

Project Report

Enhancing Lettuce Biomass

Olds College Centre for Innovation

Report Prepared By: Grayson Chamlers, Angie Stoute, Ashutosh Singh

Reporting Date: June 29, 2026

Project Dates: Feb 2, 2025 to June 29, 2026



Summary

This project evaluated the use of Green Lightning Treated Water (GLT) as a foliar nitrogen enhancement strategy to improve lettuce biomass production within the Olds College Vertical Controlled Environment Agricultural (CEA) container. The study compared a standard nutrient control stream against a second production stream receiving standard nutrient delivery for lettuce production along with a weekly 30% GLT foliar application consisting of 30% GLT and 70% water, 30% GLT derived from treated water at a concentration of 33.8 ppm.

GLT-treated lettuce consistently demonstrated greater canopy development and strong vegetative growth compared with the standard nutrient treatment. Statistical analysis confirmed a significant overall positive treatment effect on GLT treated lettuce with increased leaf area, canopy area and vigor ratings compared to lettuce only receiving standard nutrients. Biomass was recorded at harvest with GLT treated lettuce weighing statistically more than lettuce receiving standard nutrients. Tissue samples were collected at harvest and submitted for agronomic plant tissue analysis to characterize nutrient status and nitrate-nitrogen concentrations following weekly GLT foliar applications.

Overall, the results indicate that weekly GLT foliar applications enhanced vegetative growth under controlled environment conditions and demonstrated the potential of GLT as a foliar nutrient enhancement strategy for vertical lettuce production.

Key Findings:

- Weekly 30% GLT foliar applications promoted greater canopy development compared with the standard nutrient treatment
- Statistical analysis confirmed a significant overall treatment effect on canopy development, with the greatest differences observed near harvest.
- Statistical analysis confirmed a significant overall biomass accumulation effect within GLT-treated lettuce.
- Agronomic tissue analysis identified higher nitrate-nitrogen concentrations in GLT-treated lettuce compared with the standard nutrient treatment, providing additional information on plant nutrient status following foliar application.
- The results support continued evaluation of GLT as a foliar nutrient enhancement strategy for controlled environment lettuce production.

Introduction

Nitrogen remains one of the most important drivers of lettuce biomass production utilizing inorganic fertilizers within a hydroponic controlled environment system typically through nitrate or ammonium (Zayed O. 2023) Improving nitrogen use efficiency while maintaining crop quality is essential for increasing production economics through sustainable means.

Green Lightning Treated Water (GLT) provides a nitrate-rich water enhancement generated from atmospheric nitrogen conversion and represents a potential alternative or complementary nitrogen strategy for controlled environmental production systems. Nitrogen is the primary element for foliage development of plants being a requirement within leafy greens production.

Lettuce was selected as an ideal model crop for this evaluation because of its rapid vegetative growth, high sensitivity to nitrogen availability, and strong visual response in leaf expansion and canopy development. In a vertical controlled environment system, lettuce provides a highly effective platform for showcasing GLT's ability to enhance plant growth, accelerate canopy expansion, and translate improved vegetative performance into measurable fresh biomass gains.

This project was designed to evaluate whether GLT, applied as a weekly 30% GLT(9.98 ppm) foliar supplement in addition to standard fertigation, could improve lettuce biomass accumulation in the Olds College ZipGrow vertical container system.

The primary response variable for this project was fresh lettuce biomass measured at harvest, with secondary response variables including weekly leaf area progression , canopy development, and crop vigor along with tissue nutrient concentration, and marketability assessments made post harvest.

Methodology

Study Site and Production System

The trial was conducted in the Olds College controlled environment container using vertical ZipGrow tower production.

The crop used was Newham pelleted lettuce (butterhead bibb X romaine cross) with a target maturity of approximately 42 days. Controlled environmental setpoints geared to lettuce production were developed to follow through the trial period, to ensure similar growing conditions were applied to the T1 (standard nutrient control) and T2 (GLT-treatment) streams. Table 1 shows the environmental set points throughout the course of the trial.

Table 1.

Targeted Controlled environment production conditions

Photoperiod	Day Temperature	Night Temperature	Reservoir Electric Conductivity (EC)	Reservoir Temperature	Monitoring Frequency	Light (PPFD)
16 Hrs	20°C	17°C	1000-1200 $\mu\text{S}/\text{cm}$	17–20°C	Daily	289-302 $\mu\text{mol m}^{-2} \text{s}^{-1}$

Experimental Design

The experimental design was structured to isolate the effect of GLT foliar application under consistent environmental and nutrient conditions. The system was designed with separate nutrient tanks to accommodate the potential for minor crossover between foliar applications and the recirculating nutrient solution. In vertical production systems, it is expected that a portion of foliar-applied solution may enter the return flow and be redistributed through the root zone at subsequent fertigation events. The automated nutrient management system maintained predetermined EC and pH set points throughout the trial, minimizing the potential impact of minor crossover between treatment streams. The two-track system implemented ensured that both treatments experienced identical lighting, temperature, and EC irrigation conditions. Allowing for direct comparison between the control and GLT-treated streams while minimizing fertigation variability.

The experimental layout was designed with the use of replicated blocks and uniform tower layouts supporting reliable comparison of treatment effects at both the tower and plant levels. Each treatment had two walls with 8 blocks with identical spread to limit micro-climate variability. Each block had 5 towers, and 8 plants per tower (Appendix A.).

Zoning & Sub-Zoning

To account for potential environmental variability within the controlled environment container, the production system was divided into predefined wall zones and tower sub-zones (Appendix B.). Zoning enabled comparisons between different locations within the container while minimizing the influence of microclimatic variation on treatment assessments.

Each treatment wall was divided into eight experimental blocks, with each block consisting of five towers. Unique zone identifiers were assigned to each block to facilitate consistent data collection and statistical analysis.

Within each tower, plants were further categorized into top, middle and bottom sub-zones based on their vertical position. These sub-zones were established to account for potential differences in light intensity, airflow, temperature, and irrigation distribution that may occur along the height of a vertical growing tower.

Observational data collected during the final two weeks of the trial were evaluated by both wall zone and tower sub-zone to determine whether plant position influenced canopy development, growth uniformity, or treatment response (Table 2). The zoning framework improved the accuracy of treatment comparisons by separating potential environmental effects from treatment effects and provided a standardized approach for documenting potential differences within the production system (Appendices B).

Table 2.

Treatment Structure

Track	Treatment Description	Nutrient Program
Track A	Standard nutrient delivery control	Base nutrient solution (~1150–1250 $\mu\text{S}/\text{cm}$; ~160 ppm N)
Track B	Standard nutrient delivery + weekly 30% GLT foliar spray	Base nutrient solution (~1150–1250 $\mu\text{S}/\text{cm}$; ~160 ppm N) + 30% GLT foliar application (weekly)(9.98 ppm NO_3)

Treatment Application

Green Lightning Treated Water (GLT) was applied as a 30% foliar solution once per week throughout the production cycle. Applications were performed using the integrated spray system within the Zippy Pod, allowing treatment to be applied uniformly across the designated GLT towers while maintaining normal production practices.

To support the foliar application program, the production system was operated with separate nutrient reservoirs for each treatment stream. This design minimized cross-contamination while recognizing that a small amount of foliar-applied solution may return to the recirculating system under normal operating conditions. This reflects practical commercial production conditions within vertical hydroponic systems.

All foliar applications were performed using a standardized application procedure to ensure consistent treatment coverage and timing throughout the trial. Treatment frequency and application rates remained constant for the duration of the study to allow direct comparison between the standard nutrient and GLT treatments.

Weekly Monitoring and Plant Measurements

Weekly monitoring and plant measurements were conducted after transplanting to track vegetative growth progression and capture early indicators of treatment response prior to harvest. Measurements focused on leaf expansion and canopy development, which are closely linked to biomass accumulation in lettuce. Consistent measurement techniques (Table 3.) were applied across both treatment tracks to ensure comparability, and environmental parameters (Table 4.) were recorded alongside plant data to confirm stability of growing conditions throughout the trial. Crop vigor was recorded alongside measurements on a weekly basis, to provide observational data on crop health, and to document potential nutrient deficiency symptoms observed during the trial period (Appendix C.).

For weekly canopy and leaf expansion measurements as well as vigor rating observations, 32 samples were selected per treatment with equal representation between, wall, and block. Samples were selected from among the middle portion of each tower to lower micro-climate variability. Middle tower growth was selected as the monitoring point due to the position within the tower providing the most sufficient growing conditions compared to top and bottom growth that may have reduction in light as well as air circulation.

Table 3.

Weekly plant measurements

Assessment	Measurement Method
Leaf length	Measured from the leaf tip to the petiole junction (cm)
Leaf width	Calculated by multiplying leaf length by maximum leaf width (cm ²)
Leaf area	Measured as the maximum horizontal spread of the plant canopy (cm)
Canopy width	horizontal canopy spread
Canopy Length	Measured as the maximum vertical spread of the plant canopy (cm)
Canopy area	Calculated by multiplying canopy length by canopy width (cm ²).
Crop Vigor	Visual rating based on plant colour, uniformity, leaf development, and overall plant health.

Table 4.

Environmental Monitoring Parameters

Parameter	Purpose
EC	Monitor nutrient concentration
pH	Monitor nutrient availability
Container Temperature	Verify environmental stability
Reservoir Temperature	Confirm nutrient solution conditions
Irrigation System	Verify consistent nutrient delivery

Harvest and Tissue Assessments

At the completion of the production cycle, harvest assessments were conducted to evaluate crop productivity, quality, and treatment performance. Fresh biomass of leafy green shoots (whole head of plant) was identified as the primary response variable and was measured for individual plants and towers to compare overall yield between treatments. Visual marketability assessments were also completed to document crop uniformity, colour, leaf quality, and overall harvest appearance.

To complement the harvest evaluations, leaf tissue samples were collected and submitted for laboratory analysis. Tissue testing was performed to determine nutrient and nitrate concentrations within the edible leaf tissue following weekly foliar GLT applications. This analysis was included to verify that foliar application did not result in abnormal nutrient accumulation while providing additional information on plant nutrient status at harvest.

The harvest assessments and laboratory analyses conducted during the study are summarized in Table 5.

Table 5.

Harvest and Tissue Assessment

Assessment	Purpose
Fresh biomass (leafy green shoot mass, head of plant) per tower	Compare productivity between treatments at harvest
Marketability assessment	Evaluate crop quality, uniformity, colour, and visual appeal
Tissue nutrient analysis	Determine nutrient concentrations within harvested leaf tissue
Tissue nitrate analysis	Verify nitrate concentrations within edible tissue following foliar GLT application

Results & Discussion

Environmental Conditions

Environmental conditions were monitored throughout the production cycle to verify that both treatment systems were maintained under comparable growing conditions. Reservoir electrical conductivity (EC) and pH remained within the target operating ranges for lettuce production and exhibited similar trends between the standard nutrient and GLT treatment tanks throughout the trial (Appendix D).

Minor fluctuations in EC and pH were observed as part of normal hydroponic system operation and routine nutrient management. A temporary increase in EC variability was observed near the end of April, corresponding with an interruption in the delivery of the Stock B calcium nitrate solution when the concentrate intake line became buoyant and drew air instead of nutrient solution. The issue was identified and corrected by securing the intake line below the solution surface, restoring consistent nutrient delivery to the system.

Despite this temporary operational issue, environmental conditions remained sufficiently stable to support treatment comparisons, and both treatment streams continued to follow similar overall EC and pH trends throughout the production cycle. Detailed environmental monitoring records and supporting statistical analyses are provided in Appendix D.

