Studying the Effects of Fusion Gyp A & B on Soil Health and Plant Growth in Crimson Table Grapes

(Third year)

Dual Chelate Fertilizer Pty Ltd, 162 New Guinea Road, Robinvale, Victoria 3540, Australia
Corresponding author: Tel: +61 3 5026 4052, Email: info@dualchelate.com

Abstract

Gypsum is used as a soil amendment to assist in improving soil structure in sodic soil. Gypsum not only improves soil structure, but it also can be a source of soluble essential plant nutrients calcium and sulphur which both improve plant health. This experiment was carried out to assess the effectiveness of Fusion Gyp A&B on improving soil health and crop performance in crimson seedless grapes. Two applications were done during the active growth period at the rate of 30L/ha. The application of Gyp A&B slightly improved the bunch weight, Brix and nutritional status of plant tissues including Magnesium, Potassium, Manganese and Boron levels. However, there was no considerable difference was found in soil infiltration levels. In addition, the application of Gyp A&B improved the soil nutritional status. Also, Gyp A&B improved the yield quality and shelf life of crimson seedless grapes. In addition, the application of Gyp A&B was beneficial in reducing berry shattering during the storage time. In conclusion, the application of Gyp A&B is beneficial in improving soil health, plant growth, yield quality and shelf life in crimson seedless table grapes.

Keywords: Fusion Gyp A&B, Soil Structure, Chlorophyll, Plant Growth, Yield

1. Introduction

In agriculture, gypsum is used as a soil amendment to assist in improving the soil structure in sodic and also Magnesic soils (soils with high magnesium content). Gypsum is comprised of calcium sulphate dihydrate and had been used in agriculture for more than 250 years (Chen and Dick, 2011).

Often, gypsum is applied to the topsoil before planting or shortly after harvest. When applied to the topsoil, the gypsum then leaches down into the subsoil through irrigation and rainfall where its benefits can take effect. Gypsum can also be deep ripped into the soil to target the subsoil directly if there are hard clay pans. Deep ripping can also break up any hard soil and provide aeration. Gypsum can also be applied as a liquid soil amendment which works faster and more efficiently.

Gypsum not only improves soil structure, but it also can be a source of soluble essential plant nutrients calcium and sulphur which both improve plant health. Gypsum works by separating and disturbing the clay sheets in the soil. Large calcium ions replace the small sodium ions between clay sheets and move the clay sheets apart which breaks up the soil into smaller aggregates. This process helps to prevent soil dispersion, reduces surface crust formation, increases seedling emergence, and increases water infiltration rates in the soil (Chen and Dick, 2011). This process can also reduce the concentration of aluminium in the soil by replacing the aluminium ions with calcium and sulphur ions.

Powdered gypsum has been the main source of gypsum used in agriculture however recently liquid gypsum has come into the market with many benefits over traditional gypsum. Liquid gypsum is easier to handle and apply, it is fast acting and more mobile than natural gypsum, liquid gypsum guarantees a specific elemental analysis compared to natural gypsum and liquid gypsum reaches the subsoil much quicker than natural gypsum which can take many months or years to take effect in the subsoil.

Dual Chelate fertilizer has created a 2-part liquid gypsum soil amendment called Gyp A & B which can create calcium sulphate efficiently in the root zone. This effectively distributes the gypsum to where it is targeted in the subsoil. In this study, Fusion Gyp A&B will be applied two times per season to a Crimson seedless block which has clay soil with poor soil structure with aims to improve water infiltration and reduce sodium and aluminium content in the soil and also increase calcium and sulphur levels in the grape vines.

2. Objectives

The specific objectives of this trial were to:

- Determine if applications of Fusion Gyp A&B increase the soil structure.
- Measure the shoot length and chlorophyll in each treatment to check the impact of Gyp A&B application on vine growth and development
- Collect soil samples and test for increases in calcium and sulphur post-application.
- Determine the effectiveness of the Gyp A&B application on yield increment.

