California Agribusiness Executive Seminar

Controlled Environment Agriculture: Disruption in the California Leafy Greens Industry?

Don Goodwin
President/Owner
Golden Sun Marketing

Tom Thompson
Vice President/Owner
Golden Sun Marketing

Department of Agricultural and Resource Economics
University of California, Davis
https://agribusiness.ucdavis.edu/

University of California, Davis
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Tina L. Saitone, Editor and Faculty Director, California Agribusiness Executive Seminar
Juliet McNamara, Managing Editor, Assistant Director, California Agribusiness Executive Seminar
Joshua Bingham, Publication and Graphics Coordinator, ARE Outreach Coordinator

Ninety percent of the leafy greens consumed in the United States and Canada are grown outdoors in California and Arizona. In Monterey County, California, alone, leafy greens are the highest-value agricultural crop, representing $830 million in revenue in 2017 (Monterey County Crop Report, 2017). In the same year, leafy greens were planted on more than 60,000 of the county's 393,315 total acres dedicated to farmland. This crop alone fulfills about six months of the demand for both food service and retail in the U.S. and Canada. According to the Leafy Greens Marketing Association, the strong demand for and the high value of this crop have directly impacted the agricultural land values in the county.

The California leafy greens industry has faced a number of challenges in recent years. They include availability and cost of farm labor, increased government regulations, rapidly escalating trucking costs, and highly publicized product recalls.

On top of these mounting challenges looms a new competitive threat for the leafy greens industry in California in the form of Controlled Environment Agriculture (CEA) operations that are sprouting up in major metropolitan areas across the United States. Major investments in the space are coming from a number of private equity firms, as well as notable backers like Jeff Bezos, IKEA, and the crown prince of Dubai. The most recent farm bill has an allocation of funds to open the USDA Office of Urban Agricultural and Innovative Production. This is the first time the farm bill has allocated monies dedicated to indoor agriculture. While the exact number of CEA-based businesses currently in operation is not clear, some analysts are estimating that over 50 facilities are open or under construction across the United States. Many of these operations are located in the Midwest or Eastern United States in close proximity to densely populated areas. For example, Minnesota has four CEA operations growing leafy greens within one hour of Minneapolis, none of which existed five years ago.

This rapid expansion of CEA leafy greens operations has not been driven by the sudden availability of capital alone. The cost and effectiveness of light-emitting diode (LED) has improved significantly in recent years and is expected to continue to significantly outperform other lighting solutions, allowing for CEA operations to operate more efficiently with higher yields (Figure 1). Transportation costs have increased nearly 40 percent since 2002, driving up the delivered cost of California-grown leafy greens (Figure 2). These and other factors are driving the rapid expansion of CEA leafy greens operations across the United States. In 2018, only 5 percent of CEA operations were dedicated to supply leafy greens (Agrilyst, 2018), yet it is estimated that 65 percent of CEA expansion will be in the leafy greens category (USDA, 2014).

The purpose of this issue paper is to explore the opportunities and challenges facing the CEA leafy greens industry and the potential for CEA operations to disrupt the California leafy greens industry.

Challenges and Opportunities Facing CEA-Grown Leafy Greens

The CEA leafy greens industry faces both significant challenges and competitive advantages, when compared to the California leafy greens industry. CEA will likely have winners and losers as a steep learning curve confronts the players in their path to profitability. The potential success of CEA could have a significant impact on California leafy greens players and land values in Monterey County, other areas of California, and beyond.

Challenges Facing CEA Leafy Greens Operations

Challenge 1 – CEA operations are facing profitability challenges with nearly 50 percent of operations self-reporting that they have yet to reach profitability (Agrilyst, 2017). Players in this industry are focused on methods to maximize yields, automating to reduce labor, and finding the right balance of products to satisfy retail and food service demand. Some operations do not have founders or leaders with any produce-industry experience, which may be contributing to the delays in achieving efficiency and profitability.

Challenge 2 – Competition from national brand salad companies is fierce, with their experience at winning the business and the shelf space. Most bagged salad relationships between retailer and processor are contractual, with many containing substantial rebates and clauses to limit in-store competition. These national brand companies are very adept at maintaining shelf space and encouraging frequent promotions to help grow sales in the category. They have made substantial investment in new product development and are frequently launching new mixes, pack styles, and other value-added formulations.

