

# Trials Testing the Efficacy of OTC Injection Treatments on Mature Trees-Yr. 1, 2023-2024

## Overview

This project is a simple side-by-side evaluation of OTC injection treatments on citrus trees that are more than 20 years old. There is a Hamlin site and a Valencia site. Data were collected on factors relevant to citrus growers.

## Hamlin Site – Frostproof

A Hamlin/Swingle block was selected for the early variety cultivar. The block is 30-years old and planted in traditional central Ridge fashion. The spacing is 12' x 25' and the planting density is 145 trees per acre.

All treatments were conducted on March 30, 2023. The start time for injection was 9:00 am and all injection devices were empty by 10:00 am. The soil within the drip line of the tree was moist but the soil outside the wetted zone of the microjet emitters was dry. The air temperature was 74°F and the soil temperature at 6 inches deep was 71°F. The sky was clear with a 3-4 mile per hour wind. Relative humidity was 55%.

The OTC product label called for the maximum dosage according to trunk diameter. The volume needed per injector was 150 mL and the OTC concentration was 11,000 ppm.

Three treatments were evaluated, to wit:

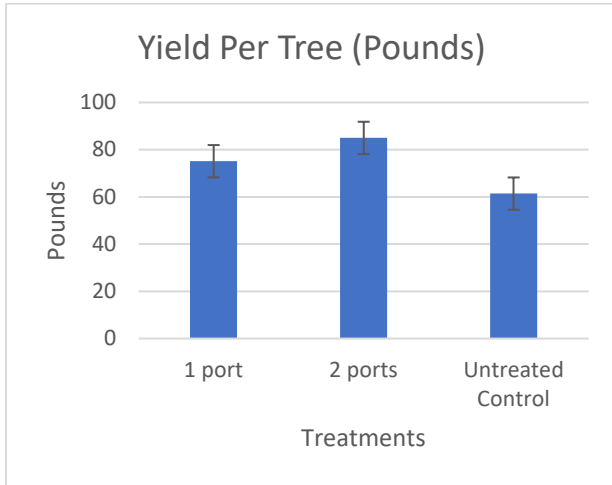
1. Untreated Control
2. Single port injection: Injection of 150 mL of an 11,000 ppm OTC solution with a single injection port on the east side of the tree
3. Two port injection: Injection with 2 injection devices. Each injection device had a volume of 75 mL of an 11,000 ppm OTC solution. One injection device was inserted on the east side of the tree and the second was inserted on the west side of the tree.

The trial design was comprised of 5 replicated plots per treatment with each plot containing 5 trees. At the start of the trial, trees were selected according to DI ratings to reduce tree-to-tree variability. Data were collected on yield, fruit drop, DI ratings, and fruit quality.

Data were analyzed using ANOVA and Tukey HSD. Significant differences are so at a p value less than 0.05.

## Yield

Yield data was collected on January 8, 2024. Each tree was harvested separately, and a single weighed value was reported for each tree in the trial.

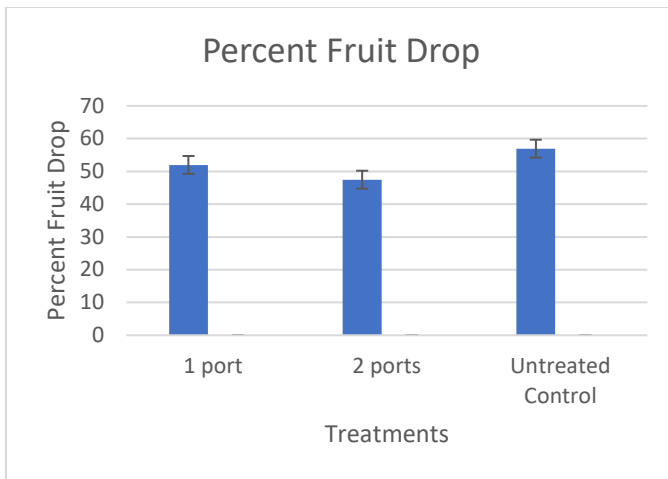


Treatment	Yield Per Tree (Pounds)	
1 port	75.12	A
2 ports	85	A
Untreated Control	61.4	A
Model p>F	0.139	

There was no significant difference in yield found between the treatments. The 2-port injection treatment was numerically higher than the 1 port treatment and untreated control treatment.