3. Materials and Methods

Site Selection and Trial Design

This trial was conducted in Merbein on a Crimson table grape block within the Sunraysia region of Victoria. The areas were divided into 4 irrigation sections roughly 4 ha each. One 4ha section (section D) was a control and another 4ha section (Section C) was treated with Fusion Gyp A&B. Section C has a soil monitoring probe that was able to measure soil temperature, water volumetric content, and soil EC. Data were gathered before and after the application of Gyp A&B to get quantitative soil data.

Each section had roughly 20 rows of crimson table grapes vines. In both sections C and D, the middle of the 10th row was selected to take measurements to prevent biases. Fusion Gyp A&B was applied through drip irrigation to the entirety of section C.

Table 1 shows the application rates and dates for the Fusion Gyp A&B trial.

Table 1: Application rates and application dates of Fusion Gyp A&B

Treatment	Rate (L/ha)	Application Date
Control (Section D)	0 L/ha	N/A
Fusion Gyp A&B (Section C) – First Application	30L/ha Gyp A 30L/ha Gyp B	26/10/2023 09/11/2023
Fusion Gyp A&B (Section C) – Second Application	30L/ha Gyp A 30L/ha Gyp B	29/12/2023 12/01/2024

4. Observations

Soil Nutrient Analysis

Soil samples (30cm deep) were taken before the application and 4 weeks post application of Gyp A and B. Soil samples were then sent to Analytical Laboratories & Technical Services Australia (ALTSA) for a full soil nutrient profile analysis. The soil was also tested for emersion classification, bulk density, soil colour, and soil texture. The results were then analysed using GraphPad Prism software to determine any significant differences in soil nutrient concentration between control and treated soil.

Soil Infiltration Test

To measure the water infiltration rate into the soil, a simple manual single-ring soil infiltrometer was made using a 10.5 cm diameter PVC pipe. The Murray Catchment Management Authority (NSW Government) was referenced when making this soil infiltrometer. A

20cm tube of PVC was cut. On the outside perimeter of the pipe, a 5cm line was marked which indicated how far the pipe was to be hammered into the ground. On the inside of the tube, a 0.5cm mark was made from the top which indicates when to start timing water infiltration, and 2 other lines 5 and 10cm from the 0.5cm line indicates when to record the time it takes for the water to drop from then initial 0.5cm line to the subsequence 5cm and 10cm lines (How to Measure Infiltration, 2012). Figure 1 shows the soil infiltrometer being used in the field. Measurements were taken in the treated and control blocks before and after the application of Gyp A&B.

Figure 1: Soil infiltrometer

Shoot Length, Chlorophyll

To measure the shoot length, 50 shoots were randomly selected from each block and shoot lengths were recorded.

Chlorophylls were checked 4 weeks after the first application and 5 weeks after the second application. 30 leaves from each treatment were measured using the SPAD chlorophyll meter to measure the greenness of each leaf. Each leaf had 5 tests taken from each side on the main vein and then averaged to get an average whole leaf reading.

Grapes Nutrient Analysis and BRIX

Grapes samples were collected at the commercial harvesting time in treated and controlled vines. Grapes samples were taken randomly in the 10th row in each treatment area. 3 Replicates per treatment were collected to perform a statistical analysis of the grapes' nutrient concentration differences between treated and control vines. Grapes samples were then directly taken to Analytical Laboratories & Technical Services Australia (ALTSA) for a full nutrient profile analysis. The results were then analysed using GraphPad Prism software to determine any significant differences in grapes nutrient concentration between control and treated vines.

During the commercial harvesting time, 10 grapes bunches were randomly selected from each block to measure the BRIX in grapes.

Comparative Drone Images

During the time of data collection, a drone image of each treatment area was taken to visually compare shoot biomass between each treatment. A DJI Phantom 4 Pro drone was used to take these images.

