Environmental Parameters

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Plant Requirements

Let's think about what plants need to grow:

All these requirements are provided in a controlled indoor environment, like Growcer's modular farm.

- light
- water
- space
- air (CO_2)
- nutrients
- time
- temperature

Controlled Environment Agriculture

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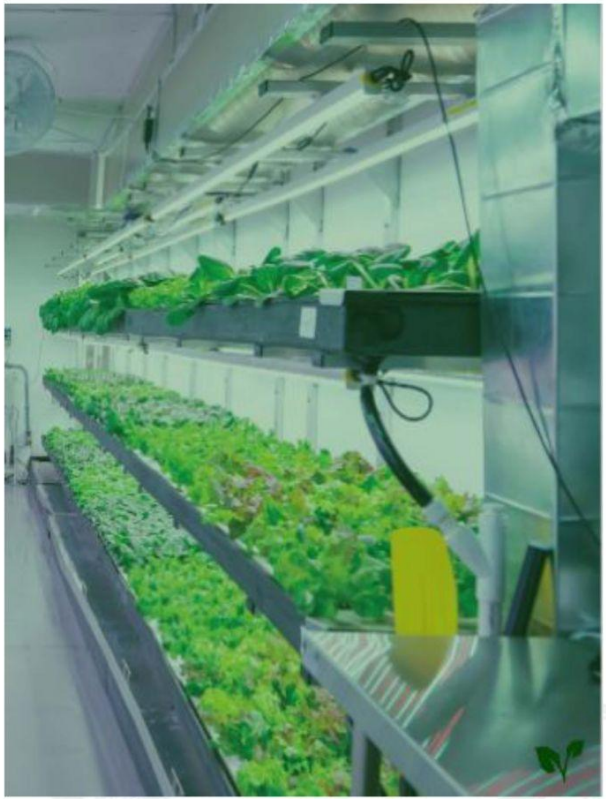
Growcer farms have the capacity to maintain optimal growing conditions to produce high quality produce.

Important environmental conditions to consider for growing:

- Temperature
- Relative Humidity (RH) or Vapour Pressure Deficit (VPD)
- Light intensity and quality
- Airflow
- Carbon dioxide (CO_2) concentration
- Dissolved oxygen
- Nutrition - more on this in the next section!

Hydroponic Pro:
Environment can be optimized for groups of plants so they can grow their best!



Temperature

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What is the role of temperature in CEA:

Staying within a certain temperature range is crucial for plant physiological processes such as photosynthesis (creating food/energy), respiration (breathing), germination (growth from seed), and more.

If its too high or too low:

Plant health and growth is affected and you may see plant stunting or flowering (bolting), or not even start germinating.

Range we maintain:

18-22°C

Relative Humidity

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What is the role of humidity in CEA:

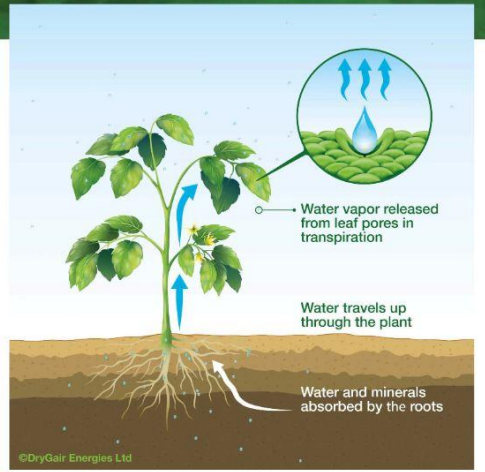
Humidity is crucial for the plant process of transpiration (water movement)- which affects water and nutrient uptake (immobile nutrients).

If its too high or too low:

Too little humidity can lead to slower crop growth, poor leaf development, and a greater risk of dehydration and heat stress. Whereas, if too high, conditions like edema may be present. Inconsistent humidity levels can leave plants more susceptible to pathogens & pests.