## Percent Drop

Fruit drop counts were conducted at six points in time leading up to harvest. Fruit drop counts began in October 2023 and continued through January 2024. Fruit drop was assessed on a per tree basis.

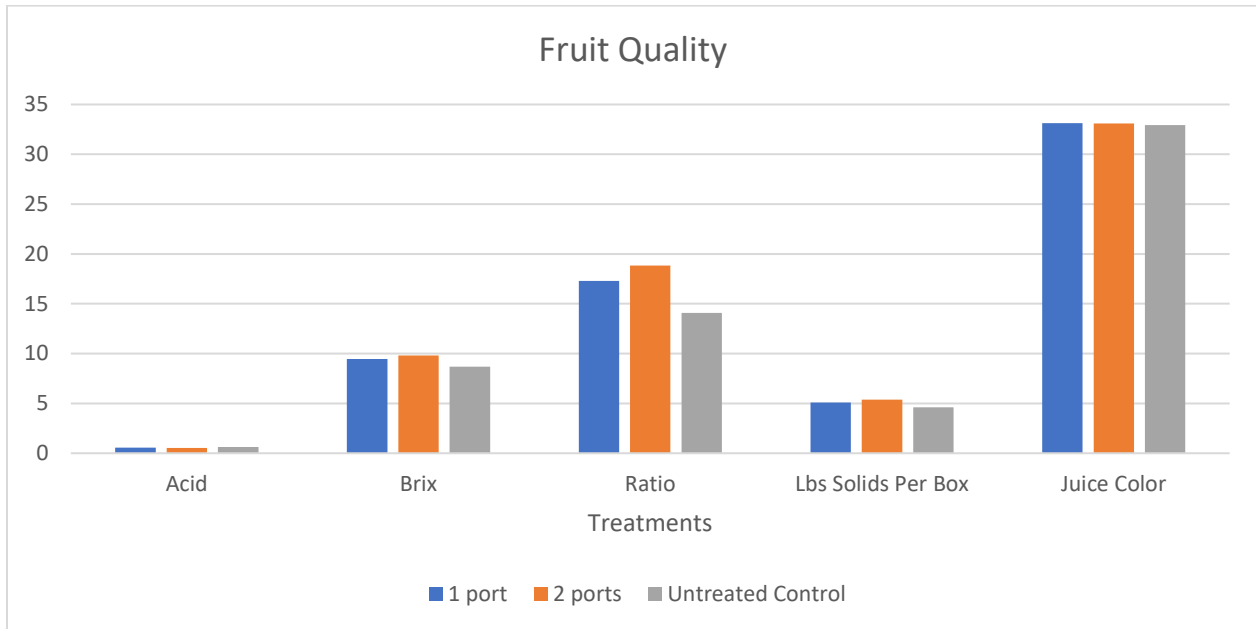


Treatment	Percent Fruit Drop	
1 port	51.97	A
2 ports	47.47	A
Untreated Control	56.94	A
Model p>F	0.106	

There was no significant difference found in the analysis of fruit drop. The untreated control had the highest amount of fruit drop at 56.9%. The 2-site treatment had the lowest amount of fruit drop at 47.4%.

## Fruit Quality

Fruit quality analysis was performed at the CREC Pilot Plant on January 9, 2024. A single fruit quality sample was collected from each plot in the trial.



	Acid		Brix		Ratio		Pound Solids Per Box		Juice Color	
1 Site	0.548	AB	9.458	A	17.29	A	5.0873	A	33.114	A
2 Site	0.522	B	9.824	A	18.84	A	5.36864	A	33.104	A
Untreated Control	0.624	A	8.682	B	14.1	B	4.605	B	32.924	A
Model p>F	0.027		0.002		0		0.002		0.56	

Analysis of titratable acid showed a significant difference between the untreated control at 0.624 and the 2-port treatment at 0.522. The 1 port treatment was not significantly different from either the untreated control or the 2-port treatment.

