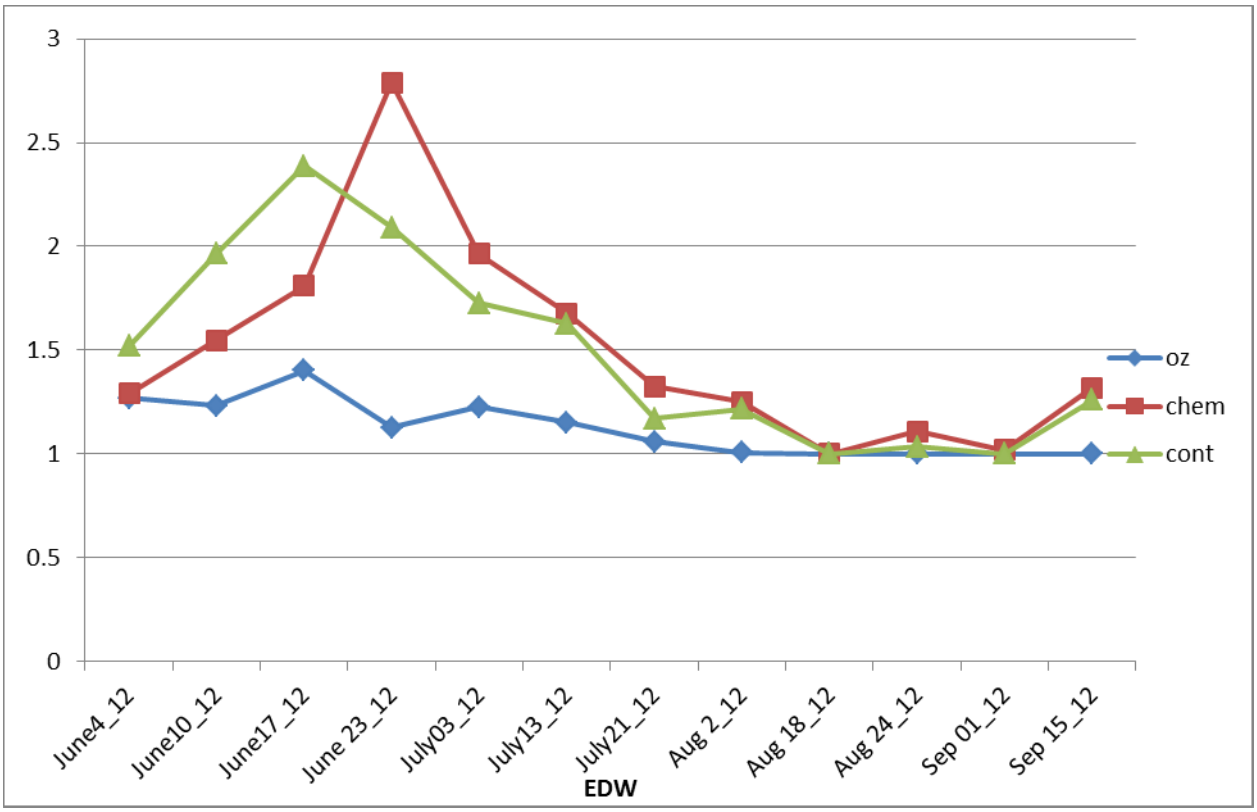
Goals/Achievement of Goals

Goal #1: To investigate the efficacy of ozone application to control disease in a commercial vineyard application.

Goal #2: To investigate the efficacy of ozone application to control insects in a commercial vineyard

Results, Conclusions, Lessons Learned

Average ratings on all vines within each of the three groups (Control, Tx1,Tx2) for each of the two cultivars (Edelweiss, Marechal Foch) were analyzed (ANOVA) and compared weekly (see graph below).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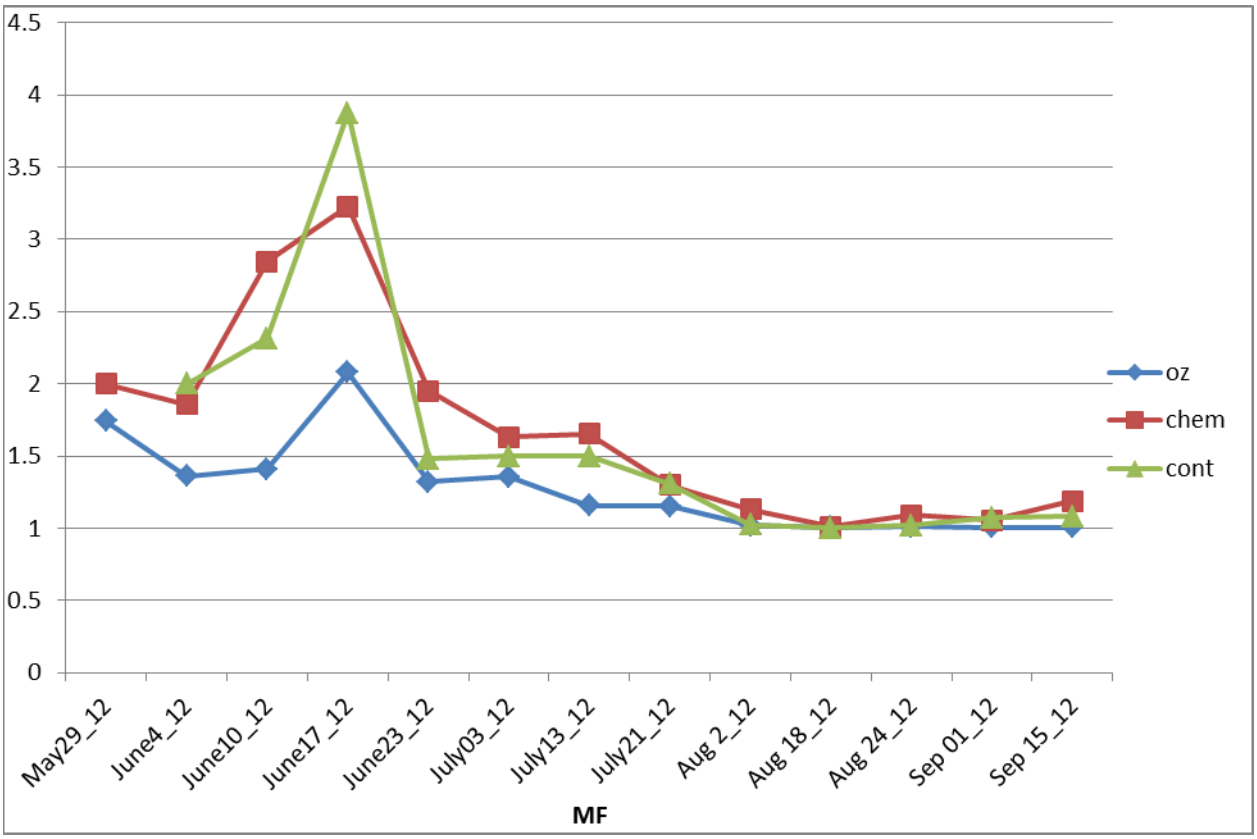