Range we maintain:

55-75% RH



Source

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Vapour Pressure Deficit (VPD)

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What is the role of VPD in CEA:

VPD measures the difference between the moisture in the air and the moisture that is required to completely saturate the air. Plants require the flow of water from roots to shoots and then to release water in the process of transpiration.

If its too high or too low:

Plant transpiration may be slowed down or sped up and plants will not receive the same benefits

Range we maintain:

0.8-1.1 kPa (20C/65%RH)

Perfect Grower Vapor Pressure Deficit Recommendations (kPa)

TEMPERATURE		Relative Humidity													
°C	°F	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
15	59	1.11	1.02	0.94	0.85	0.77	0.68	0.60	0.51	0.43	0.34	0.26	0.17	0.09	0
16	61	1.18	1.09	1.00	0.91	0.82	0.73	0.64	0.55	0.45	0.36	0.27	0.18	0.09	0
17	63	1.26	1.16	1.06	0.97	0.87	0.77	0.68	0.58	0.48	0.39	0.29	0.19	0.10	0
18	64	1.34	1.24	1.13	1.03	0.93	0.83	0.72	0.62	0.52	0.41	0.31	0.21	0.10	0
19	66	1.43	1.32	1.21	1.10	0.99	0.88	0.77	0.66	0.55	0.44	0.33	0.22	0.11	0
20	68	1.52	1.40	1.29	1.17	1.05	0.93	0.82	0.70	0.58	0.47	0.35	0.23	0.12	0
21	70	1.62	1.49	1.37	1.24	1.12	0.99	0.87	0.75	0.62	0.50	0.37	0.25	0.12	0
22	72	1.72	1.59	1.45	1.32	1.19	1.06	0.92	0.79	0.66	0.53	0.40	0.26	0.13	0
23	73	1.82	1.68	1.54	1.40	1.26	1.12	0.98	0.84	0.70	0.56	0.42	0.28	0.14	0
24	75	1.94	1.79	1.64	1.49	1.34	1.19	1.04	0.89	0.75	0.60	0.45	0.30	0.15	0
25	77	2.06	1.90	1.74	1.58	1.42	1.27	1.11	0.95	0.79	0.63	0.47	0.32	0.16	0
26	79	2.18	2.02	1.85	1.68	1.51	1.34	1.18	1.01	0.84	0.67	0.50	0.34	0.17	0
27	81	2.32	2.14	1.96	1.78	1.60	1.43	1.25	1.07	0.89	0.71	0.53	0.36	0.18	0
28	82	2.46	2.27	2.08	1.89	1.70	1.51	1.32	1.13	0.94	0.76	0.57	0.38	0.19	0
29	84	2.60	2.40	2.20	2.00	1.80	1.60	1.40	1.20	1.00	0.80	0.60	0.40	0.20	0
30	86	2.76	2.54	2.33	2.12	1.91	1.70	1.48	1.27	1.06	0.85	0.64	0.42	0.21	0
31	88	2.92	2.69	2.47	2.24	2.02	1.80	1.57	1.35	1.12	0.90	0.67	0.45	0.22	0
32	90	3.09	2.85	2.61	2.38	2.14	1.90	1.66	1.43	1.19	0.95	0.71	0.48	0.24	0
33	91	3.27	3.02	2.76	2.51	2.26	2.01	1.76	1.51	1.26	1.01	0.75	0.50	0.25	0
34	93	3.46	3.19	2.92	2.66	2.39	2.13	1.86	1.59	1.33	1.06	0.80	0.53	0.27	0
35	95	3.65	3.37	3.09	2.81	2.53	2.25	1.97	1.69	1.40	1.12	0.84	0.56	0.28	0

