

Evaluating foliar applied calcium carbonate on table grapes and observing cold storage potential

Objectives

- Determining how pre-harvest applications of calcium carbonate can extend cold storage potential of table grapes.
- The purpose is to not only increase storage times but increase the structural integrity of the cell wall through texture, strength and grape chemistry of table grapes.

Introduction

- As grapes are non-climacteric they are prone to physiological and parasitic diseases, such as gray mold (*Botrytis cinerea*) which grows fast and spreads at low temperatures¹. With the fresh table grape market, there are high standards to uphold quality and longevity of grapes in cold storage.
- Calcium has been known to reduce or delay physiological and parasitic disorders and is able to reduce spore germination of gray mold⁴.
- Calcium carbonate can be beneficial to plants as it breaks down to carbon dioxide which is essential for photosynthesis and elemental calcium which is important for cell wall structure². However, CaCO₃ has a large particle size that can be difficult for the plant to absorb and increase calcium in the fruit².

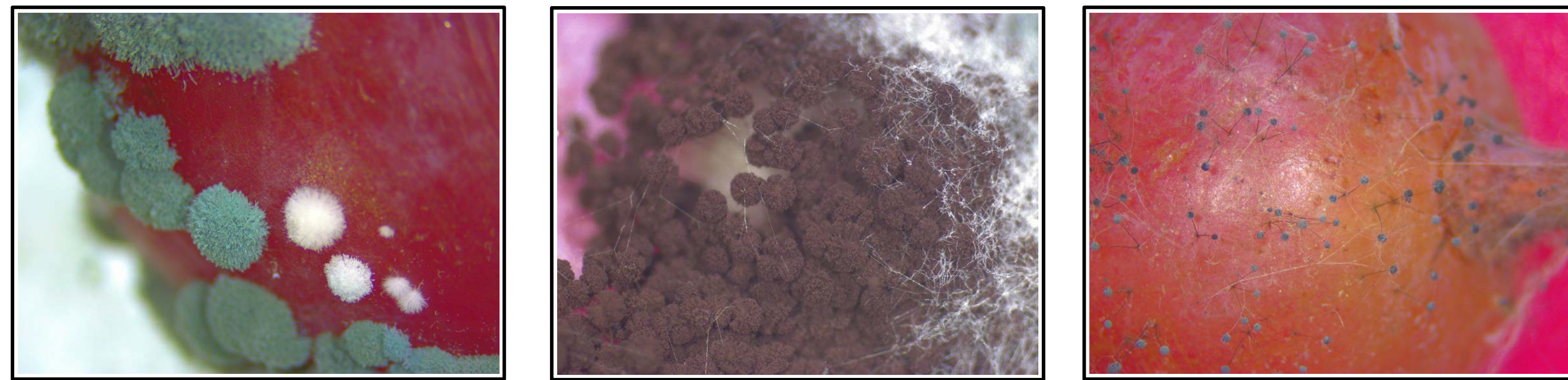


Figure 1. Potential fungal infections that can develop during cold storage.

- CaCO₃ in a nano or micro particle size has been shown to be taken up through leaves of the plant and broken down for immediate use³.
- The calcium-based product OR-244B falls within the nano calcium category with a particle size less than 1 micron. OR-244B has shown to improve shelf life and storability in tuber crops and increase fruit firmness in tree fruit.