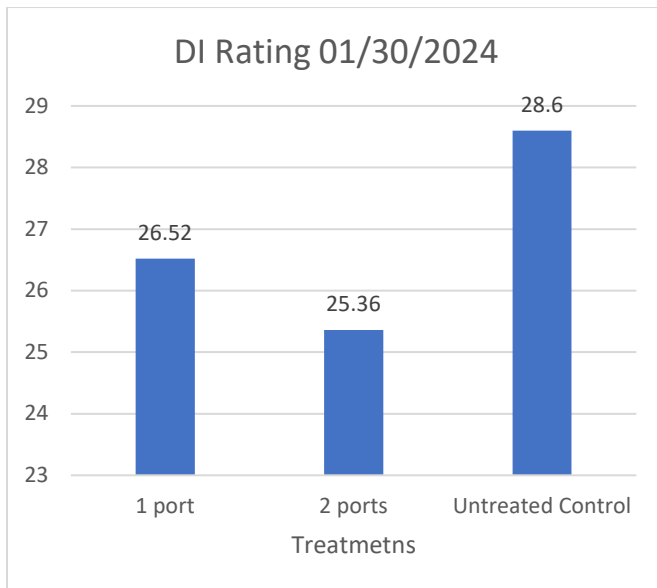
Brix content and Brix/Acid Ratio was significantly different for both OTC treatments compared to the untreated control. The 1 port and 2 ports treatments were not significantly different from each other.

Pound solids per box values for both OTC treatments were higher than the recent historical performance for Hamlin. The 2-port treatment provided the highest pound solids per box at 5.36 and the 1 port treatment produced 5.08-pound solids per box. Both the 1 port and 2 port treatments were significantly different (higher) than the untreated control.

There was no significant difference between any of the treatments for juice color.

## DI Ratings

DI Ratings were taken at the start of the trial and after harvest. DI ratings were first taken on March 30, 2023. The crop consultant used his best judgement to select trees that were of similar visual appearance. The crop consultant was able to select trees which all had a combined DI rating of 32, indicating this block is uniformly declined with HLB. The DI rating scale for mature trees is 0 – 40. The higher the score the more pronounced the HLB disease expression and tree decline. A DI rating of 32 is high but not unheard of for a commercial block. The second DI rating was taken on January 30, 2024. DI ratings improved across the block for all treatments. The average improvement for the treatments showed that the untreated control decreased (improved) by an average of 3.4 points, the 1 port treatment decreased by an average of 5.5 points, and the 2-port treatment decreased by an average of 6.6 points.

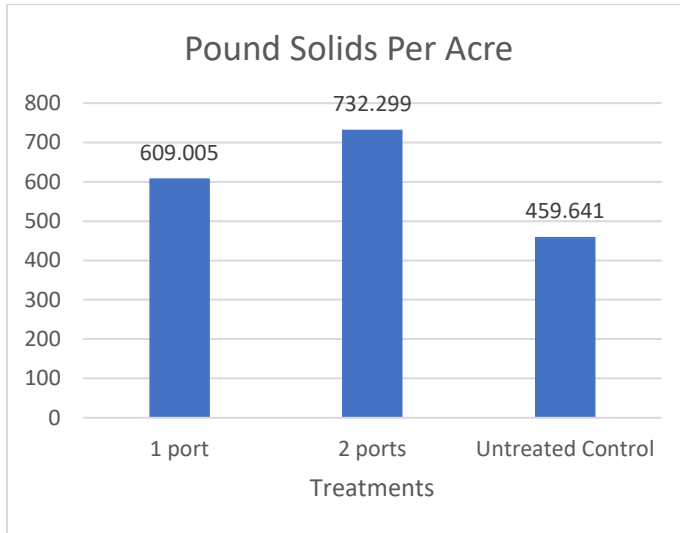


Treatment	DI Jan 30, 2024	
1 port	26.52	B
2 ports	25.36	C
Untreated Control	28.6	A
Model p>F	<.0001	

Treatments	DI_March_30_2023	DI_Jan_30_2024
1 port	32	26.52
2 ports	32	25.36
Untreated Control	32	28.6

## Economic Analysis

By using yield values and planting density, a calculation of boxes per acre can be performed. Additional calculations using the fruit quality data and the per acre yield values can provide a close estimation of pound solids per acre.



Treatment	Pound Solids Per Acre	
1 port	609.005	AB
2 ports	732.299	A
Untreated Control	459.641	B
Model p>F	0.0373	

The analysis showed a significant difference between the 2-port treatment and the untreated control. There was no significant difference between the untreated control and the 1 port treatment.