5. Results

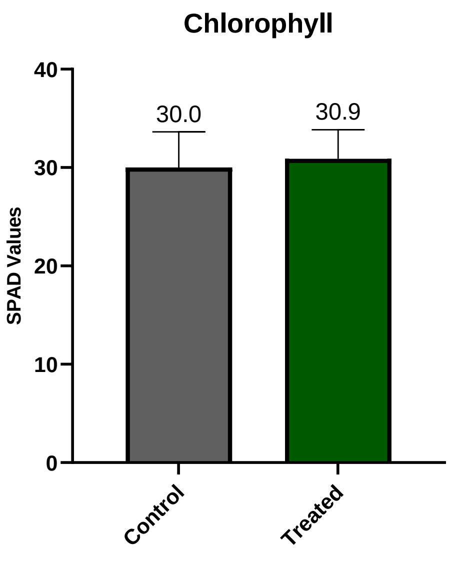


Figure 1: Effectiveness of Gyp A&B application on leaf Chlorophyll (SPAD) content in vines after 4 weeks of the first application.

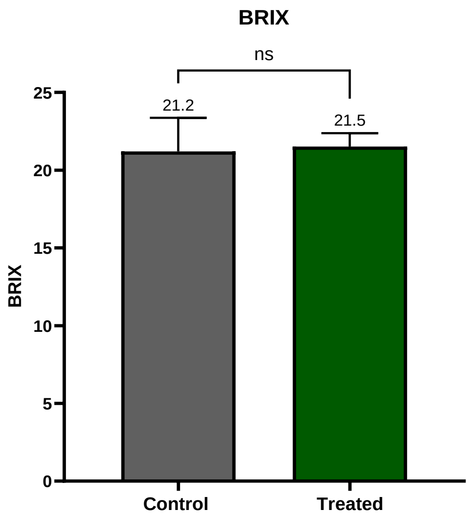


Figure 3 Average BRIX values of grapes collected from control and treated vines at commercial harvesting time.

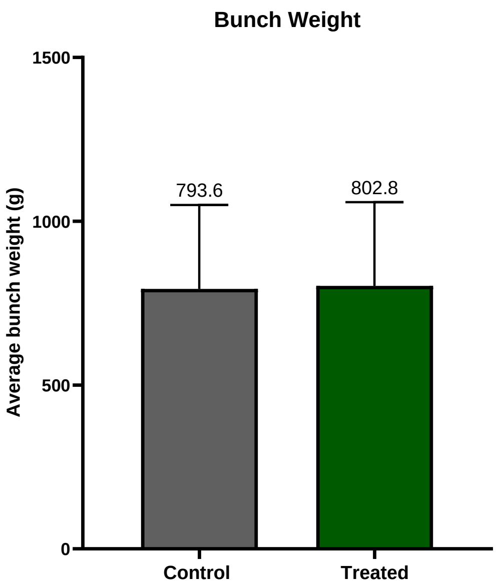
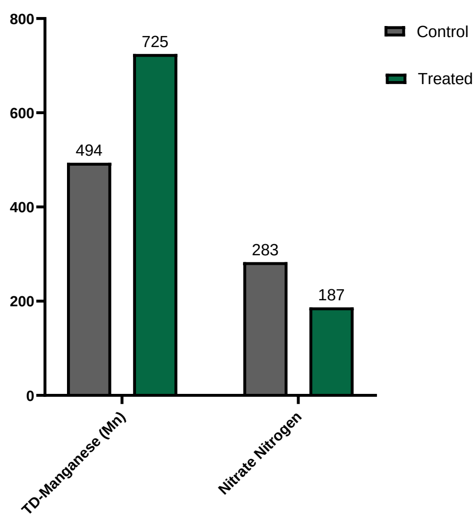


Figure 2 Average weight of grapes bunches collected from control and treated vines at commercial harvesting time.