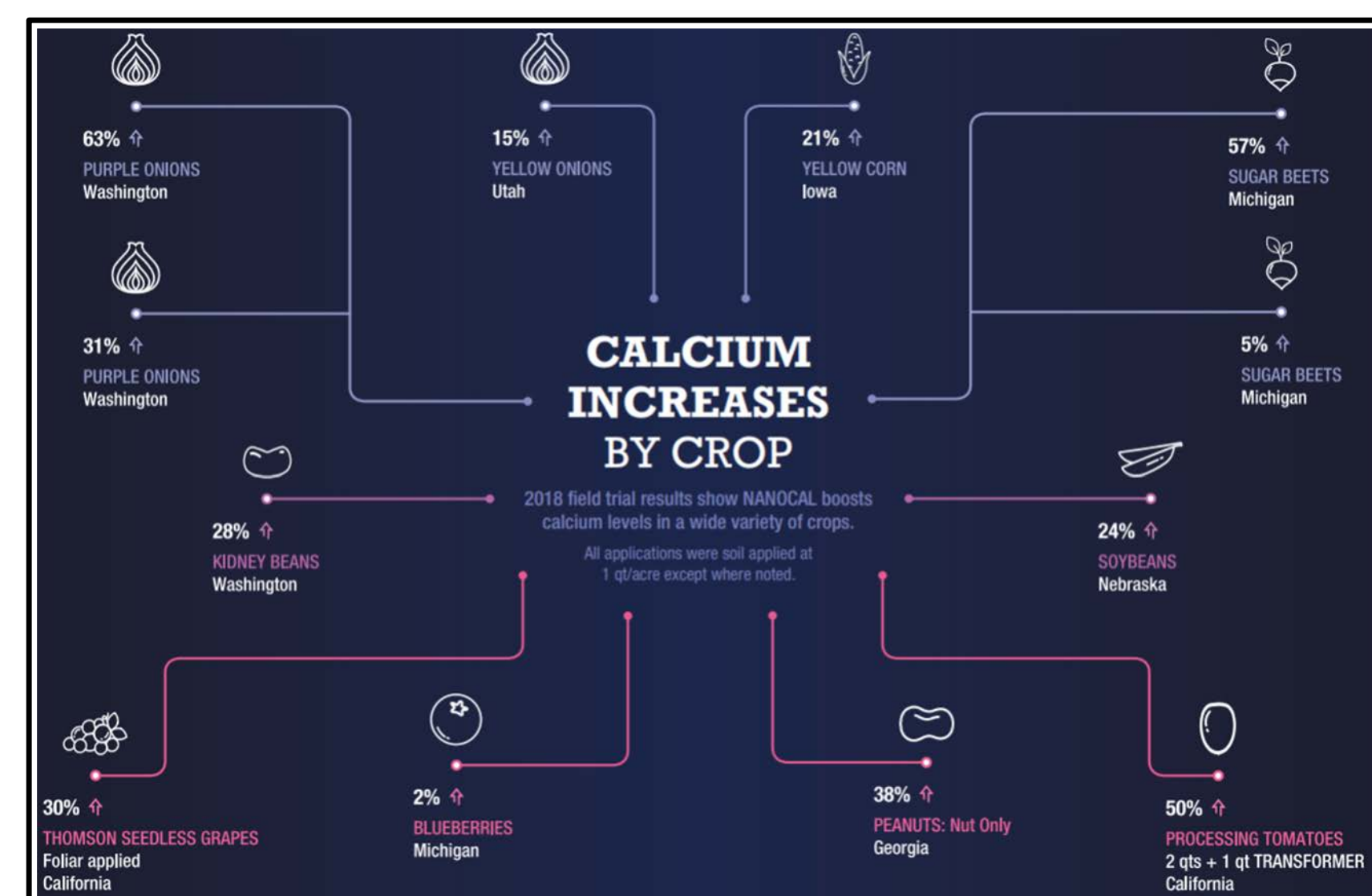


Figure 2. Nano calcium increase in other crops

Materials and Methods

Experimental Design

- The experimental layout was designed as a randomized complete block design.
- Located at Fresno State in the Sweet Scarlet vineyard block.
- Eight treatments were applied, replicated six times.

| | | | | | | | |
|----------------------------|----------------------------|---------------------------------|--|---|----------------------------|---|--------------------------|
| Control | OR-244B | OR-244B w/out CaCO ₃ | CaCO ₃ <1 micron w/out surfactant | CaCO ₃ >20 micron w/out surfactant | Calcium Chloride | CaCO ₃ <1 micron with surfactant | OR-244B |
| Application Method: Foliar | Application Method: Foliar | Application Method: Foliar | Application Method: Foliar | Application Method: Foliar | Application Method: Foliar | Application Method: Foliar | Application Method: Soil |

Application

- All products were applied at the rate recommended by manufacturers.
- Vines were treated four times throughout the growing season – at 25% bloom, beginning of fruit set, and twice at 14-day intervals.