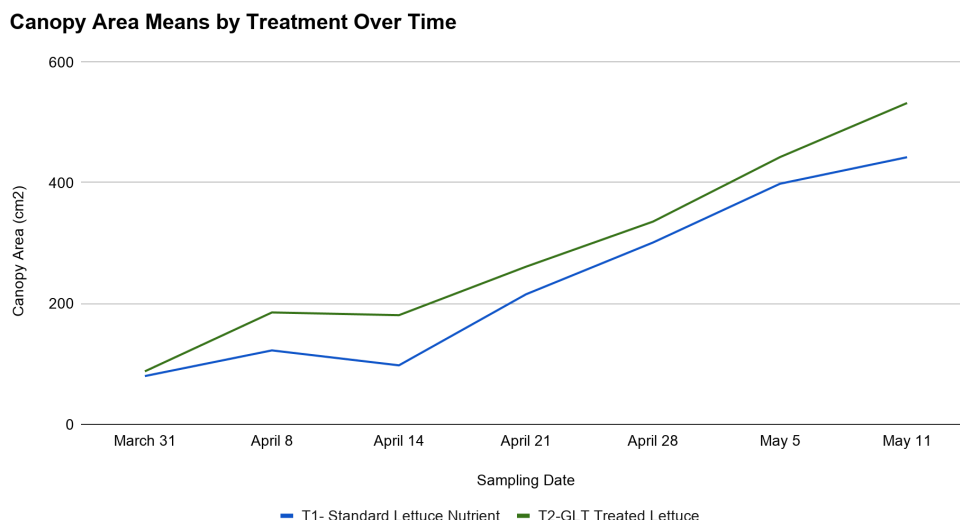
Canopy Development

Canopy development increased steadily throughout the production cycle for both treatments (Figure 1). Plants receiving the GLT treatment consistently developed larger canopy areas than those receiving the standard nutrient treatment, with the greatest differences observed during the later stages of production.

Statistical analysis identified a significant overall treatment effect on canopy development, with the strongest evidence of treatment response occurring at the final sampling date. Although differences at individual sampling dates were not always statistically significant, the GLT treatment maintained greater average canopy coverage throughout the trial (Appendix E).

Figure 1.

Canopy Development Over Time

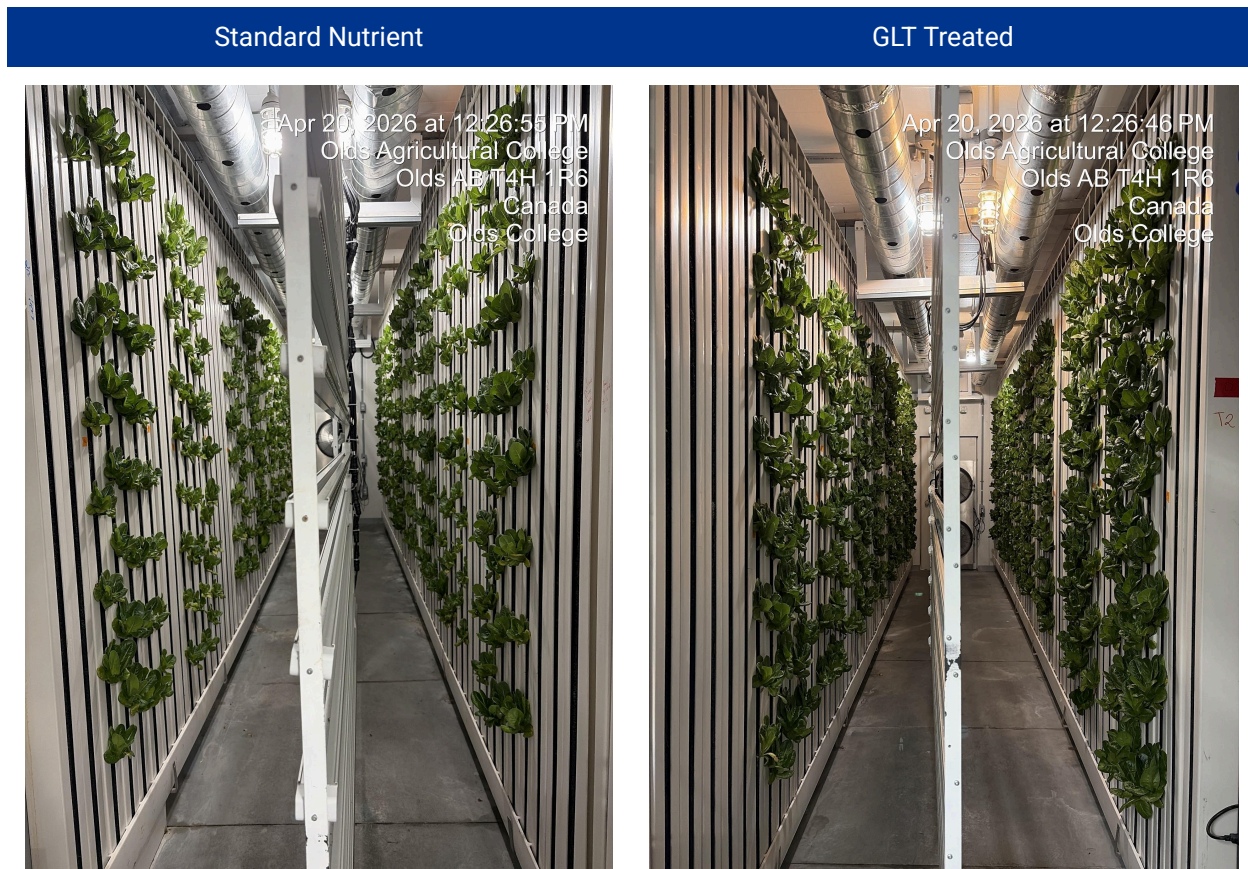


A temporary reduction in canopy expansion was observed during mid-April following the interruption in Stock B calcium nitrate delivery. After the issue was corrected, canopy development resumed in both treatments, with the GLT treatment maintaining greater canopy coverage through to harvest.

Figure 2. Shows the visual impact between canopy development between treatments. GLT-treated had a fuller canopy sooner showcased visually in the reduction of space between walls.

Figure 2.

Canopy Development Between Treatments

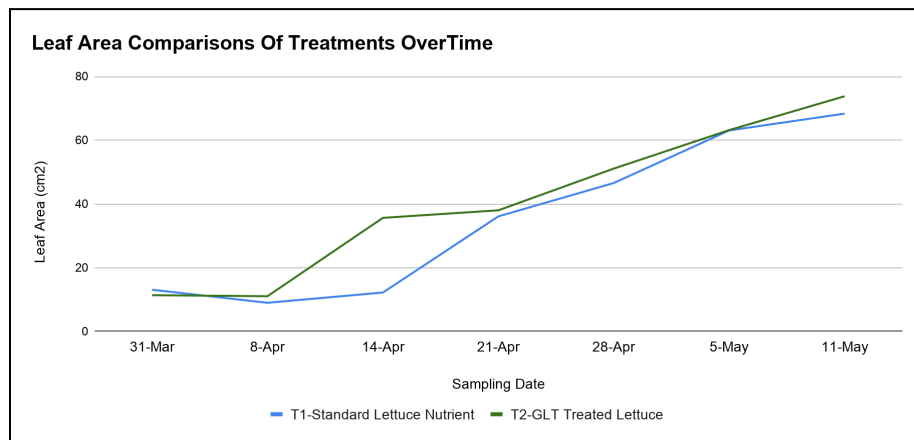


Leaf Area Development

Leaf area increased steadily throughout the production cycle for both treatments, reflecting normal vegetative growth under controlled environment conditions (Figures 3). While the GLT treatment generally exhibited greater leaf area than the standard nutrient treatment, statistical analysis indicated that treatment differences were not consistent throughout the trial.

Figure 3.

Leaf Area Development

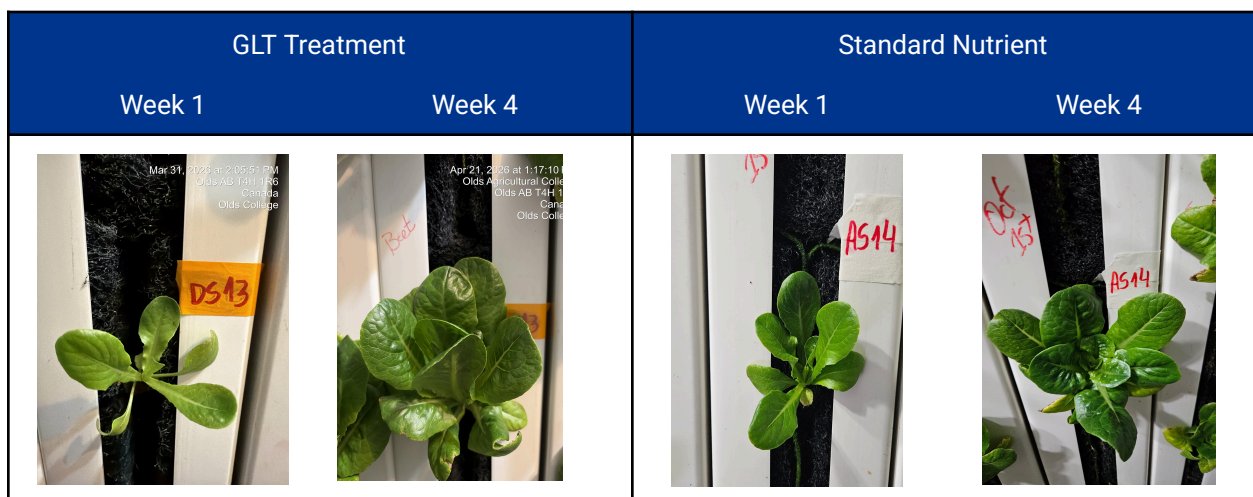


A significant increase in leaf area was observed for the GLT treatment during the mid-April sampling; however, no significant differences were detected at the remaining sampling dates (Appendix F). Overall, both treatments followed similar growth patterns, suggesting that the primary treatment response was expressed through improved canopy development rather than sustained increases in individual leaf area.

Figure 4. shows the visual difference on leaf development between treatments, taken at two interval periods over the course of the trial.

Figure 4.

Difference In growth between transplant (Left Side) and 4 weeks of growth (right side). GLT applied (top) Control (bottom).



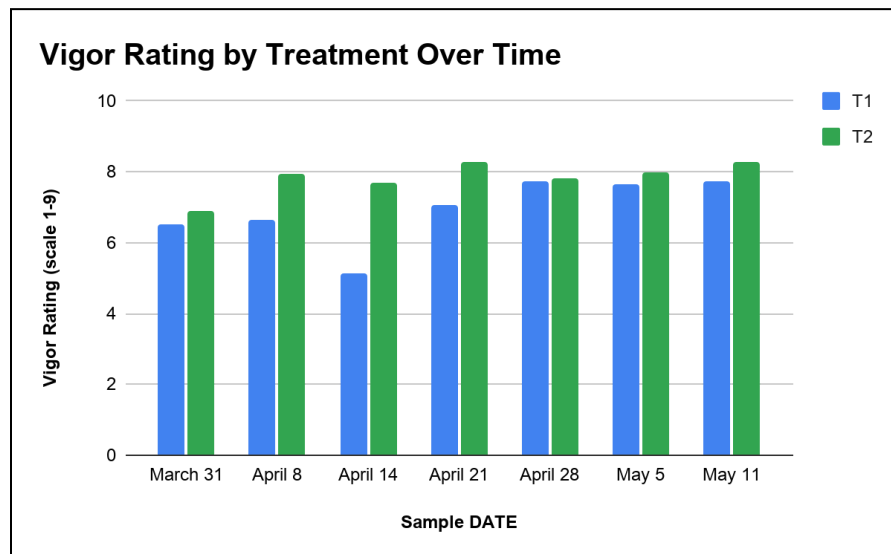
Plant Vigor

Crop Vigor observations were recorded weekly to compare growth of GLT-treatment compared to standard nutrient. Figure 5 indicates that T2 (GLT-treated) showed positive consistent results in overall plant vigor in comparison to T1 (standard nutrient control). The visual ratings were also used as an observational means to catch indicators of nutrient deficiencies. T1 showcased signs of stunted growth likely resulting from a calcium deficiency impacting comparison in week 3 of trial. Though T1 improved over the duration of the trial, T2 showcased higher Visual Crop Vigor ratings. T2 visuals crop ratings did drop in both week 3 and 5, likely due to nutrient feed reductions in fertigations, though there were no significant implications that would lead to a reduction in marketability.

Representative images collected throughout the trial support the weekly vigor assessments and demonstrate the visual differences in plant development between the standard nutrient and GLT treatments (Appendix G).

Figure 5.