Challenge 3 – With increasing pressure on reducing labor to drive profitability, CEA operations are turning to automation. The largest cost drivers in the labor category are harvesting and packing. Some CEA operations have built automation into their original build out, while others race to adapt current operations. The ability to automate and the cost to do so vary widely depending on the type of operation. The three most common operations—hydroponics, aeroponic, and aquaponics—all have different labor-saving automation solutions, depending on the configuration of the plant. The most advanced setups are able to automate from seeding to harvesting; affording them the ability to claim no human hand has touched your lettuce until you open it in your kitchen.

Challenge 4 – Overall yield and predictability of yield are significant challenges for CEA operations. Many industry participants report underestimating this challenge after opening their operation (Agrilyst, 2018). The vegetable seed industry has been slow to embrace this space as they try to understand not only the differences in temperature, humidity, and pest pressure but also the correct lighting protocol to maximize production. A few operations have become organically certified, creating additional challenges for plant breeders as they try to determine the correct formula for organic fertilizers.

Opportunities for CEA Leafy Greens Operations

Opportunity 1 – Consumers are seeking more locally grown foods as they express their values through their purchasing power. They are looking for foods that are sustainable and demonstrate transparency. CEA is well-positioned to capitalize on this trend, in comparison to the California growers, as they are often located in the communities they serve.

Opportunity 2 – Freight rates have escalated rapidly, affecting the delivered cost of California-grown product. Locations farthest from California enjoy the greatest freight advantage. Operations located on the East Coast are reporting a $6–8 per case freight advantage when compared to California-grown product. With newly implemented regulations restricting drivers and expected increases in fuel costs, freight rates are likely to continue to escalate in the near and longer term.

Opportunity 3 – Retail and food service buyers continue to seek simplified and streamlined supply chains. As their customers demand more locally sourced products, buyers are embracing the simplicity of buying leafy greens with one- to two-day lead times. This can be compared to four- to 10-day lead times for product being shipped from California. CEA buyers are reporting lower inventories, fresher product, and lower shrink

Opportunity 4 – From the spinach crisis of 2006 through the two romaine lettuce recalls in 2018 (Yuma and Central Coast), consumers' confidence in the safety of leafy greens has been waning and buyers are responding by seeking a supply chain with less risk. The cost of each of these recalls has exceeded $100 million across the industry. CEA operations are positioned to benefit from this shift in consumer confidence, as their operations appear to be safer sources of leafy greens.

Major Types of CEA Operations and Structures

CEA operators have to choose between various types of growing systems and structures. Key factors to consider include initial investment, product mix, yields of leafy green types, and overall operating costs.

Growing Systems

Hydroponics – Plants are grown in water as opposed to soil. Nutrients are fed through channels or pools to feed the plant roots.

Aeroponics – Plant roots are suspended in air and misted with a solution of nutrients.

Aquaponics – Aquatic species, mostly fish, are grown in tanks adjacent to a leafy greens growing operation. The biomass produced by the fish is used as nutrients for the leafy greens. Marketable crops include both fish and leafy greens. Interdependence exists between the production and sales rate of fish and success of the leafy greens segment.

Soil-Based – Plants are grown in soil and nutrients are typically applied through drip methods.

Growing Structures

Glass – A transparent and fully enclosed structure. Plants are grown using natural light, but may be supplemented with artificial light.

Indoor Farms – Fully enclosed and opaque facility. Plants are grown using 100 percent artificial light sources.

The most common type of growing system is hydroponics (49 percent), followed by soil-based (24 percent), aquaponics (15 percent) and aeroponics (6 percent). The most common structure is glass/poly (47 percent) followed by indoor vertical farm (30 percent) (Agrilyst, 2018). In comparing revenue per square foot, aquaponics ranked highest at $53.89 followed by indoor farms at $41.16, and hydroponics at $21.15 (Agrilyst, 2018).