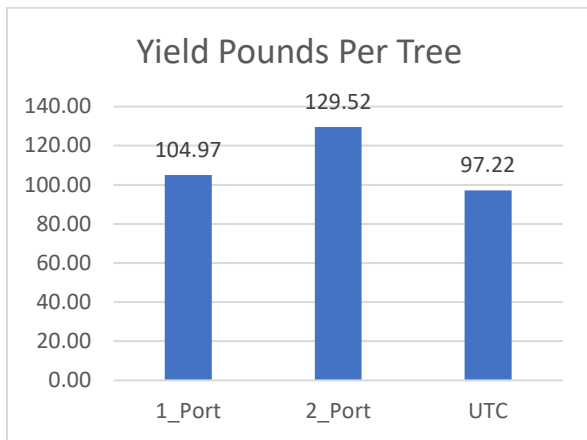
**Valencia Site – Avon Park**

A Valencia/Swingle block was selected for the early variety cultivar. The block is 21-years old and planted in traditional central Ridge fashion. The planting density is 200 trees per acre.

All treatments were conducted on May 2, 2023. The start time for injection was 10:45 am and all injection devices were empty by noon. The soil within the drip line of the tree was moist but the soil outside the wetted zone of the microjet emitters was dry. The air temperature was 86°F and the soil temperature at 6 inches deep was 75°F. The sky was clear with a 5 mile per hour wind out of the northwest. Relative humidity was 46%.

**Yield**

Yield data was collected on April 15, 2024. Each tree was harvested separately, and a single weighed value was reported for each tree in the trial.

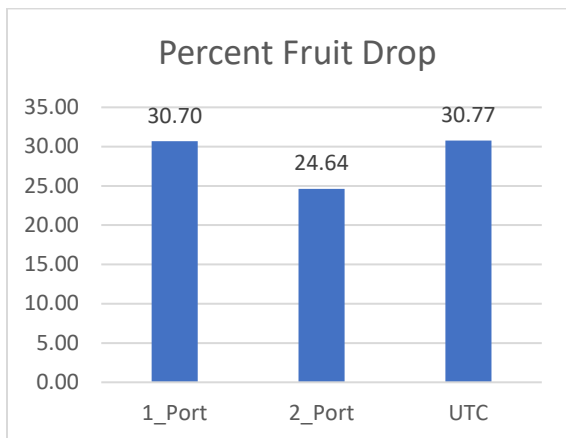


Treatment	Yield Per Tree Pounds	
1_Port	104.97	B
2_Port	129.52	A
UTC	97.22	B
Model p>F	0.0002	

The analysis of yield shows significant differences between the treatments. The 2-port treatment yielded 129 pounds of fruit per tree and that value was significantly different from the 1 port and UTC yield.

**Percent Fruit Drop**

Fruit drop counts were conducted at four points in time leading up to harvest. Fruit drop counts began in January 2024 and continued through April 2024. Fruit drop was assessed on a per tree basis.