Vigor Rating by Treatment



Fresh Biomass Response

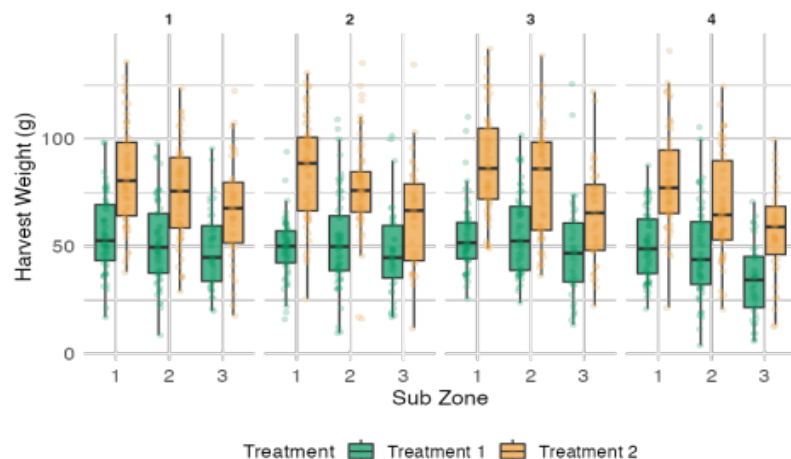
Fresh biomass (wet mass) was used as the primary indicator of harvest productivity. GLT-treated lettuce consistently produced greater harvest weights than the standard nutrient treatment across all production zones and sub-zones (Figure 6.).

Statistical analysis demonstrated that the GLT treatment resulted in significantly greater harvest biomass throughout the production system, with the largest treatment responses observed in the upper growing positions. Although the magnitude of the response varied among production locations, the positive effect of GLT was consistent across the trial, supporting the enhanced canopy development and vegetative growth observed throughout the production cycle.

Detailed statistical comparisons by production zone and sub-zone are provided in Appendix H.

Figure 6.

Harvest biomass by treatment across production zones



Tissue Nutrient and Nitrate Analysis

Laboratory tissue analysis identified differences in nutrient composition between the standard nutrient and GLT treatments (Table 6.). In addition to differences in several nutrient concentrations, GLT-treated lettuce exhibited higher nitrate-nitrogen concentrations at harvest than the standard nutrient treatment.

The tissue analysis complemented the harvest assessments by providing additional information on plant nutrient status following weekly GLT foliar applications. Although higher nitrate-nitrogen concentrations were observed in the GLT treatment, interpretation of these results relative to food quality or regulatory limits was beyond the scope of this study. Complete laboratory tissue analysis results are provided in Appendix F & G.

Because the tissue analysis was performed using an agronomic plant tissue testing protocol, future research should include fresh tissue nitrate analysis using food chemistry methods to facilitate direct comparison with published food nitrate concentrations and regulatory reference values.

Table 6.

Nutrient treatment Comparisons

Parameter	Standard Nutrient	GLT Treatment	Observation
Total Nitrogen (%)	4.67	5.01	Slightly higher in GLT-treated lettuce
Nitrate (%)	.25	.72	Higher than GLT-treated lettuce
Phosphorus (%)	0.67	0.70	Comparable between treatments
Potassium (%)	3.69	5.34	Higher in GLT-treated lettuce
Calcium (%)	1.57	1.59	Similar between treatments
Iron (mg/kg)	94.5	85.7	Similar between treatments

Conclusions

Throughout this study, results demonstrate strong potential for Green Light Treated (GLT) water as an effective product to increase biomass of lettuce in a controlled environment vertical grow system.

Foliar application of GLT at 30% concentration increased biomass accumulation in comparison to a standard nutrient fertigation not receiving foliar application. Trends from visual vigor ratings, leaf development and canopy development support the influence of GLT treatment to increase biomass throughout production compared to standard nutrient plans. Zone and sub-zone locality comparisons support variation within treatments but demonstrate supportive evidence that GLT foliar application increases biomass compared to zones residing within standard nutrient control.

Environmental stability remained consistent throughout the study allowing for accuracy of isolating GLT foliar treatments to be the main cause for accumulative biomass compared to a standard nutrient control. pH stability within fertigation tanks remained consistent between the two treatments throughout the 7 week trial allowing the increase in biomass accumulation to be a result from the GLT foliar treatment.

Tissue sampling and results reflect that GLT-treated water increases nitrate concentration within foliage of lettuce however, does not complicate edibility or marketability of produce, leading to the result that Green Light Treated (GLT) water at 30% concentration can increase biomass of lettuce improving timelines and produce vigor for market.

Future Work

Future work of Green Light Treatment (GLT) water should focus on implementation on other leafy green crops grown in a controlled environment. Implementation of the product should be utilized within other systems such as Nutrient Film Technique (NFT) or other hydroponic systems to test its applicability to current industry controlled environments on a commercial scale. Recommendation of application could include foliar and fertigation methods to determine its use as fertigation product in addition to a foliar product. Recommended crops would be spinach, basil or mint as these plants require higher nitrogen levels to push productivity of foliage development.

As this was an initial evaluation of GLT within a controlled environment lettuce production system, repeating the trial under the same production conditions is recommended to confirm the consistency and repeatability of the observed results and provide greater confidence in the technology. Additional studies evaluating a range of GLT application rates should also be conducted to determine the most effective application strategy.

Future research should continue to investigate nutrient and nitrate-nitrogen concentrations within harvested tissue using agronomic plant tissue analysis and incorporate food chemistry methods where direct comparison with published food nitrate values is desired. Expanding tissue analysis alongside growth and yield evaluations will provide additional information on nutrient uptake, product consistency, and the commercial application of GLT technology.

Acknowledgements

Client	Nytro Ag Corp 555 Nykolaishen Dr. Box 1989 Kamsack, SK S0A 1S0
External Sponsor	Chris Nykolaishen <i>Responsible for providing general oversights of the project goals, approving any changes to scope, schedule or budget</i>
Internal Sponsor	Olds College (David Fullerton; Director, Applied Research) <i>Responsible for providing general oversight of project goals and internally approaching any change in scope, schedule or budget</i>
Program Manager	Olds College (Herman Simons; Manager, Applied Research) <i>Responsible for overall project management (scope, schedule, budget) and communication with the sponsors</i>
Project Coordinator	Olds College (Angie Stoute; Research Technician, Applied Research) <i>Responsible for overall project management (scope, schedule, budget) and communication with the sponsors</i>
Project team members	Christina Kaye, Smart Ag Project Lead Daniel Stefner, Smart Ag Project Lead and Farm Liaison Ashutosh Singh, Data Scientist Julie Cobb, Research Technician Lexie Herspiegel, Research Technician Blair Bateman, Research Technician Russell Milk, Research Technician Angela Stoute, Research Technician Protus Nyende, Research Technician Abraham Pichardo, Research Technician Juan Ramos Jara, Research Technician Grayson Chalmers, Student Research Assistant OCCI Interns and Summer Students Other OCCI Staff as required

References

Zayed O., Hewedy O. A., Abdelmoteleb A., Ali M., Youssef M. S., Roumia A. F., Seymour D., Yuan Z. C. (2023). Nitrogen Journey in Plants: Uptake to Metabolism, Stress Response, and Microbe Interaction. *Biomolecules*, 13(10), 1443. <https://doi.org/10.3390/biom13101443>

Appendices

Appendix A - Experimental Design Block Layout

Experimental Layout

Parameter	Value
Blocks per treatment	16
Towers per block	5
Towers per treatment	80
Plants per tower	8
Total plants per treatment	640

Appendix B - Zoning and Sub-Zoning

Zone Layout

Block #	Zone
1 and 2	1
3 and 4	2
5 and 6	3
7 and 8	4

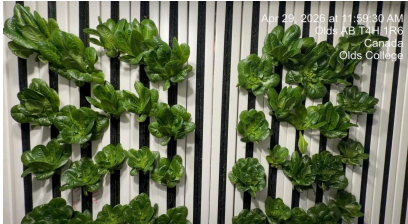
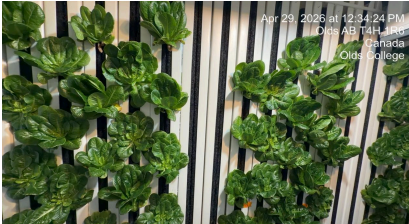
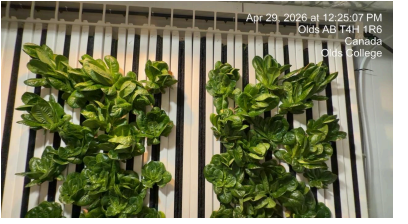
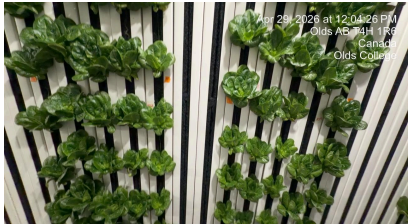
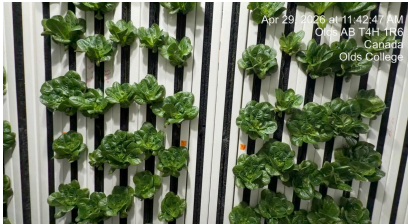
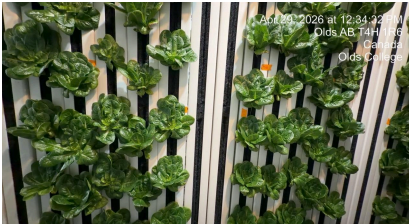
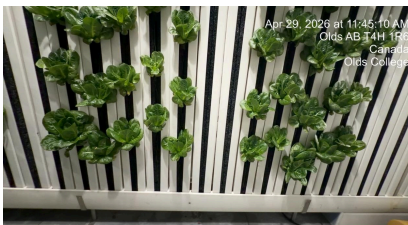
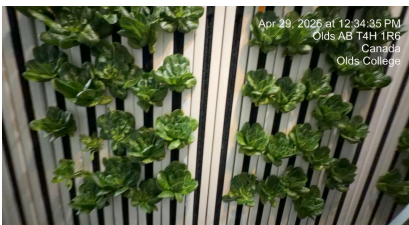
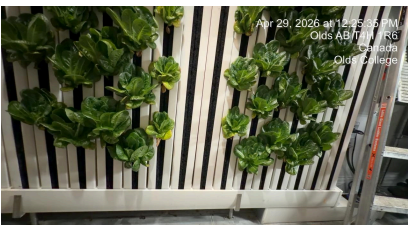
Tower Sub-Zone Classification

Tower Sub-Zone	Growing Conditions Consideration	Primary Use During Trial
Top	Greater exposure to overhead HVAC airflow, reduced light intensity, and potentially greater irrigation flow	Visual observations and documentation of positional effects.
Middle	Most consistent growing environment with primary influence from circulation fans.	Source of all physical plant measurements and visual ratings to standardize data collection.
Bottom	Potential for reduced irrigation, lower light intensity, and reduced air movement.	Visual observations and documentation of positional effects.