A Look at the Minneapolis Market

In 2000, Minneapolis retailers primarily offered their consumers three national brand choices of value-added salads. Fresh Express and Dole were available in conventional form while Earthbound Farms was the primary organic brand in the market. A small amount of private label product was also available, conventionally grown by California companies. In the last 10 years, Taylor Farms, Ready Pac, and Organic Girl have gained market share with Minneapolis-based retailers as private label suppliers have also expanded in both conventional and organic offerings. Since 2014, six CEA operations growing leafy greens have gained distribution in the Minnesota market (Exhibit 1) (Exhibit 2). Of the six, the following three are the main players in the market.

Urban Organics – Based in St. Paul, Minnesota, Urban Organics is an indoor aquaponics operation serving the retail market with a range of leafy greens packed in 5-oz clamshells. All products are organically grown.

Revol Greens – Based in Medford, MN, Revol Greens is a 2-acre, highly automated, hydroponic grower of conventional leafy greens. They recently announced an expansion to 10 acres, focused on taking share from the conventionally grown leafy greens category. Their products are offered in 4.5-oz clamshells.

Gotham Greens – Gotham is a multi-location CEA operation growing conventional leafy greens. Their distribution in Minnesota comes through Whole Foods and is served out of Gotham's Chicago-area plant. They offer their products in 5-oz clamshells.

According to syndicated data from IRI, the Minnesota, Iowa, and Wisconsin markets have estimated sales of $252 million in the packaged salad category. The current production potential of the six CEA operations in this area is estimated at $73 million, which would reflect a 29 percent share of the three-state market. Local retailers (Exhibit 3) are reporting adding local CEA items while discontinuing some California-grown products. With the planned expansions of CEA growers in the Midwest, locally grown lettuce could conceivably capture a majority share of the retail market within five years in this three-state area.

Food Safety Implications of Leafy Greens Grown Indoors versus Outdoors

In 2018, consumers faced two well-publicized recalls of romaine lettuce. In the spring, a grower in Yuma, AZ, was identified as a potential source. Just before Thanksgiving, a second recall occurred that eventually implicated a grower in Central California. In both cases, the growers' water supply was identified as a likely source of contamination. It took weeks to sort this out. The media reported on it daily and the initial government statements said romaine, regardless of growing region, may not be safe to eat. No doubt, consumers were confused. Romaine growers everywhere lost sales, incurred costs, and endured difficulties in satisfying their retail and food service customers.

Both CEA growers and open-field growing and packing operations in the Western United States go through similar food-safety certifications. Yet, the risk profiles of the two types of operations are vastly different. CEAs have lower potential contamination from land animals or birds. Their water source is more controlled and frequently tested. CEAs have indoor harvesting operations affording them greater ability to control the work environment, when compared to outdoor operations.

In some cases, CEAs have been able to automate their harvest operation fully, eliminating any human contact throughout the growing or harvesting process. An advantage Western growers have is that they wash their product as many as three times before shipping. Most CEA growers harvest directly into the shipping container with no wash step. The stark differences between the two types of growing and packing operations raise several potentially game-changing implications.

The Growing Opposition to Organic Certification for CEA Farms

Within the last year, organizations such as the Organic Trade Association and Center for Food Safety have come out against allowing produce that is not grown in soil to gain organic certification. Opponents contend that one of the key pillars of an organic certification is providing for a regenerative process to improve soil health. The Real Organic Project was started by a group of farmers who wanted to create a higher level of organic certification that includes assuring that soil health is intact. Most consumers who purchase organic products however, do so to avoid ingesting pesticides and have limited or no information or interest in soil health.

Because of the highly controlled environments, CEA growers naturally use fewer, if any, pesticides. Many CEA growers would consider eliminating the use of synthetic fertilizers if organic certification were possible. Some indoor growers have lamented that this move to “real organic” is nothing more than a protectionist move to limit competition. One has to wonder if the “real organic” movement will just confuse the consumer while providing little incentive for consumers to switch from conventionally grown product. Focusing on organics will likely continue to be challenging for CEA operations.

Marketing Value-Added Salad

The national brands offer little to no consumer marketing or brand building beyond slotting fees, merchandising support, off-invoice allowances, and rebates to encourage their customers to advertise the category. Over the years, the salad category has become ultra-competitive with thinning margins, and any real funds for brand development nearly eliminated. Slotting allowances and rebates have become a significant profit margin to the retailer.