Fruit Composition

- Juice analysis - Brix, pH, and TA data was collected weekly starting at veraison until harvest to track the ripening curve.

Texture Analysis

- Evaluated skin strength and berry firmness
- Completed for all treatments at harvest, after 4 weeks and again after 8 weeks of cold storage.
- Stable Micro Systems, TA XT Plus Texture Analyzer with the 2mm needle probe attachment.

Post Harvest Decay Forecast

- Berries were collected at harvest from each treatment to monitor for rot infections or other defects present in the vineyard throughout the season.

Cold Storage Potential

- All samples were picked to mimic commercial table grape packing operations into 19-lb boxes.
- Two boxes per treatment were picked and stored in cold storage at 0°C and 80% relative humidity. The grapes were stored for four weeks and eight weeks respectively, then moved to 20°C for 5-7 days to simulate a commercial market period.
- After cold storage, all grape clusters were inspected for shattered berries, cracks, decay, damages, and softness. All infected berries were weighed and presented as a percentage of the total grape cluster weight in the box.

| SOIL APPLICATIONS | CROP | SOIL APPLICATION TIMING | SOIL APPLICATIONS | CROP | FOLIAR APPLICATION TIMING | FOLLOW UP APPLICATIONS |
|----------------------------|----------------------------|-------------------------|----------------------------|----------------------------|---------------------------|------------------------|
| Tree crops | Tree crops | Petal fall | Tree crops | Tree crops | Petal fall | 14 days |
| Vine fruits and vegetables | Vine fruits and vegetables | At bloom | Vine fruits and vegetables | Vine fruits and vegetables | Pre-bloom | Every 10-14 days |
| Grapes | Grapes | At bloom | Grapes | Grapes | At fruit set | Every 7-14 days |
| Peanuts | Leafy Vegetables | At bloom | Leafy Vegetables | Leafy Vegetables | At bloom | Every 14 days |
| Potatoes | Potatoes | At hook | Potatoes | Potatoes | At hook | Every 14 days |
| Ground fruit | Ground fruit | At bloom | Ground fruit | Ground fruit | At bloom | Every 14 days |
| | Corn | | Corn | Corn | V4 - V6 | |
| | Soybeans | | Soybeans | Soybeans | V2 - R2 | |