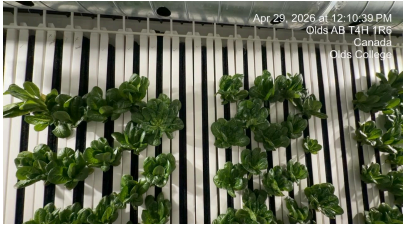
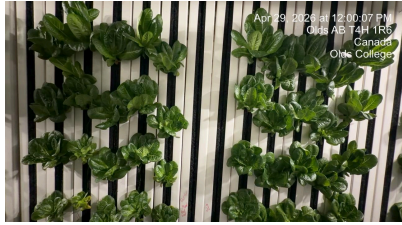
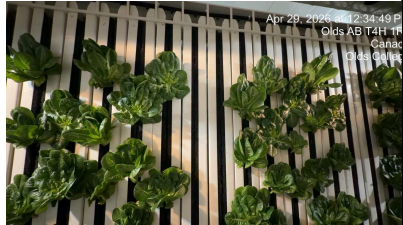
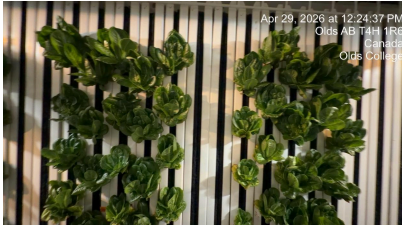
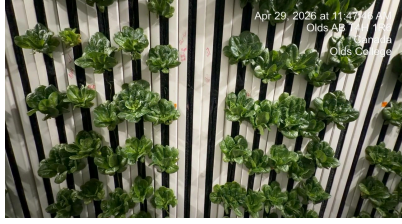
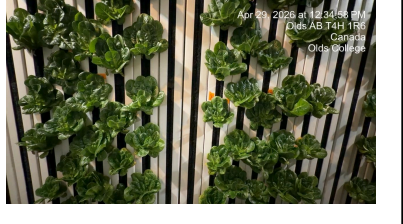
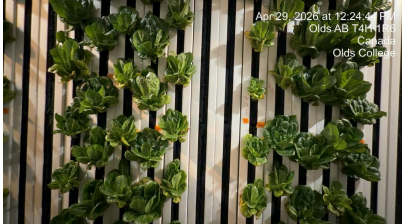
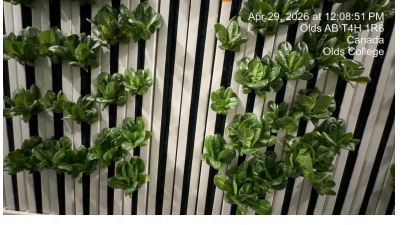
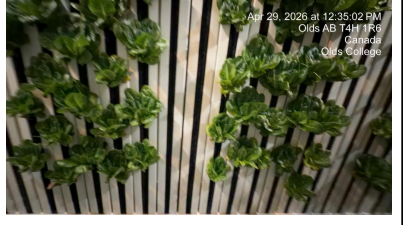
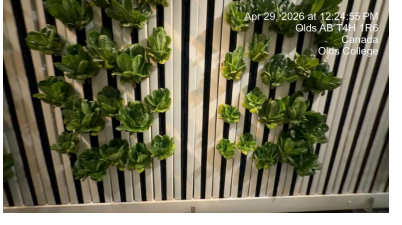
Note: To minimize variability associated with plant position within the tower, all quantitative plant measurements were collected from the middle sub-zone. Top and bottom sub-zones were used to document positional differences and visual observations throughout the production cycle.

Zone Comparisons (April 29, 2026)

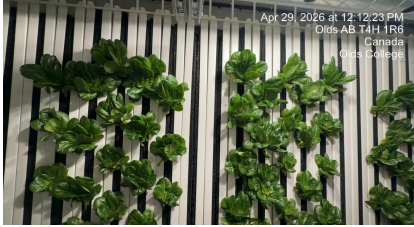
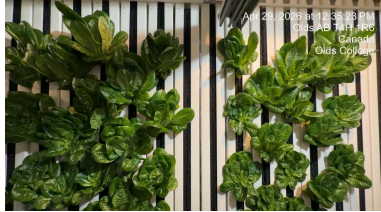
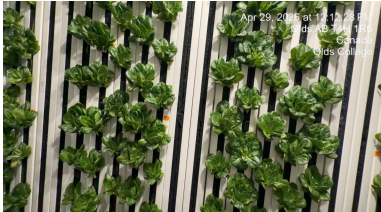
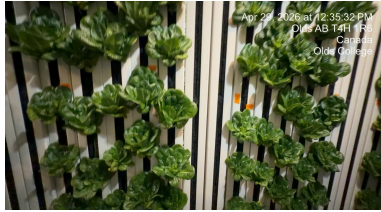
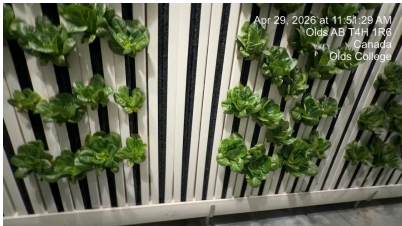
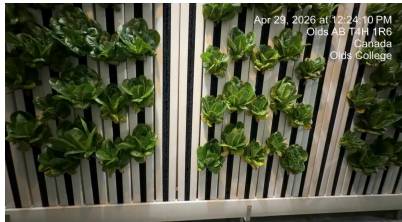
Zone 1 (Blocks 1 and 2) April 29, 2026

	Wall A (Standard Nutrients)	Wall B (Standard Nutrients)	Wall C (GLT Treatment)	Wall D (GLT Treatment)
Top of tower (sub-zone 1)	 Apr 29, 2026 at 12:22:01 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 11:59:30 AM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:34:24 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:25:07 PM Olds AB T4H 1R6 Canada Olds College
Mid of tower (sub-zone 2)	 Apr 29, 2026 at 12:04:26 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 11:42:41 AM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:34:32 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:25:13 PM Olds AB T4H 1R6 Canada Olds College
Bottom of tower (sub-zone 3)	 Apr 29, 2026 at 12:04:30 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 11:45:10 AM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:34:35 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:25:16 PM Olds AB T4H 1R6 Canada Olds College
NOTES	Top and mid uniform, bottom plants are smaller, a bit of necrosis on mid growth leaf margins	Uniform growth, a few stunted plants, mature plants have some necrosis on leaf margins.	Even canopy, small amounts of necrotic margins on older growth	Mid and low growth are rosetted while the top growth stands away from the wall most likely due to air flow not being as strong allowing more elongated growth

Zone 2 (Blocks 3 and 4) April 29, 2026

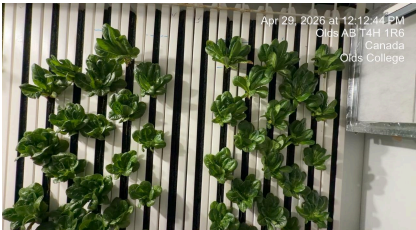
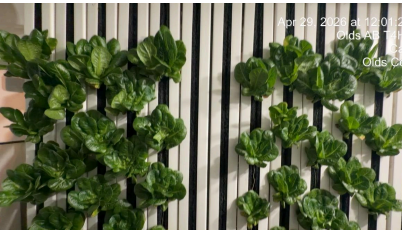
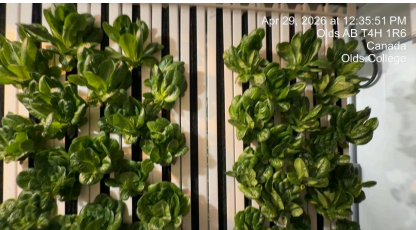
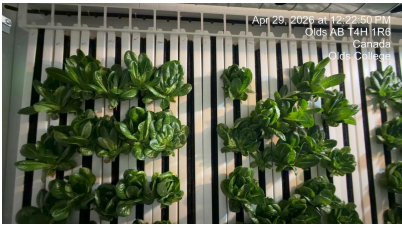
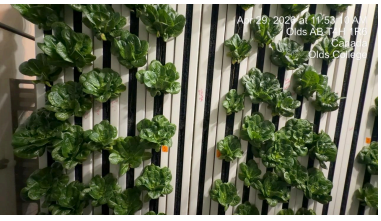
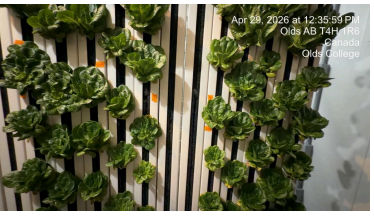
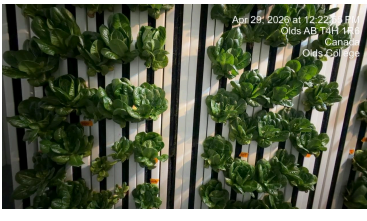
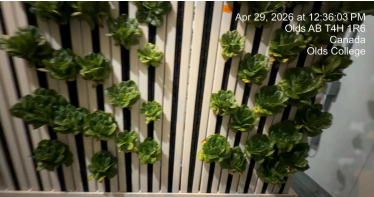
	Wall A (Standard Nutrients)	Wall B (Standard Nutrients)	Wall C (GLT Treatment)	Wall D (GLT Treatment)
Top Growth (Sub zone 1)	 Apr 29, 2026 at 12:10:39 PM Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 12:00:07 PM Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 12:34:49 P Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 12:24:37 PM Olds AB T4H TR6 Canada Olds College
Mid Growth (sub-zone 2)	 Apr 29, 2026 at 12:10:11 PM Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 11:57:19 PM Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 12:34:49 PM Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 12:24:37 PM Olds AB T4H TR6 Canada Olds College
Bottom Growth (sub-zone 3)	 Apr 29, 2026 at 12:08:51 PM Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 11:47:51 AM Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 12:35:02 PM Olds AB T4H TR6 Canada Olds College	 Apr 29, 2026 at 12:24:35 PM Olds AB T4H TR6 Canada Olds College
NOTES	Uniform growth, necrosis on margins of leaves Sub Zone 1 has more protruding growth compared to bottom and middle sections	Uniform growth, large biomass, a bit of necrosis on leaf margins.	Slight necrosis on margins. Healthy, robust, even growth	Chlorosis on bottom of tower samples. Uniform even rosettes middle of tower

ZONE 3 (blocks 5&6) April 29, 2026

	Wall A (Standard Nutrients)	Wall B (Standard Nutrients)	Wall C (GLT Treatment)	Wall D (GLT Treatment)
Top Growth (sub-zone 1)	 Apr 29, 2026 at 12:12:33 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:00:58 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:35:28 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:23:47 PM Olds AB T4H 1R6 Canada Olds College
Mid Growth (sub-zone 2)	 Apr 29, 2026 at 12:12:33 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 11:51:21 AM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:35:32 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:24:02 PM Olds AB T4H 1R6 Canada Olds College
Bottom Growth (sub-zone 3)	 Apr 29, 2026 at 12:12:33 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 11:51:28 AM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:35:38 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:24:10 PM Olds AB T4H 1R6 Canada Olds College
NOTES	Healthy even growth, lower density on the bottom third of the towers	Overall growth is good, necrotic leaves and curling, a few plants are stunted. Block 5 looks better than Block 6	Longer foliage extending away from tower compared to mid and low growth, even Canopy density throughout	Lower section less dense than top and mid growth on towers

Zone 4 (blocks 7 and 8) April 29, 2026

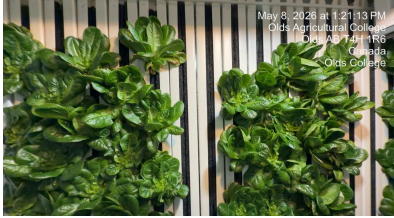
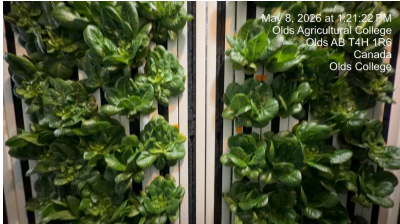
	Wall A (Standard Nutrients)	Wall B (Standard Nutrients)	Wall C (GLT Treatment)	Wall D (GLT Treatment)
--	-----------------------------	-----------------------------	------------------------	------------------------

Top Growth (sub-zone 1)	 Apr 29, 2026 at 12:12:44 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:10:11 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:35:51 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:22:50 PM Olds AB T4H 1R6 Canada Olds College
Mid Growth (sub-zone 2)	 Apr 29, 2026 at 12:12:48 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 11:53:11 AM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:35:59 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:22:50 PM Olds AB T4H 1R6 Canada Olds College
Bottom Growth (sub-zone 3)	 Apr 29, 2026 at 12:12:58 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 11:53:15 AM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:36:03 PM Olds AB T4H 1R6 Canada Olds College	 Apr 29, 2026 at 12:23:06 PM Olds AB T4H 1R6 Canada Olds College
NOTES	Uniform growth, some marginal necrosis, small in comparison to Wall C and D	A few stunted plants in Block 7 compared block 8, Bottom plants seem to be smaller than mid and top sections	Very dense and large healthy growth, would be ready for harvest	Very dense and healthy would be harvest ready, top growth extends away from the wall compared to mid and bottom growth.