The marketing of CEA operations has taken two paths. Revol Greens was launched in 2018 by two former Bushel Boy tomato executives and a former Target Corporation executive in Medford, MN, where they built a 2-acre greenhouse that is highly automated, grows crops conventionally, and offers their products in clamshells. Their primary competition is the national brand supplier. Beyond some local public relations, their marketing strategy has mostly focused on price promotions (e.g., coupons and trade allowances) as well as a strong social media presence. They also have provided demos and partnerships with companies such as Salad Girl, a local Minnesota salad dressing company. They recently announced a plan to expand their growing operation from 2 to 10 acres. Their focus will be on high volume and lowering their production costs per package. They are positioning themselves to take a leadership place in the market against conventionally grown national brands.

Urban Organics has taken an approach similar to a successful local craft brewery. They have been deliberate in building their story and their brand, focusing on high-profile partnerships, strong public relations, and "meet the maker" demos at local stores. You can find their branded greens at local medical clinics and in the cafeteria of a local hospital system, where messaging on Urban Organics' story is shared with patients and consumers via serving trays and tabletop signage. Urban Organics offers varieties grown exclusively for a handful of Minneapolis-area restaurants, including Spoon and Stable, a James Beard award-winning restaurant.

Buyers Seek Simplicity and Reliability

As retail becomes more competitive and in some ways more complex, retail buyers are seeking simplicity. They are being challenged to reduce shrink and improve in-stocks while maintaining broad assortments. CEA operations offer a significant competitive advantage, as they are often located within 1–4 hours of a retailer's warehouse. This affords the retailer the opportunity to order with just 1–2 days lead time, lower inventory levels, and improve freshness. Rick Steigerwald, Senior VP of Perishables of Lunds Food Holdings, Inc, stated it this way. "We can get product in 24 hours. This is meaningful to us. Our California product requires a seven-day lead time. We can be more precise with orders and maintain lower inventory. This has led to lower shrink levels." (Exhibit 4)

Seed Industry Opportunity

The vegetable breeding industry has long focused on open field production. Vegetable breeders work on challenges like disease resistance, adaptability to a wide range of growing areas, and performance at varying temperatures. Many, not all, of these issues are eliminated or significantly minimized when growing indoors. The pipeline to develop new varieties can be 5–15 years, depending on species. As the indoor agricultural space explodes in North America, seed breeders are scrambling to play catch-up.

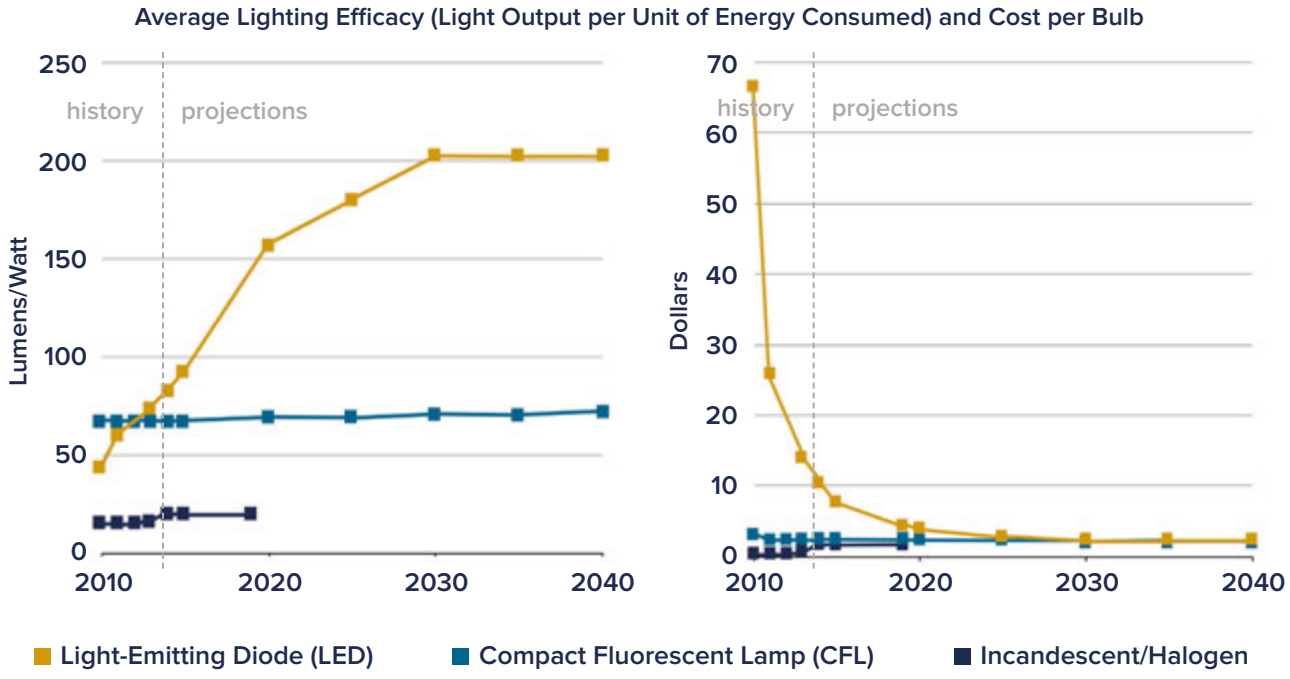
Two of the highest-volume leafy greens are romaine and spinach, which are both used widely in food service and retail. Each item presents unique challenges when grown indoors. When romaine is grown indoors, it tends to be smaller with a softer texture when compared to open field production. Spinach is susceptible to downy mildew in this high-humidity environment. Breeders will undoubtedly solve these challenges, which will expand the potential of CEA-grown leafy greens significantly.