Each weekly data point on the graph represents statistically significant differences between ozone group and controls, and, between ozone group and pesticide group; $p<.001$, i.e., significantly less disease.

1) Tx2 (ozone) vines were consistently rated as having significantly less observable disease than Control (no treatment group).
2) Tx2 (ozone) vines were consistently rated as having significantly less observable disease than Tx1 (pesticide sprayed) vines.
3) Tx2 (ozone) vines were consistently rated as having no insect presence. Both Controls and Tx1 were rated with considerable presence of insects and Tx1 (pesticide sprayed) appears to be equally or more so impacted by insects as the Controls.

Percent of Vines Showing Presence of Insects (Marechal Foch)

Group	8/24/12	9/1/12	9/15/12
Control	4	29	38
Chemical	5	26	93
Ozone	2	0	2

Percent of Vines Showing Presence of Insects (Edelweiss)

Group	8/24/12	9/1/12	9/15/12
Control	0	0	42
Chemical	9	9	22
Ozone	0	0	0

Conclusions

These data should be considered as preliminary at best. This spring and summer of 2012 was one with intense heat, low moisture, and low humidity and thus, disease pressure in the vineyard was much less than usually seen. That said, these results are extremely encouraging. Ozone treatment consistently, i.e., in each of the 13 weeks rated, document significantly less disease pressure than did the untreated controls and, the vines sprayed with pesticides. Even during the time span of the most observable disease pressure (June10-July3) as observed with both the Controls and Tx1 (pesticide treated) vines, the ozone treated vines continued to exhibit minimal presence of disease ranging from no disease to very low disease pressure.

Summary

These results are profound. Additional research is necessary to replicate these findings across multiple years (i.e., differing weather conditions from summer to summer), multiple vineyard sites (and thus microclimates throughout Nebraska), and across multiple cultivars. Moreover,

while the methodology in this study controlled for variability of application of pesticides and ozone (i.e., same sprayer, same volume applied per acre, spraying at exact same time /days and intervals), research is needed to investigate varying volumes of application and intervals to incur equal disease control.

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Progress Achieved According to Outcome Measures

a) Move more closely to organic production: With the potential elimination or reduction of the use of chemicals in the production of the food product (grapes) the winery will move more closely to an "organic" method of production.

b) Safer raw product. The industry has done a good job of training/informing growers 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, there is an ever-increasing concern with potential harmful impact on the raw product, environmental impact, and, potential public/consumer impact resulting from the continued and increasing usage of these practices. Considering the number of grape acres in Nebraska (Grape Board Survey, 2009) this concern will only continue to increase.

c) Flexibility for disease control at the time of harvest: Each of the pesticides used recommend "harvest intervals", i.e., the amount of time the grower must wait after application until the fruit can be safely harvested. When the disease pressure is heavy, this can result in diseased fruit being harvested, which can lower production and potentially even result in fruit that is rejected by the winery because of poor quality, or, diseased fruit is taken by the winery resulting in poor quality wine production. The other possible outcome is that the fruit is sprayed and must be left hanging until the harvest interval has passed which again can result in poor fruit quality and poor wine quality (e.g., wait too long to harvest and the grape ph is too high/acidity too low, etc.). Using ozone could mean that spraying or disease control can be done immediately prior to harvest with no harvest interval being necessary.

d) Improved food product safety for the consumer could directly also significantly impact the marketing/sales of the Nebraska wine product.

e) Reduced exposure of workers to restricted use pesticides.

Benefits to the Ecology could be equally as positive and significant. These benefits could include:

a) 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 of the usage of different pesticides, resistance continues to build up including herbicides, fungicides, and insecticides. The use of ozone will not result in any such known build-up of resistance.

b) Reduced usage of toxic chemicals

c) Reduced negative environmental impact and chemical residual build up in soil and/or water supply.

d) Increased consumer safety. This study could result in improved food product safety for the consumer.

Therefore, major strides could be taken via this project to enhance sustainability of the viticulture industry all across Nebraska while also enhancing the Growers' stewardship of the environment

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Financial Report

Grant expenditures aligned with projected budget and were expended as follows:

Equipment Rental	$4000
Consultation and Project Coordination	500
Set up of research blocks and data collection	1100
Data Entry/Statistical Analysis	700
Research Consultant	1000
Total:	$7300