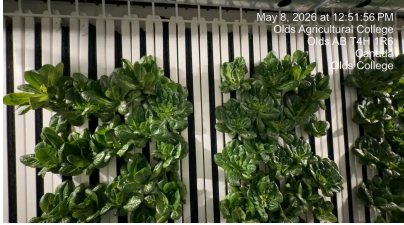
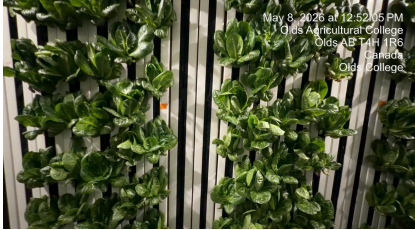
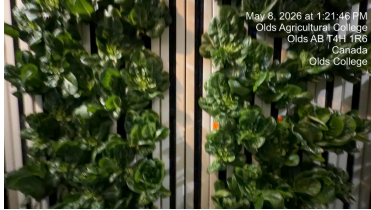
Zone Comparisons (May 8, 2026)

ZONE 1 (blocks 1 and 2) May 8, 2026

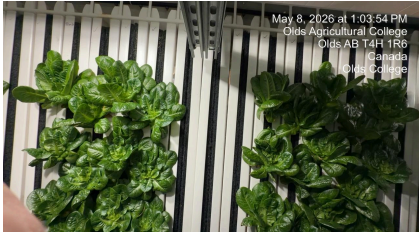
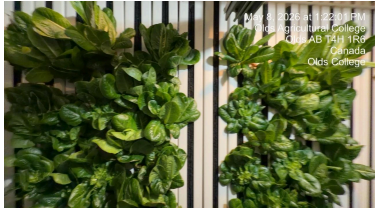
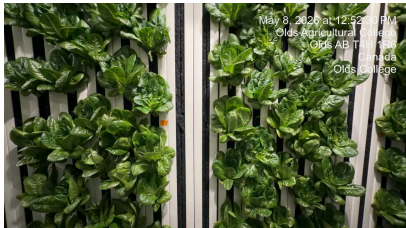
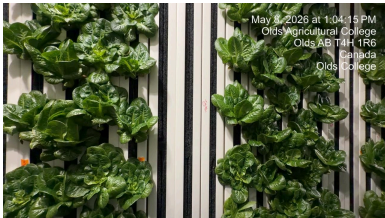
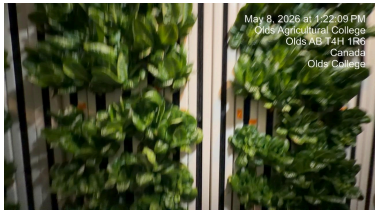
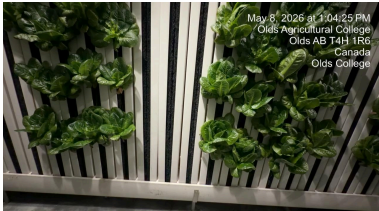
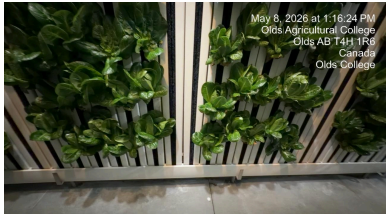
	Wall A (Standard Nutrients)	Wall B ((Standard Nutrients)	Wall C (GLT Treatment)	Wall D (GLT Treatment)
--	-----------------------------	------------------------------	------------------------	------------------------

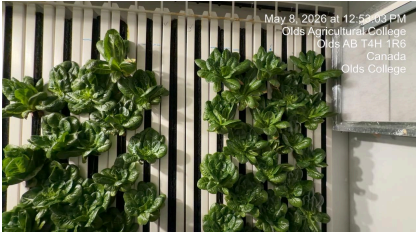
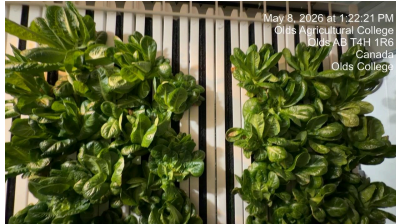
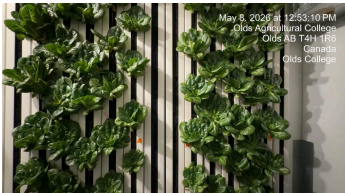
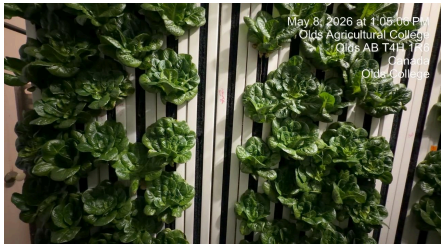
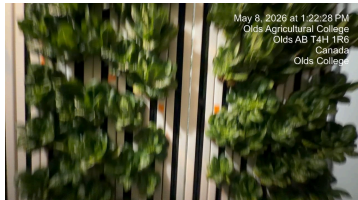
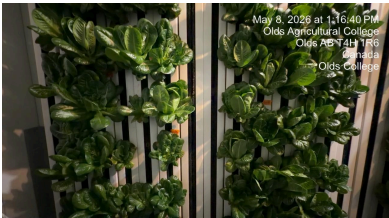
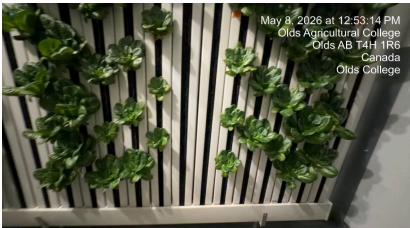
Top of tower (sub-zone 1)				
Mid of tower (sub-zone 2)				
Bottom of tower (sub-zone 3)				
NOTES	Uniform growth, top section growth does appear to stand away from wall	Uniform growth on both blocks, almost none necrosis on leaf margins	Uniform growth, a few plants with necrosis on leaf margins	Uniform growth, a few plants with necrosis on leaf margins

Zone 2 (blocks 3 and 4) May 8, 2026

	Wall A (Standard Nutrients)	Wall B (Standard Nutrients)	Wall C (GLT Treatment)	Wall D (GLT Treatment)
Top Growth (sub-zone 1)	 May 8, 2026 at 12:51:56 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:03:11 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:21:36 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:15:38 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
Mid Growth (sub-zone 2)	 May 8, 2026 at 12:52:05 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:03:20 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:21:46 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:15:44 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
Bottom Growth (sub-zone 3)	 May 8, 2026 at 12:52:07 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:03:24 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:21:49 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:15:50 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
NOTES	Growth uniform for the most part	General uniform growth on both blocks, middle part on block 3 looks bigger, almost no necrosis on leaf margins	Both middle parts look bigger compared with top and bottom, necrosis on leaf margin mostly on middle part	Uniform growth on both top parts, a few samples in the bottom part of block 3 have more serious necrosis on leaf margins and look smaller than block 4

Zone 3 (blocks 5 and 6) May 8,2026

	Wall A (Standard Nutrients)	Wall B (Standard Nutrients)	Wall C (GLT Treatment)	Wall D (GLT Treatment)
Top Growth (sub-zone 1)	 May 8, 2026 at 1:52:20 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:03:54 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:22:09 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:16:11 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
Mid Growth (sub-zone 2)	 May 8, 2026 at 12:52:07 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:04:15 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:22:09 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:16:22 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
Bottom Growth (sub-zone 3)	 May 8, 2026 at 1:17:17 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:04:25 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:22:11 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:16:24 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
Notes	Little necrosis on leaf margins, full canopy	Minimal presence of necrosis on leaf margin in block 6 Block 5 looks bigger	Top part on block 5 looks bigger, necrosis on leaf margin mostly on middle and bottom part of both blocks	Samples on block 5 looks way smaller than block 6, block 6 does not have as much of leaf margin necrosis compared to block 5

ZONE 4 (blocks 7 and 8) May 8, 2026				
	Wall A (Standard Nutrients)	Wall B (Standard Nutrients)	Wall C (GLT Treatment)	Wall D (GLT Treatment)
Top Growth (sub-zone 1)	 May 8, 2026 at 12:53:13 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:04:53 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:22:21 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:16:38 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
Mid Growth (sub-zone 2)	 May 8, 2026 at 12:53:10 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:05:10 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:22:28 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:16:40 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
Bottom Growth (sub-zone 3)	 May 8, 2026 at 12:53:14 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:05:12 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:22:29 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College	 May 8, 2026 at 1:16:43 PM Olds Agricultural College Olds AB T4H 1R6 Canada Olds College
NOTES	Growth, less full of a canopy, necrosis on margins	General uniform growth on both middle and bottom part, top part of block B looks bigger Minimal samples with leaf margin necrosis	Middle and bottom part clearly smaller than top growth, necrosis on leaf margin on a few samples on both blocks	General uniform growth beside a few samples in the middle part of block B that looks way smaller than the rest, both blocks contain a few samples with leaf margin necrosis

Appendix C. Crop Vigor Rating

Crop Vigor Ratings	
Rating: 1-3 • Pale/light colouring of foliage • Stunted growth • Uneven growth • Necrosis/chlorosis present over 50% of foliage	
Ratings: 4-6 • Moderate vigor • Uneven colouring between older foliage and new • Minimal necrosis/chlorosis present	
Ratings: 7-9 • Strong vigor • Even/robust growth • Even dark green colouring in foliage	

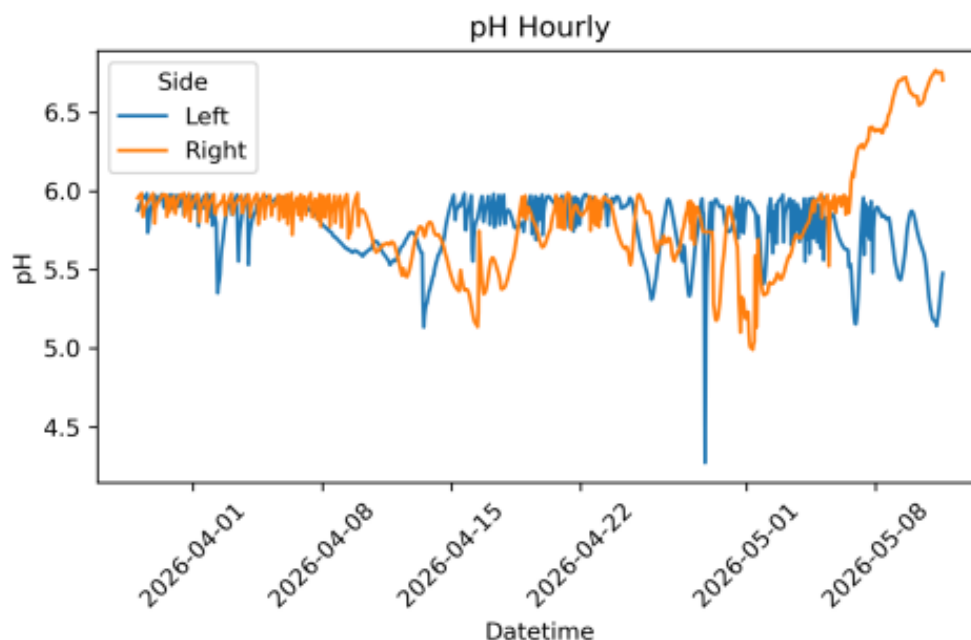
Appendix D. Environmental Statistical Analyst

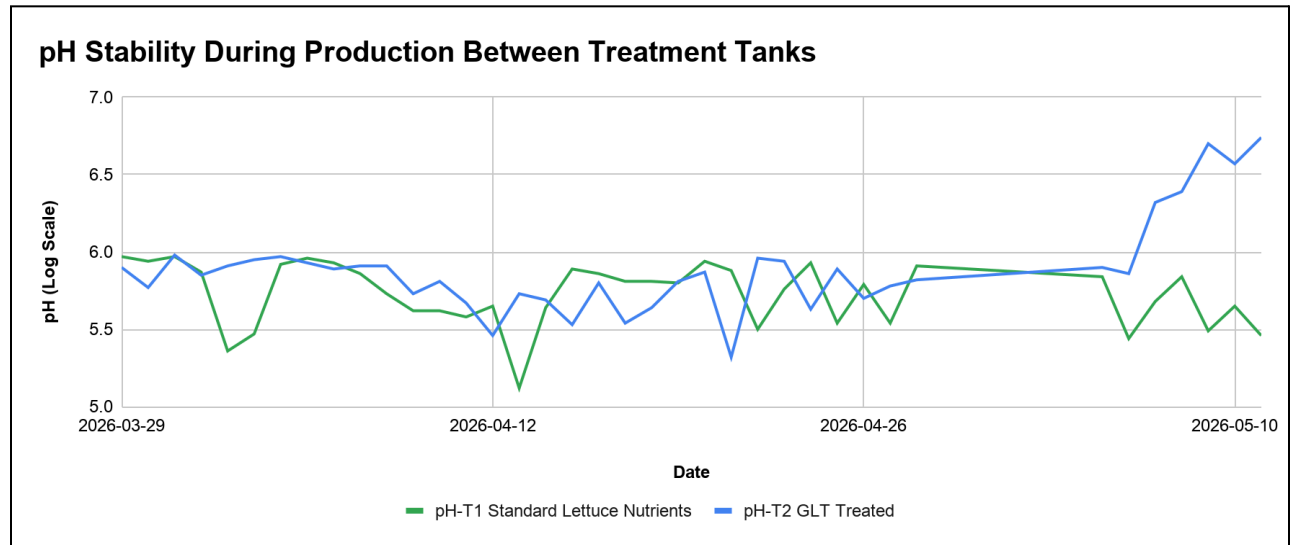
pH Stability

Hourly pH measurements collected between 29 March and 11 May 2026 were compared between the left and right sides of the system to evaluate the consistency of pH conditions over time. Across the entire study period, the average difference between sides was small (bias = 0.06 pH units), indicating that both sides maintained similar overall pH levels. Despite this similarity in average pH, individual measurements often differed between sides, resulting in a root mean square error (RMSE) of 0.43 pH units.