Summary and Discussion Questions

CEA-grown leafy greens production is expanding rapidly across the United States. While profitability challenges remain a paramount concern and challenge, it appears consumer trends, the rising costs of California-based agricultural production, increasing transportation costs, and significant investments in the CEA space will position indoor growers to capture notable market share of the leafy greens market in some areas of the United States. The shift in the industry brings to light a number of questions:

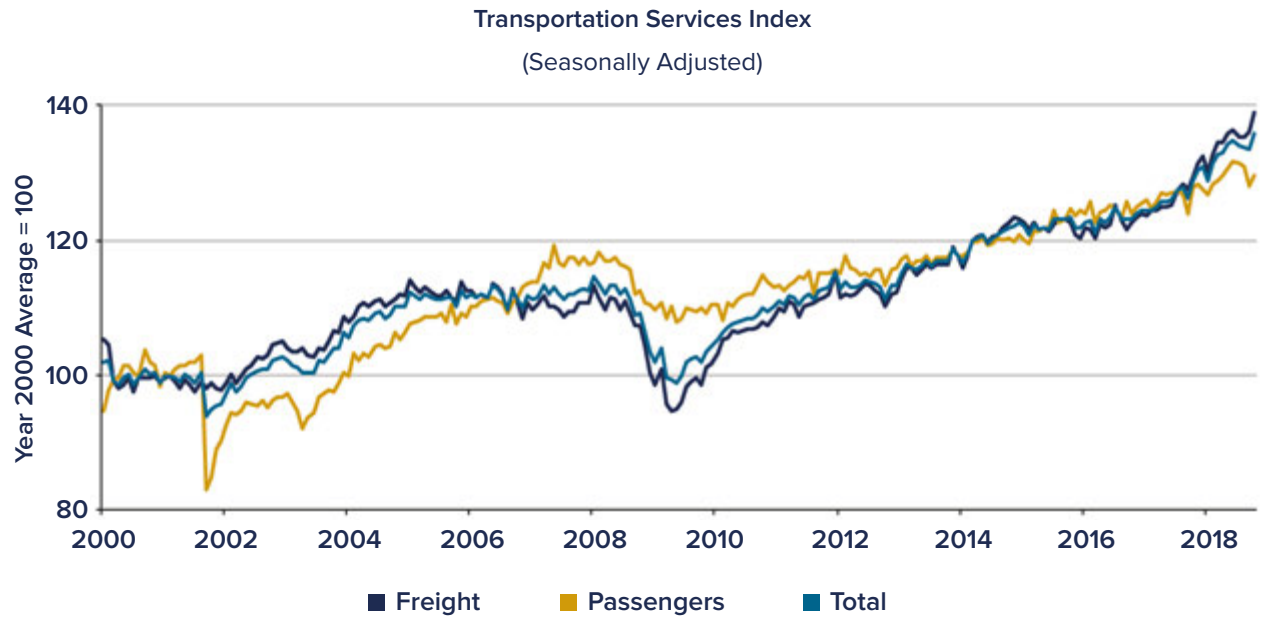
1. Which CEA models will thrive?
2. In the future, will most processing plants have some type of CEA operation adjacent to their facility?
3. Will retailers vertically integrate on a large scale by opening their own CEA operations?
4. Is the CEA movement just a blip on the competitive radar, or will it truly disrupt the California leafy greens industry and capture a notable market share of the leafy greens category?
5. Will consumer demand for local or food safety concerns be more of the driving force behind the growth of CEA?
6. What is the long-term impact on land values in Monterey County, California?