Figure 4 Comparison of grapes bunches collected from treated and control blocks during the commercial harvesting time

Figure 5 Visual comparison of grapes boxes collected during the commercial harvesting time. (a) Treated (b) Control



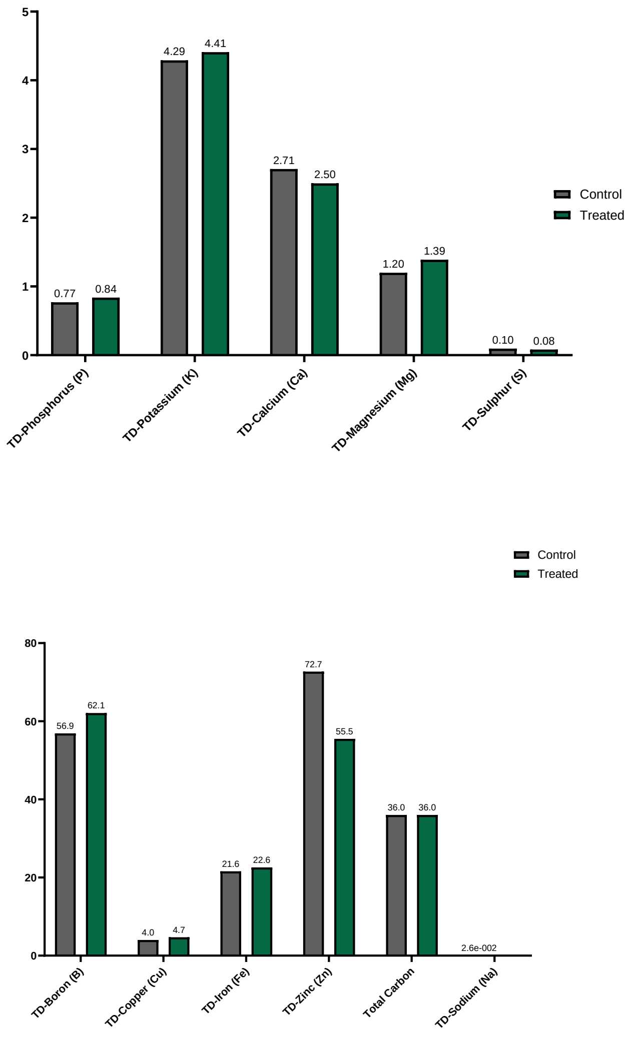


Figure 6 Post-harvest tissue test results in control and Gyp A&B treatments

Table 2 Comparison of weight loss in grapes boxes after 6 weeks of storage in the cool room.

Date	Box No	15/02 /24	21/03 /24	Difference (%)	Average weight loss
Control	1	4216	4263	-1.11	-27.7
	2	4071	4103	-0.79	
	3	4395	4399	-0.09	
Treated	1	4067	4095	-0.69	-16
	2	4348	4356	-0.18	
	3	4014	4026	-0.30	

Figure 7 Visual comparison of same grapes boxes after six weeks storage in the cool room. (a) Treated (b) Control

Table 3 Comparison of soil nutrients analysis results after 6 weeks of the treatment application

	Control	Treated
pH [1:5 H2O]	8.9	8.8
Total Nitrogen	0.083	0.13
Nitrate Nitrogen	<2	2.4
Ammonium Nitrogen	<2	<2
Chloride (Cl)	35.4	61.9
RA-Phosphorus (P)	1	0.9
RA-Potassium (K)	24.1	27.4
RA-Calcium (Ca)	87.5	103
RA-Magnesium (Mg)	12.3	15.9
RA-Boron (B)	0.6	0.5
RA-Copper (Cu)	0.2	0.2
RA-Iron (Fe)	<0.1	<0.1
RA-Manganese (Mn)	0.2	0.2
RA-Molybdenum (Mo)	<0.1	<0.1
RA-Zinc (Zn)	<0.1	<0.1
RA-Aluminium (Al)	<1	<1
RA-Sodium (Na)	64.3	50.6
RA-Silicon (Si)	12	13
RA-Sulphur (S)	19.8	10.3
Calcium (% CEC)	88.3	93.1

Figure 8 Comparison of grapes bunches and berry shattering in two treatments after six weeks storing in a cool room. (a) Treated (b) Control.