Correlation analysis revealed a weak negative relationship between sides ($r = -0.25$), suggesting that short-term fluctuations in pH on one side were not closely mirrored on the other side. Lagged correlation analysis (-6 to +6 hours) did not identify a meaningful delayed relationship between sides, as correlation values remained weak across all time lags. Occasional large deviations of up to approximately 2 pH units were observed, indicating that substantial short-term differences in pH could develop between sides despite their similar long-term averages. To further investigate changes in system behavior, the period following 3 May 2026 was analyzed separately. During this period, the average difference between sides increased substantially (bias = 0.54 pH units), indicating that one side consistently maintained higher pH values than the other. Measurement differences also became larger, with the RMSE increasing to 0.75 pH units. The relationship between sides strengthened during this later period, with a moderate negative correlation observed between pH measurements ($r = -0.48$, $p < 0.001$). This indicates that increases in pH on one side tended to coincide with decreases in pH on the opposite side. Compared with the full study period, the post-3 May results suggest that the two sides became increasingly separated in their pH behavior and exhibited more pronounced divergence over time.

Overall, the full-season analysis indicates that both sides maintained similar average pH conditions despite considerable short-term variability. However, the analysis of data collected after 3 May 2026 revealed a shift in behavior, characterized by larger and more consistent pH differences between sides. These findings suggest that pH conditions became increasingly different during the final portion of the study, despite remaining relatively similar when averaged across the entire experimental period.





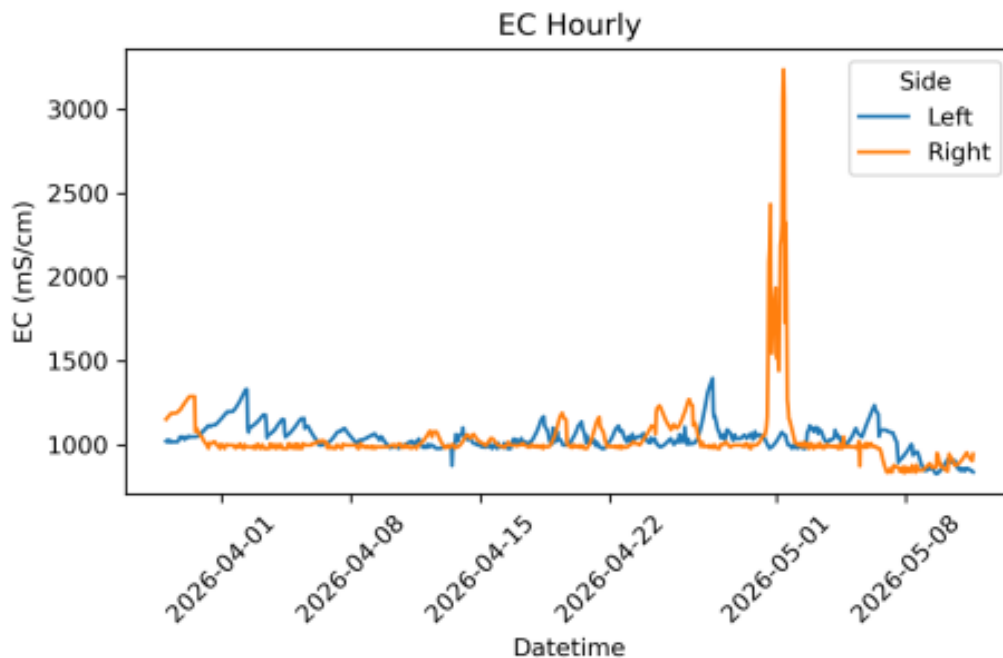
Electric Conductivity (EC)

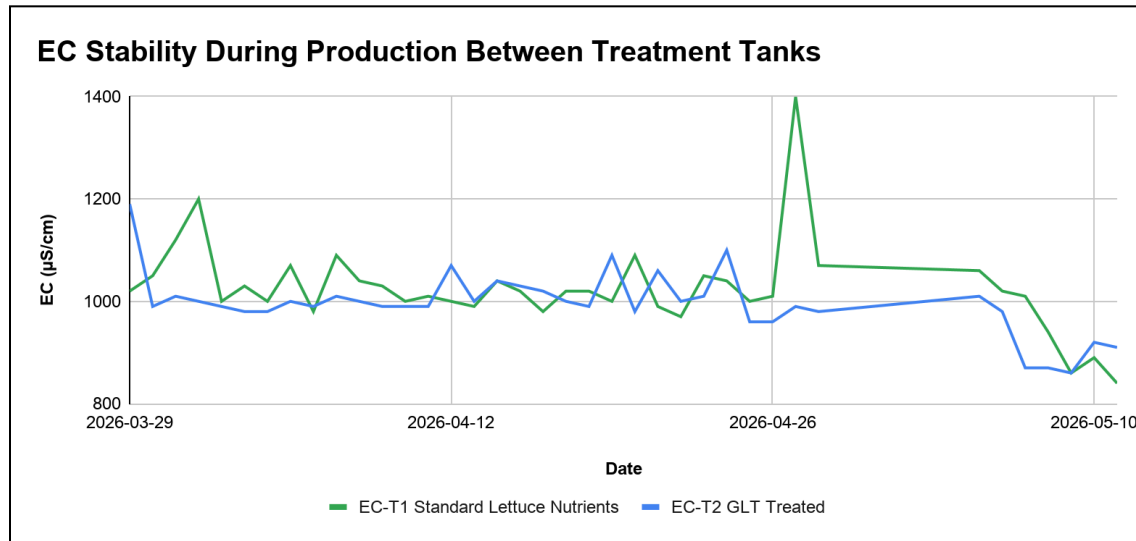
Electrical conductivity (EC) measurements were compared between the left and right sides of the system. The average difference between sides was relatively small (bias = -6.54), indicating that EC levels were generally similar between sides over the study period, with one side averaging approximately 6.5 EC units lower than the other. The root mean square error (RMSE) was 202.19, indicating that EC measurements at individual time points often differed substantially between sides. This suggests that while average EC conditions were comparable, short-term fluctuations and individual measurements could vary considerably. Correlation analysis revealed a moderate positive relationship between sides ($r = 0.57$, $p < 0.001$). This indicates that increases and decreases in EC on one side were

generally accompanied by similar changes on the opposite side. Although the relationship was not perfect, the two sides tended to follow similar overall EC trends throughout the study period.

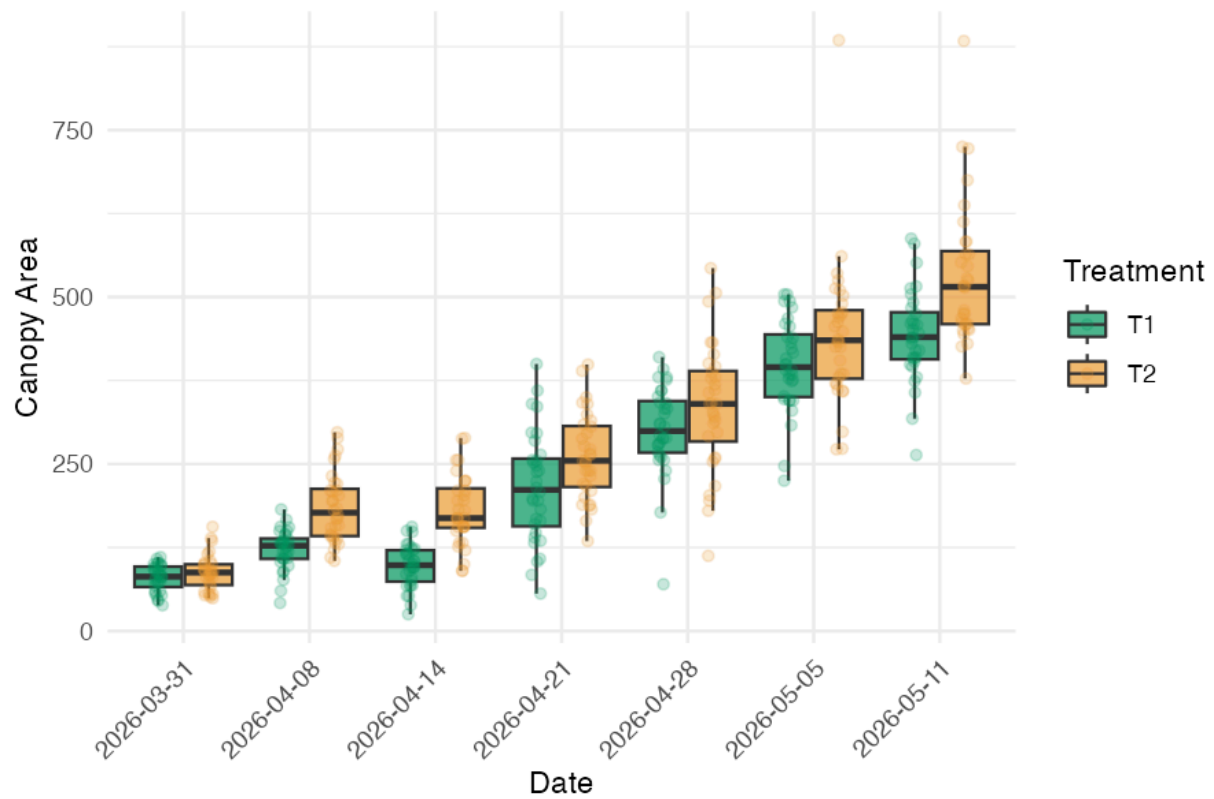
Overall, the results suggest that both sides maintained comparable average EC conditions and responded similarly over time. However, considerable variation existed at individual time points, resulting in large differences between sides on some occasions despite their shared overall trends.

NOTE: A big EC difference was observed from April 30th to May 1st. This can be closely looked at by zooming in on the interactive graph.