FIGURE 1. LED Efficacy and Cost



Source: U.S. Energy Information Administration, Annual Energy Outlook 2014 Early Release

FIGURE 2. Transportation Costs



Source: 2018 Bureau of Transportation Statistics

EXHIBIT 1. Midwest Value-Added Salad Players

Conventionally Grown National Brands	Organically Grown National Brands	CEA Grown — Conventional	CEA Grown – Organic
Dole Powering You! Fresh Express Taylor Farms Ready Pac foods Private Label	Earthbound Farm Organic organicgirl good clean greens Dole Powering You! Fresh Express Private Label	REVOL Greens Gotham Greens Local Produce Future Farm Grown Living Greens Farm	urban organics Superior Fresh

EXHIBIT 2. Midwest CEA Value-Added Salad Companies

	Background	Method	Size	Model
FUTURE FARM GROWN	Founded in 2010 in Baldwin, WI	Conventional	27,000 sq. ft.	Low-tech hydroponic greenhouse
LIVING GREENS FARM	Founded in 2015 in Faribault, MN	Conventional	45,000 sq. ft.	Indoor aeroponic vertical farm
REVOL GREENS	Founded in 2017 in Medford, MN	Conventional	108,900 sq. ft.	High-tech hydroponic greenhouse
SUPERIOR fresh	Founded in 2017 in Hixton, WI	Organic	123,000 sq. ft.	High-tech aquaponic greenhouse
urban organics	Founded in 2014 in St. Paul, MN	Organic	87,000 sq. ft.	Indoor aquaponic vertical farm