6. Discussion

The chlorophyll content of leaves was measured by using a SPAD chlorophyll meter at two different stages of the growing season. After four weeks of the first treatment application, chlorophyll content was measured and there was no significant difference between control and treated blocks (Figure 1).

At the commercial harvesting time, 20 grapes bunches were randomly collected from each block to measure the average bunch weight. Gyp A&B treated block had the highest average bunch weight than the control (Figure 2). BRIX levels of the grapes were checked by using the same sample and grapes collected from Gyp A&B treated blocks had slightly higher BRIX levels compared to the control (Figure 3). Grapes berries were tested to check the nutritional status of the control and treated berries. However, there was no noticeable difference was found between two treatments.

During the commercial harvesting time, grapes bunches were randomly collected from both treated and control blocks to check the yield and yield quality. Figure 4 shows the visual comparison of grapes bunches. Figure 5 shows the visual comparison of grapes boxes before put them in the cool room for six weeks.

During the post-harvest time, plant tissue analysis was done to compare the nutrient levels in plant tissues in control and treated vines. The results showed that treated vines had a higher level of Potassium, Magnesium, Born and Manganese levels compared to the control vines (Figure 6). At the same time, soil nutrient analysis also carried out to check the soil nutritional status in control and treated blocks. According to the results, treated block had a slightly lower pH compared to the control. In addition, treated block had higher Nitrogen, Potassium, Calcium, Magnesium, Sodium and Silicon levels as well as higher Cation Exchange Capacity (CEC) compared to the control block (Table 3).

Grapes boxes were weighed again after storing six weeks in the cool room. The results showed that the grapes boxes collected from control block had noticeably higher weight loss compared to the grapes boxes collected from treated block (Table 2). Figure 7 shows the visual comparison of grapes boxes after storing six weeks in the cool room. Berry shattering was observed after six weeks of storing grapes boxes in the cool room. It showed that the treated bunces had a smaller number of shattered berries compared to the grapes bunched collected from the control (Figure 8). Similar to these results, numerous studies have found that the application of Gypsum improved the fruit quality and shelf life in different crops such as blueberries (Bryla et al., 2023).

Similar to these results, several studies have found that the application of gypsum is beneficial in improving plant growth and development as well as crop yield in different crops such as faba beans, Jasmin rice, and maize (Amer, Aboelsoud, Sakher, & Hashem, 2023; Cha-um, Pokasombat, & Kirdmanee, 2011; Downey, 1971). In addition, Saeed & Ahmad revealed that the application of gypsum increased the plant growth and yield in tomatoes.

Gypsum is used as a soil amendment to assist in improving the soil structure in sodic soil and also soil with high magnesium content. Gypsum is comprised of calcium sulphate dihydrate and had been used in agriculture for more than 250 years (Chen and Dick, 2011). It is well documented the benefits of gypsum application on plant growth and development. In addition, gypsum is one of the most frequently used soil amendments in sodic or saline soils to improve the soil structure (Naveed et al., 2021). Gypsum helps to maintain the high Calcium: Magnesium ratio and therefore it helps to minimize the soil dispersion. As proven by previous studies, in this study we observed that the application of Gyp A&B improved the soil Ca: Mg ratio compared to the control.

7. Conclusion

This experiment was carried out to assess the effectiveness of Fusion Gyp A&B on improving soil health and crop performance in crimson seedless grapes. The application of Gyp A&B slightly improved the bunch weight, Brix and nutritional status of plant tissues including Magnesium, Potassium, Manganese and Boron levels. However, there was no considerable difference was found in soil infiltration levels. In addition, the application of Gyp A&B improved the soil nutritional status including Nitrogen, Potassium, Calcium, Magnesium, Sodium and Silicate levels as well Also, Gyp A&B improved the yield quality and shelf life of crimson seedless grapes. In addition, the application of Gyp A&B was beneficial in reducing berry shattering during the storage time. In conclusion, the application of Gyp A&B is beneficial in improving soil health, plant growth, yield quality and shelf life in crimson seedless table grapes.

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