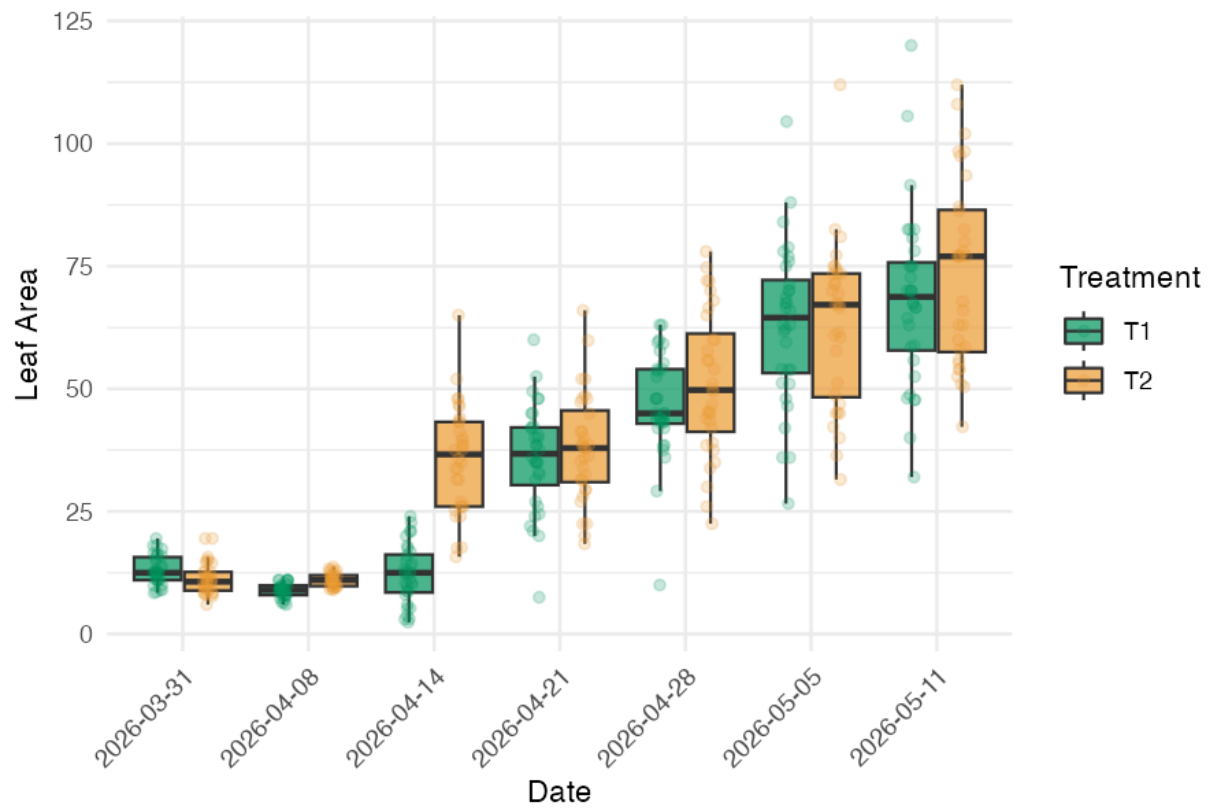




Appendix E. Canopy Area By Treatment



Appendix F. Leaf Area By Treatment



Appendix G. Canopy Area By Treatment

Figure 8.



Appendix H. Harvest Statistical Analysis

Harvest

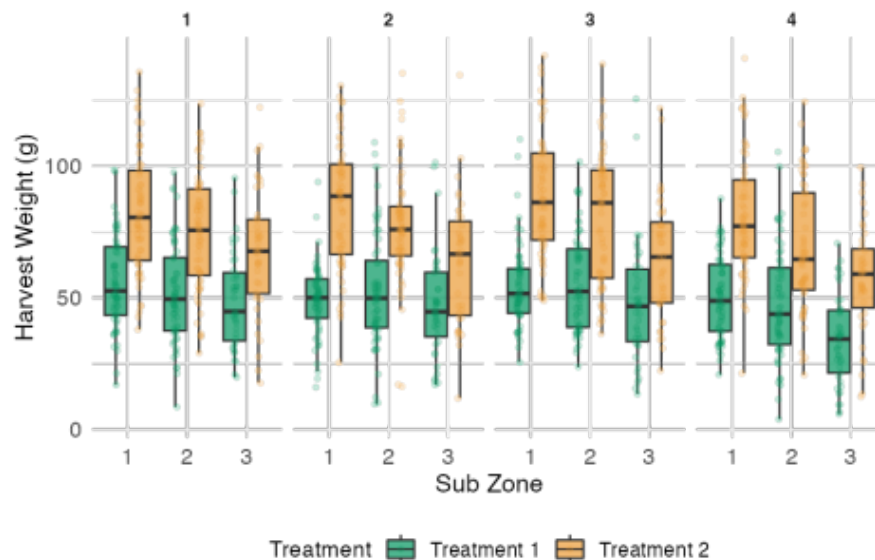
Pairwise comparisons were conducted between Treatment 1 and Treatment 2 within each Zone × Subzone combination to evaluate treatment effects on harvest weight. Across all zones and subzones, Treatment 2 consistently produced greater harvest weight than Treatment 1.

In Subzone 1, treatment differences were statistically significant in all four zones. Estimated differences ranged from 27.2 to 35.9 g, with large to very large effect sizes (Cohen's $d = 1.31$ – 1.73). The strongest treatment effect was observed in Zone 2 (difference = 35.9 g, $p = 0.0037$, $d = 1.73$), followed by Zone 3 (difference = 33.9 g, $p = 0.0044$, $d = 1.63$), Zone 4 (difference = 30.7 g, $p = 0.0066$, $d = 1.47$), and Zone 1 (difference = 27.2 g, $p = 0.0104$, $d = 1.31$).

In Subzone 2, treatment differences were also significant across all four zones. Estimated differences ranged from 20.8 to 24.9 g, with consistently large effect sizes (Cohen's $d = 1.00$ – 1.20). The largest effect occurred in Zone 2 (difference = 24.9 g, $p = 0.0144$, $d = 1.20$), followed by Zone 3 (difference = 24.5 g, $p = 0.0149$, $d = 1.18$), Zone 1 (difference = 22.9 g, $p = 0.0193$, $d = 1.10$), and Zone 4 (difference = 20.8 g, $p = 0.0266$, $d = 1.00$).

In Subzone 3, treatment differences were somewhat smaller but remained meaningful. Significant differences were observed in Zone 1 (difference = 18.1 g, $p = 0.0384$, $d = 0.87$) and Zone 4 (difference = 22.5 g, $p = 0.0168$, $d = 1.08$). Comparisons in Zone 2 (difference = 16.0 g, $p = 0.0588$, $d = 0.77$) and Zone 3 (difference = 16.3 g, $p = 0.0553$, $d = 0.78$) did not reach the conventional significance threshold of $p < 0.05$, although both exhibited moderate-to-large effect sizes.

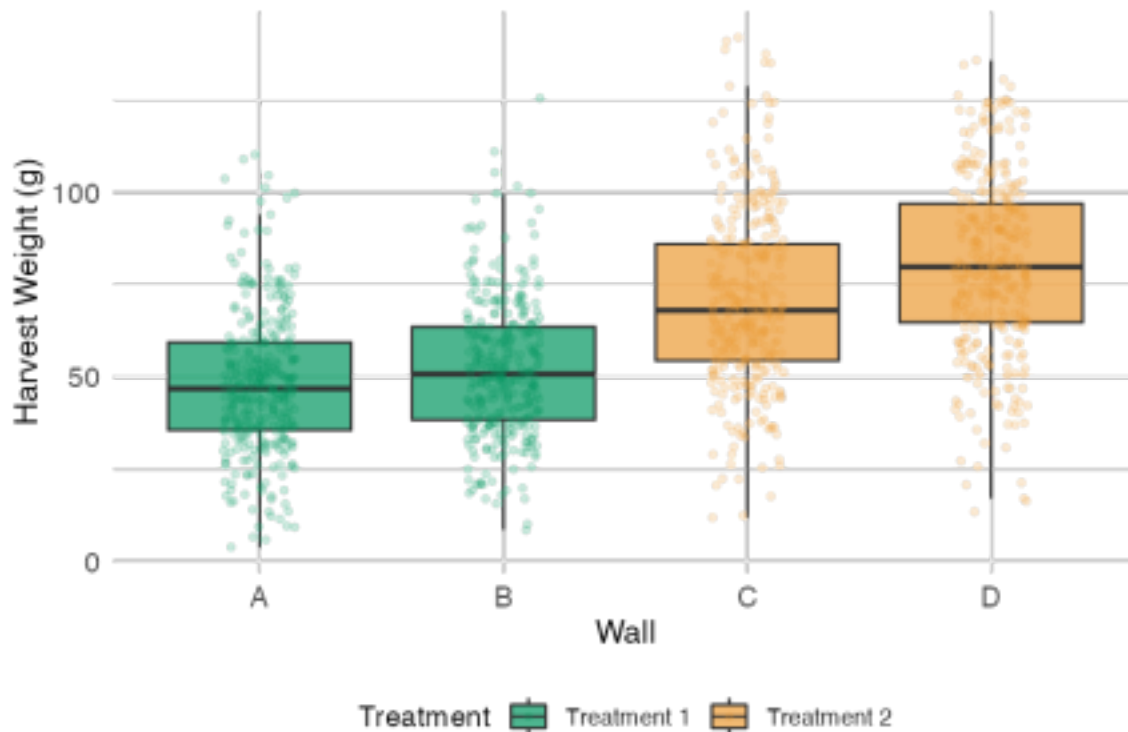
Overall, Treatment 2 produced greater harvest weight than Treatment 1 in every Zone × Subzone combination examined. The largest treatment responses occurred in Subzone 1, where effect sizes were consistently very large ($d > 1.3$). Treatment effects remained large in Subzone 2 and moderate-to-large in Subzone 3, indicating that the treatment effect was not only statistically significant in many comparisons but also substantial in magnitude across the growing area.



Harvest Between Wall

Estimated means were calculated for each wall after averaging across all zones and subzones. Mean harvest weight was 47.8 g in Wall A and 51.7 g in Wall B (Treatment 1), compared with 69.4 g in Wall C and 79.0 g in Wall D (Treatment 2).

Pairwise comparisons showed no significant difference between Walls A and B (difference = 3.9 g, $p = 0.083$). In contrast, both Treatment 2 walls produced significantly greater harvest weights than both Treatment 1 walls (all $p < 0.0001$). Within Treatment 2, Wall D produced significantly greater harvest weight than Wall C (difference = 9.7 g, $p < 0.0001$). Overall, harvest weight was consistently greater in walls receiving Treatment 2 than in walls receiving Treatment 1. Wall D had the highest average harvest weight (79.0 g), followed by Wall C (69.4 g), Wall B (51.7 g), and Wall A (47.8 g). Because treatment and wall were confounded, these differences should be interpreted primarily as treatment effects rather than true wall effects.



Appendix F. Standard Nutrient Detailed Tissue Sample Results

Report Number: C26142-50002
 Account Number: 05780

A & L Canada Laboratories Inc

2136 Jetstream Road, London, Ontario, N5V 3P5
 Telephone: (519) 457-2575 Fax: (519) 457-2664



Date Received: 2026-05-22 Date Reported: 2026-06-05

Date Printed: 2026-06-19

To: OLDS COLLEGE
 4500 50 ST.
 OLDS, AB T4H 1R6

PLANT ANALYSIS REPORT

For: ANGIE STOUTE

Sample ID: CEA1

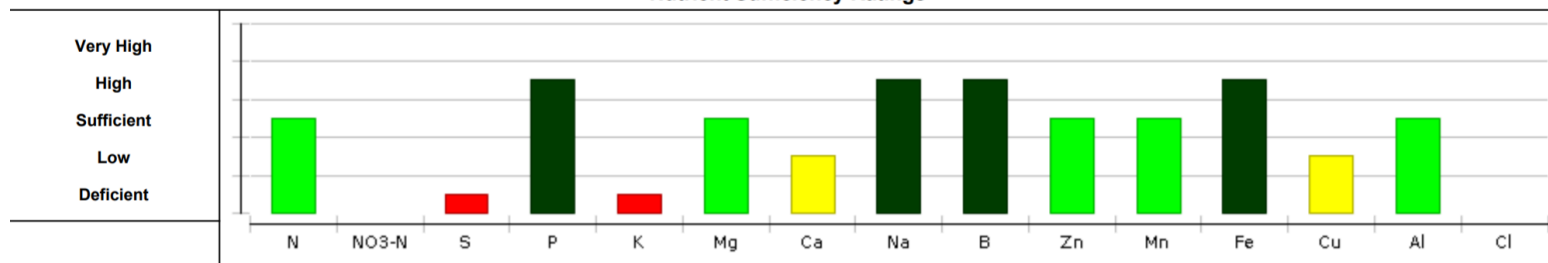
Attn: SMART AG RESEARCH

Field: CEA CONTAINER
 Farm: SMART FARM

Plant Type: Lettuce - Leaf
 Growth Stage: up to 8 leaf stage
 Plant Part: Oldest leaf

Date Sampled	Lab Number	Nitrogen (%)	Nitrate Nitrogen (%)	Sulfur (%)	Phosphorus (%)	Potassium (%)	Magnesium (%)	Calcium (%)	Sodium (%)	Boron (ppm)	Zinc (ppm)	Manganese (ppm)	Iron (ppm)	Copper (ppm)	Aluminum (ppm)	Chloride (%)
2026-05-21	1420011	4.63	0.2900	0.29	0.72	3.45	0.52	1.45	0.04	63.48	51	92	108	7.79	11	
Normal Range		4.50 5.50		0.49 1.00	0.45 0.60	6.49 9.00	0.49 1.00	1.90 3.00	0.03	24 50	24 250	14 250	49 100	9 25	300	
		N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Fe/Mn	Ca/B							
Actual Ratio		16.0	1.3	2.5	140	6.6	374	1.2	228							
Expected Ratio		6.7	0.6	0.7	39	10.3	585	0.5	667							

Nutrient Sufficiency Ratings



- These plants are deficient in POTASSIUM. Possible causes include low soil potassium levels, poor soil drainage, droughty soil conditions or compaction.
- These plants are low in CALCIUM. Possible causes include low soil calcium levels or low soil pH values.
- These plants are deficient in SULFUR. This could possibly be a result of low soil sulfur, poor root development or inadequate drainage.
- These plants are deficient in COPPER. Low copper availability may be caused by high soil organic matter or high soil pH.