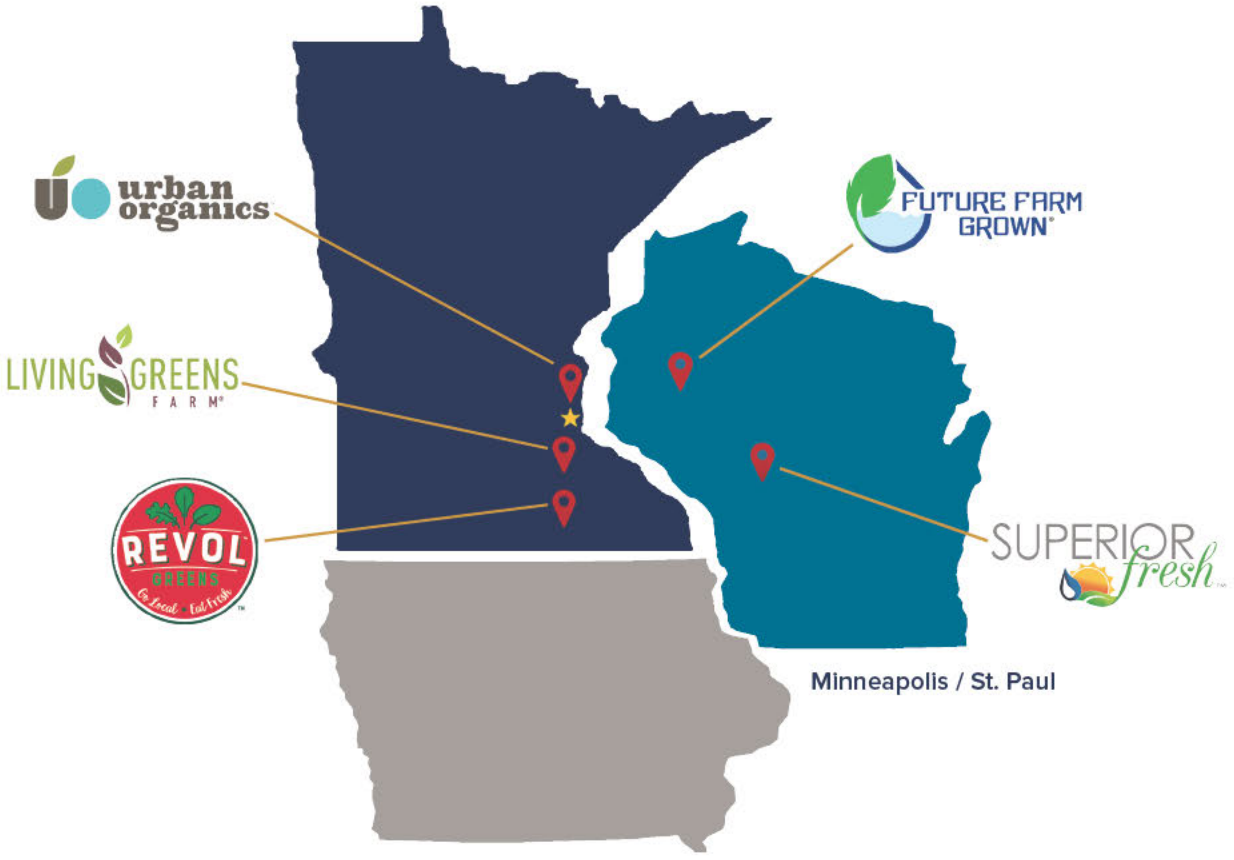


EXHIBIT 3. A Retailer's Perspective

An interview with Rick Steigerwald, Sr. VP of Perishables, of Lunds Food Holdings, Inc.

Lunds and Byerlys operate 27 upscale stores in the Minneapolis-St. Paul market. We spoke to Rick Steigerwald, Senior Vice President of Perishables, and got some insights on CEA growers and their ability to deliver sustainable food practices to the local community.

Don: How long have you been carrying products from CEA growers in the leafy greens space?

Rick: We started carrying our first local brand in 2014 and now we have multiple brands on the shelf.

Don: Why do you buy from these growers?

Rick: A number of reasons. We love that they are local, focused on sustainability, as well as grow organically in some cases.

Don: How is their quality?

Rick: We find it be equal to or better than the national brands that we buy.

Don: How about their pricing?

Rick: Most of the local players are competitive with our California suppliers.

Don: Most importantly, how are they selling?

Rick: Very well. On like items, products sell at an equal rate to the national brand.

Don: I noticed that your local lettuces are not displayed adjacent to the national brands. Is there a specific reason behind that decision?

Rick: Yes! We wanted to separate our prewashed lettuces from the non-washed. The local lettuce companies do not take their product through a wash step. We also wanted to emphasize our selection of local lettuces. We thought a separate section would help us do that.

Don: How do you market the product to your customers?

Rick: We work closely with the founders of these companies. We love when they come to our stores and conduct "meet the maker" demos. We also like to tell their story in our social marketing and through ads.

Don: Is there anything else you want to share?

Rick: We can get the product in 24 hours. This is meaningful to us. Our California product requires a seven-day lead-time. We can be more precise with orders and maintain a lower inventory. This has led to lower shrink levels.

Don: Thanks, Rick!

EXHIBIT 4. Supply Chain Life Cycle Comparison of Urban Organics versus Open Field Farms

Retail Order Lead Time

5 Days Less

Transportation

4 Days Less

Shelf Life

+50 Percent Improvement

	Conventional Farming	Urban Organics
Grow Cycle	45 days	21 days
Order	7 days out	2 days out
Harvest / Processing	2 days	1 day
Transit	4 days	< 1 hour
Average Shelf Life	12 days	18 days