Figure 3. OR-244B application timing



Figure 4. Harvest collection



Figure 5. Control decay forecast



Figure 6. OR-244B decay forecast

Results

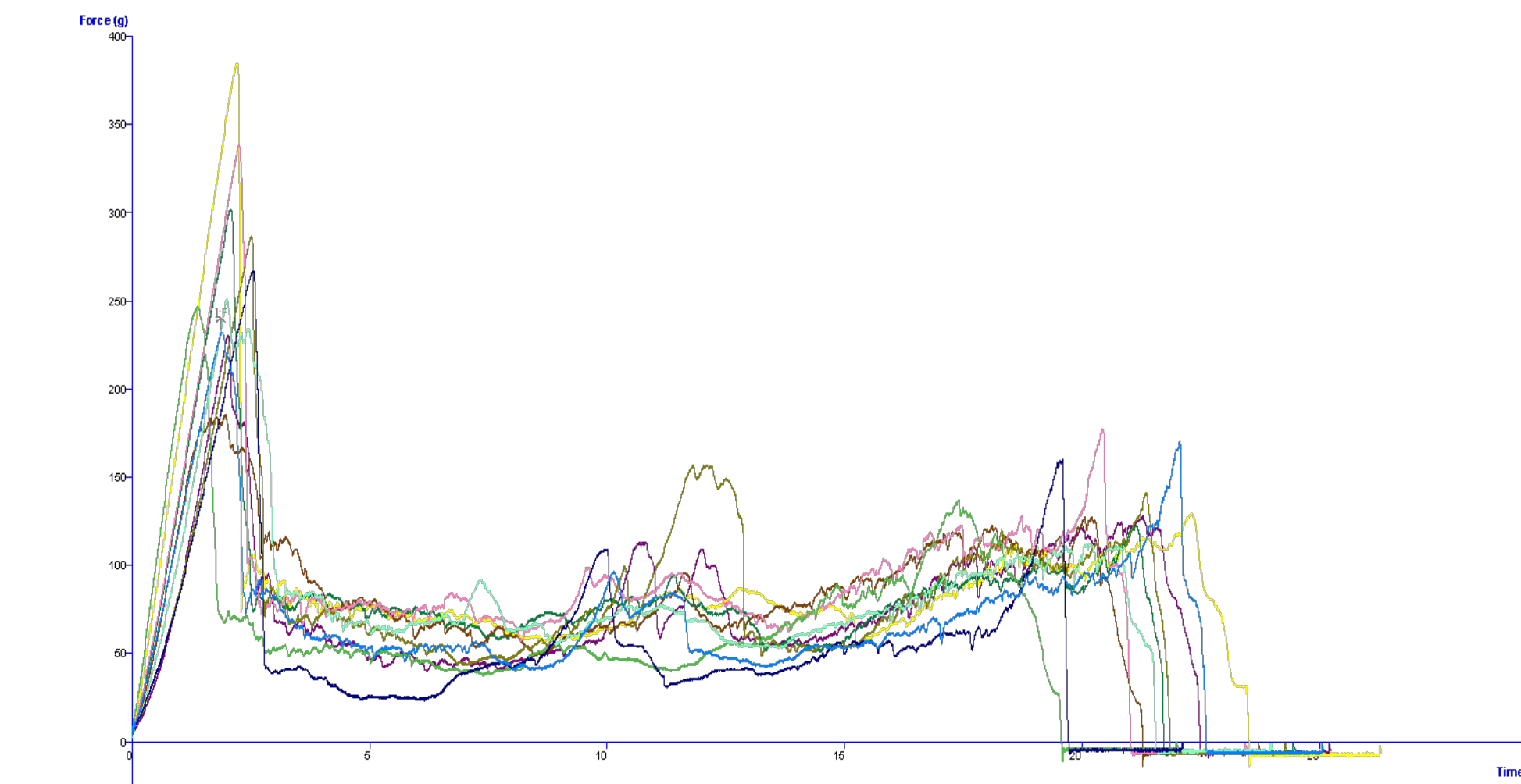


Figure 10. OR-244B texture analysis at eight weeks

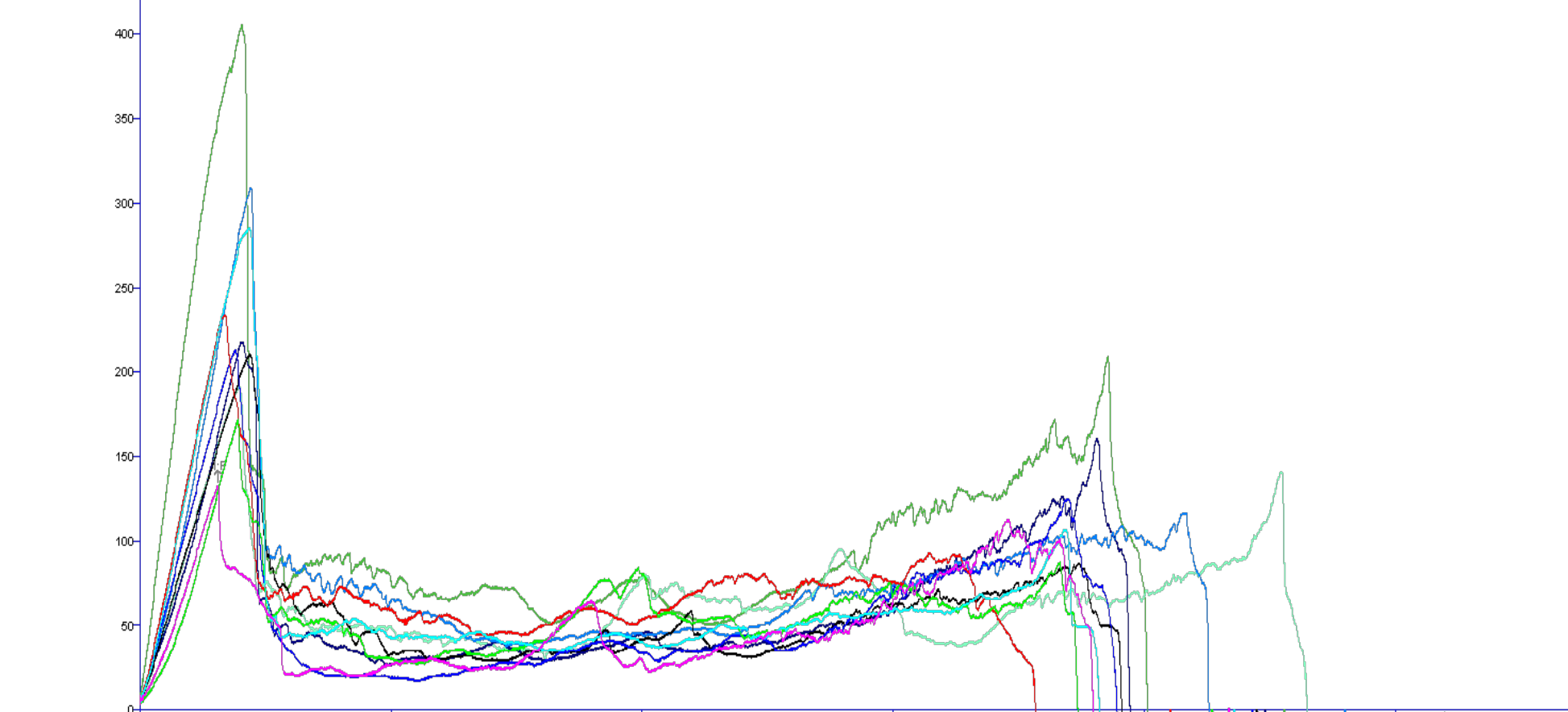


Figure 9. Control Texture analysis at eight weeks

- The texture analysis graphs show the Y-axis as the amount of force it took to penetrate the berries as a function of their elasticity and skin strength. The X-axis represents the time in seconds it took for the probe to travel through the berry.
- Each line represents a berry, some lines show a middle peak which could be seed traces.
- The berries that are treated with OR-244B are shown to have a higher force of skin strength and elasticity, ranging between 200-300 g and the control being below 250 g.
- No statistical differences were observed for the post harvest decay and cold storage potential experiments (data not shown).

Discussion

- The project was initiated during the 2020 growing season and all the applications and analyses will be repeated in the 2021 growing season.
- Preliminary results show that calcium applications, in particular calcium carbonate does not affect the cold storage ability of table grapes negatively – even under prolonged storage conditions.
- Texture of the berry skins of OR-244B are shown to have slightly higher skin strength compared to the control.

Acknowledgements

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References

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4. Nigro, F., Shena, L., Ligorio, A., Pentimone, I., Ippolito, A., & Salerno, M. G. (2006). Control of table grape storage rots by pre-harvest applications of salts. *Postharvest Biology and Technology*, 42, 142-149.