Report Number: C26142-50002
 Account Number: 05780

A & L Canada Laboratories Inc

2136 Jetstream Road, London, Ontario, N5V 3P5
 Telephone: (519) 457-2575 Fax: (519) 457-2664



Date Received: 2026-05-22 Date Reported: 2026-06-05

Date Printed: 2026-06-19

PLANT ANALYSIS REPORT

To: OLDS COLLEGE
 4500 50 ST.
 OLDS, AB T4H 1R6

For: ANGIE STOUTE

Sample ID: CEA2

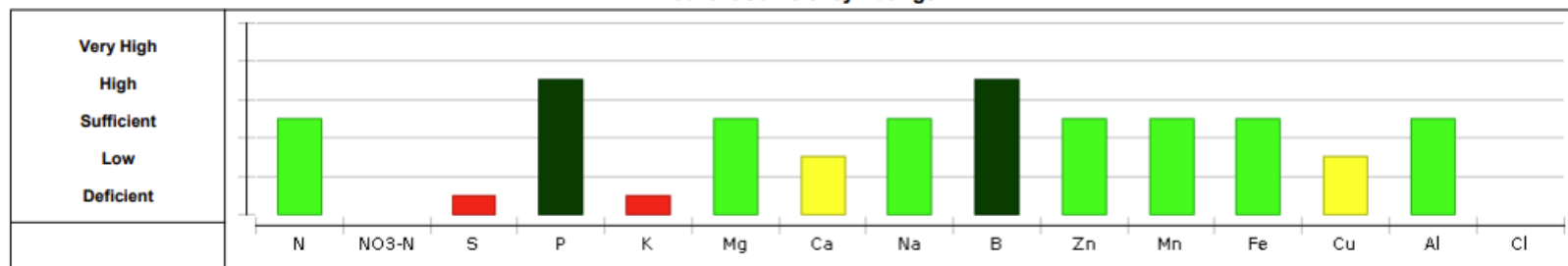
Field: CEA CONTAINER
 Farm: SMART FARM

Plant Type: Lettuce - Leaf
 Growth Stage: up to 8 leaf stage
 Plant Part: Oldest leaf

Attn: SMART AG RESEARCH

Date Sampled	Lab Number	Nitrogen (%)	Nitrate Nitrogen (%)	Sulfur (%)	Phosphorus (%)	Potassium (%)	Magnesium (%)	Calcium (%)	Sodium (%)	Boron (ppm)	Zinc (ppm)	Manganese (ppm)	Iron (ppm)	Copper (ppm)	Aluminum (ppm)	Chloride (%)
2026-05-21	1420012	4.87	0.2110	0.27	0.67	3.62	0.53	1.49	0.03	66.49	43	94	91	7.22	9	
Normal Range		4.50 5.50		0.49 1.00	0.45 0.60	6.49 9.00	0.49 1.00	1.90 3.00	0.03	24 50	24 250	14 250	49 100	9 25	300	
		N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Fe/Mn	Ca/B							
Actual Ratio		17.9	1.3	2.5	155	6.8	387	1.0	224							
Expected Ratio		6.7	0.6	0.7	39	10.3	585	0.5	667							

Nutrient Sufficiency Ratings



- These plants are deficient in POTASSIUM. Possible causes include low soil potassium levels, poor soil drainage, droughty soil conditions or compaction.
- These plants are low in CALCIUM. Possible causes include low soil calcium levels or low soil pH values.
- These plants are deficient in SULFUR. This could possibly be a result of low soil sulfur, poor root development or inadequate drainage.
- These plants are deficient in COPPER. Low copper availability may be caused by high soil organic matter or high soil pH.

Appendix G. GLT Detailed Tissue Sample Results

Report Number: C26142-50002
 Account Number: 05780

A & L Canada Laboratories Inc

2136 Jetstream Road, London, Ontario, N5V 3P5
 Telephone: (519) 457-2575 Fax: (519) 457-2664



Date Received: 2026-05-22 Date Reported: 2026-06-05

Date Printed: 2026-06-19

To: OLDS COLLEGE
 4500 50 ST.
 OLDS, AB T4H 1R6

For: ANGIE STOUTE

Sample ID: CEA_GLT1

Attn: SMART AG RESEARCH

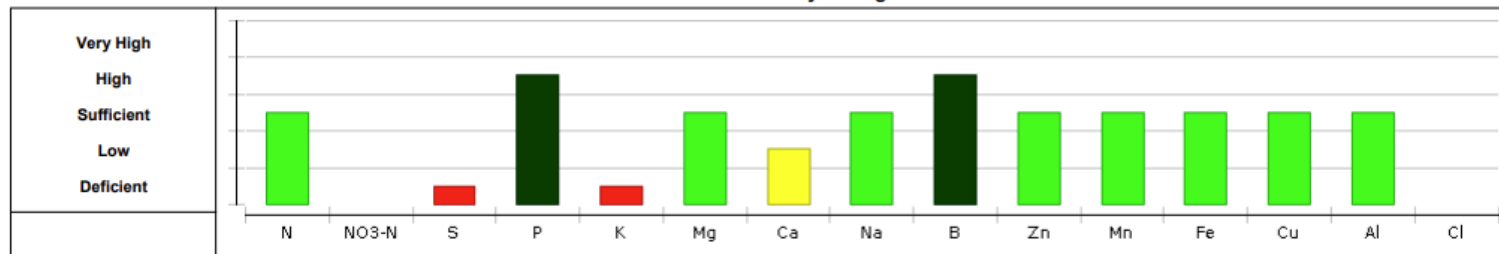
Field: CEA CONTAINER
 Farm: SMART FARM

Plant Type: Lettuce - Leaf
 Growth Stage: up to 8 leaf stage
 Plant Part: Oldest leaf

PLANT ANALYSIS REPORT

Date Sampled	Lab Number	Nitrogen (%)	Nitrate Nitrogen (%)	Sulfur (%)	Phosphorus (%)	Potassium (%)	Magnesium (%)	Calcium (%)	Sodium (%)	Boron (ppm)	Zinc (ppm)	Manganese (ppm)	Iron (ppm)	Copper (ppm)	Aluminum (ppm)	Chloride (%)
2026-05-21	1420013	5.27	0.9020	0.33	0.73	5.29	0.61	1.49	0.02	69.64	60	151	90	11.04	7	
Normal Range		4.50		0.49	0.45	6.49	0.49	1.90		24	24	14	49	9		
		5.50		1.00	0.60	9.00	1.00	3.00	0.03	50	250	250	100	25	300	
		N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Fe/Mn	Ca/B							
Actual Ratio		15.8	1.0	2.2	121	8.7	350	0.6	214							
Expected Ratio		6.7	0.6	0.7	39	10.3	585	0.5	667							

Nutrient Sufficiency Ratings



- These plants are deficient in POTASSIUM. Possible causes include low soil potassium levels, poor soil drainage, droughty soil conditions or compaction.
- These plants are low in CALCIUM. Possible causes include low soil calcium levels or low soil pH values.
- These plants are deficient in SULFUR. This could possibly be a result of low soil sulfur, poor root development or inadequate drainage.

Report Number: C26142-50002
 Account Number: 05780

A & L Canada Laboratories Inc

2136 Jetstream Road, London, Ontario, N5V 3P5
 Telephone: (519) 457-2575 Fax: (519) 457-2664



Date Received: 2026-05-22 Date Reported: 2026-06-05

Date Printed: 2026-06-19

PLANT ANALYSIS REPORT

To: OLDS COLLEGE
 4500 50 ST.
 OLDS, AB T4H 1R6

For: ANGIE STOUTE

Sample ID: CEA_GLT2

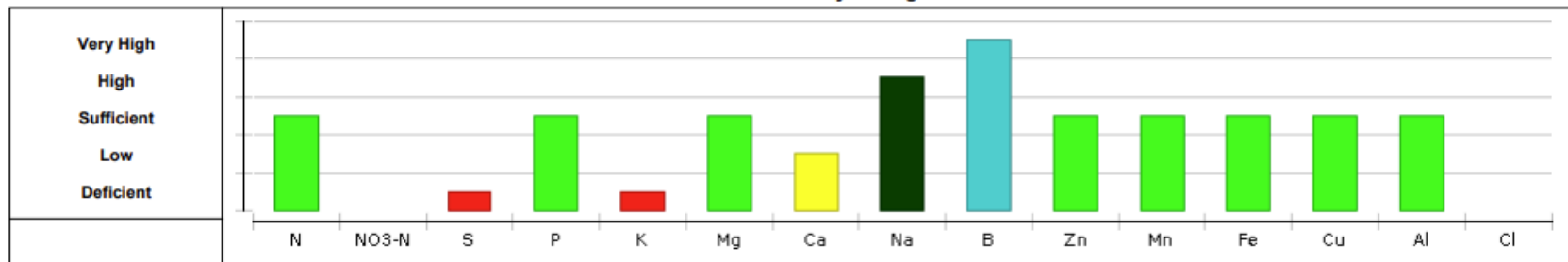
Attn: SMART AG RESEARCH

Field: CEA CONTAINER
 Farm: SMART FARM

Plant Type: Lettuce - Leaf
 Growth Stage: up to 8 leaf stage
 Plant Part: Oldest leaf

Date Sampled	Lab Number	Nitrogen (%)	Nitrate Nitrogen (%)	Sulfur (%)	Phosphorus (%)	Potassium (%)	Magnesium (%)	Calcium (%)	Sodium (%)	Boron (ppm)	Zinc (ppm)	Manganese (ppm)	Iron (ppm)	Copper (ppm)	Aluminum (ppm)	Chloride (%)
2026-05-21	1420014	4.76	0.5490	0.30	0.59	4.72	0.61	1.47	0.03	75.63	41	134	73	10.03	8	
Normal Range		4.50		0.49	0.45	6.49	0.49	1.90		24	24	14	49	9		
		5.50		1.00	0.60	9.00	1.00	3.00	0.03	50	250	250	100	25	300	
		N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Fe/Mn	Ca/B							
Actual Ratio		15.7	1.0	2.0	143	7.7	354	0.6	194							
Expected Ratio		6.7	0.6	0.7	39	10.3	585	0.5	667							

Nutrient Sufficiency Ratings



- These plants are deficient in POTASSIUM. Possible causes include low soil potassium levels, poor soil drainage, droughty soil conditions or compaction.
- These plants are low in CALCIUM. Possible causes include low soil calcium levels or low soil pH values.
- These plants are deficient in SULFUR. This could possibly be a result of low soil sulfur, poor root development or inadequate drainage.
- The very high level of BORON in this sample may be from contamination with a spray or dust.