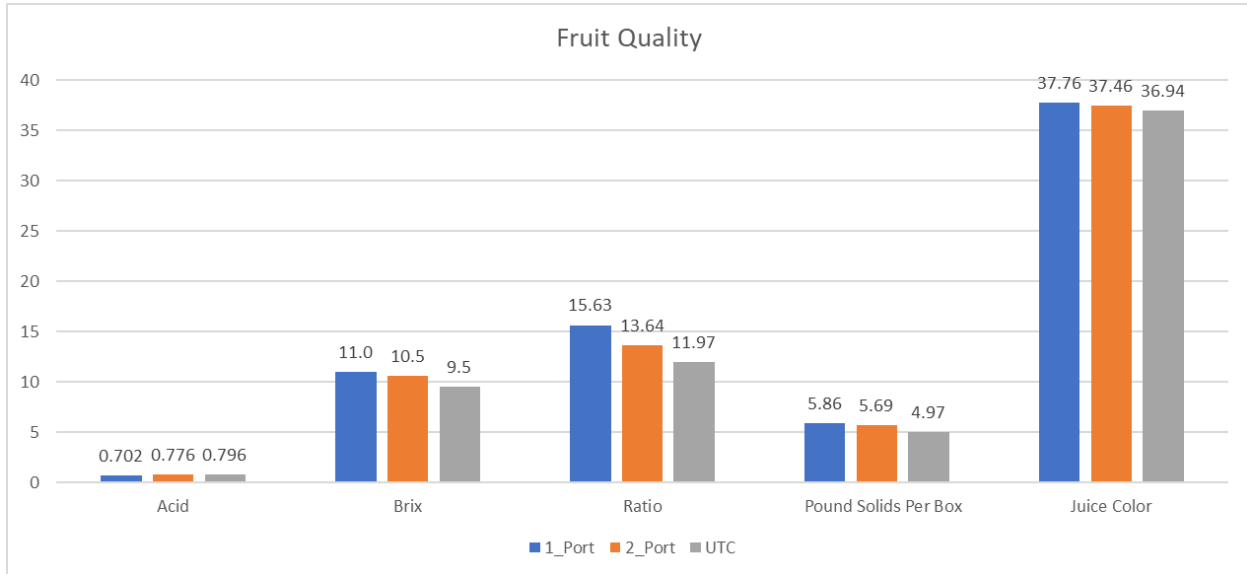


Treatment	Percent Fruit Drop	
1_Port	30.6997391	A
2_Port	24.6362371	B
UTC	30.7743872	A
Model p>F	0.0005	

The percentage of dropped fruit was significantly less in the treatment that used 2-ports compared to the 1 port treatment and UTC. There was no difference in the values for the 1 port treatment and the UTC.

## Fruit Quality

Fruit quality analysis was performed at the CREC Pilot Plant on April 18, 2024. A single fruit quality sample was collected from each plot in the trial for a total of 15 samples.



Treatment	Acid		Brix		Ratio		Pound Solids Per Box		Juice Color	
1_Port	0.702	B	10.97	A	15.626	A	5.86074	A	37.758	A
2_Port	0.776	A	10.548	A	13.644	B	5.6918	A	37.464	A
UTC	0.796	A	9.504	B	11.972	C	4.97348	B	36.936	B
Model p>F	0.01		<.0001		<.0001		<.0001		0.0005	

Several significant differences were found in the fruit quality analysis.

Titrateable acid lowest in the 1 port treatment and significantly different from the values for the 2-port treatment the UTC

Brix levels between the 1 port and 2-port treatment was not significantly different from each other. The UTC was significantly lower than both OTC treatments.

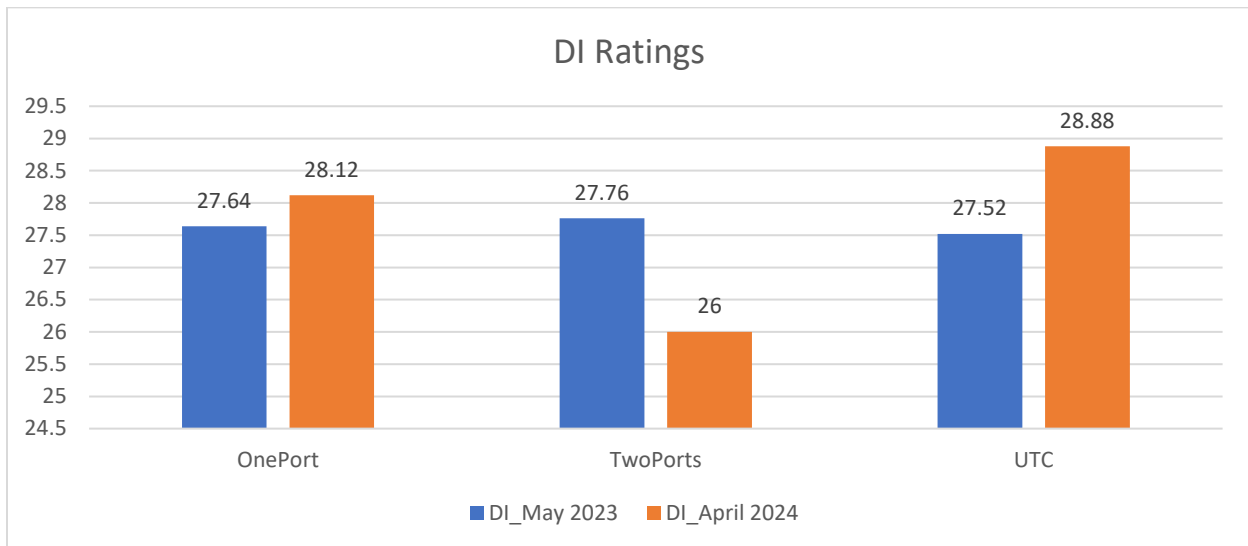
Brix/Acid Ratio was highest in the 1 port treatment at 15.6. The 2-port treatment had a ratio of 13.6. The lowest ratio was seen the UTC at 11.9. Each treatment was significantly different.

Pound Solids per Box was lowest in the UTC at 4.9. The UTC was significantly lower than the both the 1 port and 2-port treatments. There was no significant difference between the 2 OTC treatments.

Juice Color was best in the 1 port treatment at 37.75. There was no significant difference between the 1 port treatment and the 2-port treatment. The UTC was significantly lower than both OTC treatments at 36.93.

## DI Ratings

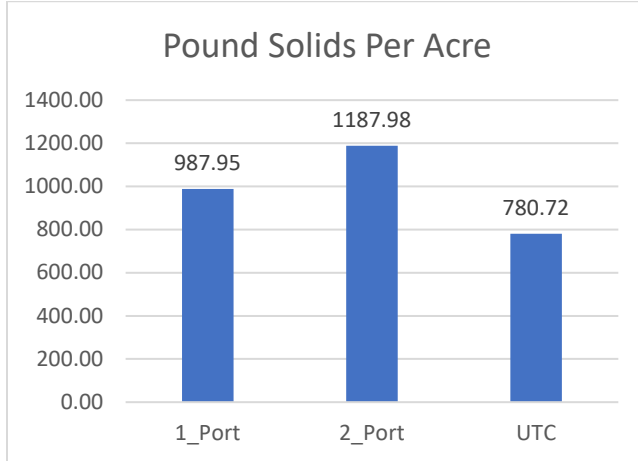
DI Ratings were taken at the start of the trial and after harvest. DI ratings were first taken on May 2, 2023. The crop consultant used his best judgement to select trees that were of similar visual appearance. The crop consultant was able to select trees which all had a combined DI rating of 27, indicating the trees selected for this trial were uniformly declined with HLB. The DI rating scale for mature trees is 0 – 40. The higher the score the more pronounced the HLB disease expression and tree decline. A DI rating of 27 is common for trees in a maintained commercial block. The second DI rating was taken on April 15, 2024. DI ratings did not vary much from the first rating in 2023 to the second rating in 2024. The 2-port treatment improved the visual health of the treatment trees, but only slightly. The improvement in the tree health for the 2-port treatment is inverse of the trend seen in the UTC and 1 port treatment, both of which increased slightly over the course of the year long trial. The DI ratings indicate that none of the treatments had any significant impact on visual tree health.





## Economic Analysis

By using yield values and planting density, a calculation of boxes per acre can be performed. Additional calculations using the fruit quality data and the per acre yield values can provide a close estimation of pound solids per acre.



Treatments	Pound Solids Per Acre	
1_Port	987.95	AB
2_Port	1187.98	A
UTC	780.72	B
Model p>F	0.0016	

Pound Solids Per Acre was highest in the 2-port treatment and was significantly different than the UTC. The UTC produced the lowest value at 780-pound solids per acre. The 1 port treatment and the UTC are not significantly different from each other.

## Summary of Findings

This trial began as an evaluation of mature trees (defined as older than 20 years) and what type of response could be elicited with OTC trunk injections. The crop consultant saw an opportunity to improve the study by adding a third treatment which used 2 injection ports to deliver the same amount of active ingredient that was scheduled for use in the original 1 port injection treatment.

The trial suggests that OTC injection in mature citrus trees can improve Brix, Ratio, Pound Solids Per Box, and Yield compared to an untreated control.

The analysis of yield and percent fruit drop was not remarkable at the Hamlin site but did show a trend of improvement over the untreated control. At the Valencia site the 2-port treatment did produce a significant impact on yield and percent fruit drop compared to the untreated control.

DI ratings at the Hamlin site improved for all treatments between March 2023 and January 2024. The 2-port treatment had the best improvement of all the treatments, but the untreated control DI ratings improved as well, just not as much as the OTC treatments. The Valencia site did not improve in visual health as the Hamlin site did. The DI ratings show the Valencia trees visually remained almost exactly the same over the course of the trial.

Using calculations to extrapolate the data to a per acre basis, the data indicates that pound solids per acre can be positively impacted by OTC injections. The 2-port treatment significantly improved pound solids per acre compared to the untreated control at both sites. The 1 port treatment was numerically higher than the untreated control, but the values were not significantly different.

A second year of this trial has been funded. Injections are planned to take place in May 2024. The practice of using multiple injection ports/locations for a single injection event needs to be better understood. Previous work on the subject supports the findings of this project. It is likely using multiple injection ports/locations during a single injection event will distribute the active ingredient more thoroughly than a single injection and enhance the treatment response. The long-term implications of twice as many injection ports compared to single port injection is unknown.