Source: www.perfectgrower.com

Light

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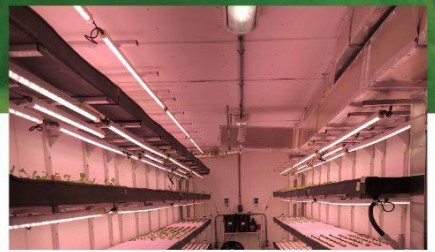
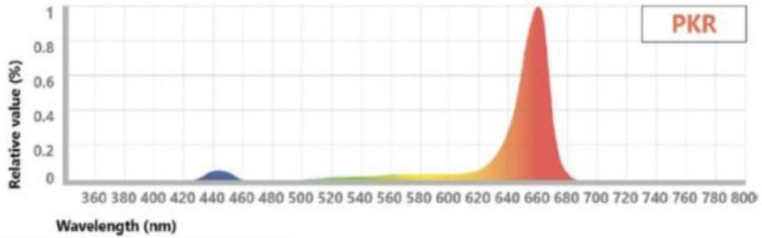


What is the role of light in CEA:

Light of certain wavelengths are vital for regulating plant processes such as photosynthesis (creating food/energy) and initiating different types of growth.

If its too high or too low:

Plants may have stunted growth, become 'leggy', or dry out. To optimize yield, the photosynthetic photon flux density (PPFD) is carefully controlled and tailored to the specific needs of the plants.



Range we maintain:

320 PPFD for 18 hours

Hydroponic Pro:
We can select and provide the wavelengths of light that are most useful to plants with LEDs

Airflow

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What is the role of light in CEA:

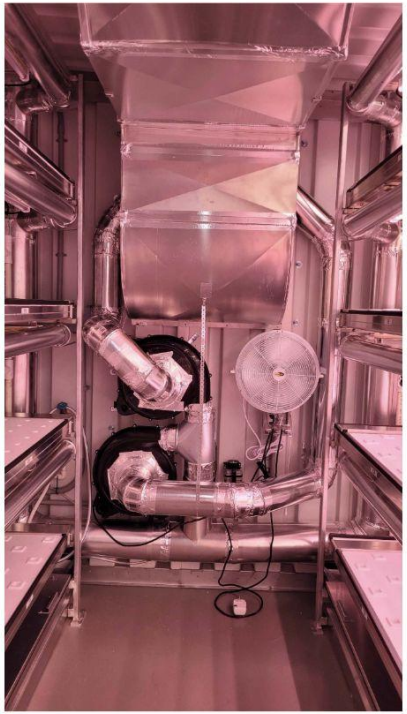
Allows for proper air mixing, ensuring that the temperature and humidity is consistent for all plants. Greatly aids with transpiration by reducing the leaf's boundary layer resistance. To do this, we use our patented VAF system.

If its too high or too low:

Temperature or humidity pockets may be created, causing inconsistent plant growth and making plants susceptible to pests/pathogens and tipburn. Too much airflow can physically damage plants.

Range we maintain:

0.3-1.2 m/s



Source: hortamericas.com

Source: scienceinhydroponics.com

Carbon Dioxide

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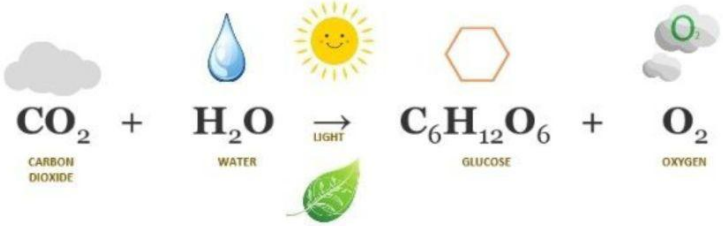
What is the role of light in CEA:

As an important ingredient for photosynthesis (creating food/energy), carbon dioxide (CO_2) must be present in the air.



Source

If its too high or too low:

If too high, it can pose a hazard to worker health. If too low, the rate of photosynthesis and thus plant growth may be slower.

Range we maintain:

Ambient CO_2 concentration (around 420 ppm)

Dissolved Oxygen

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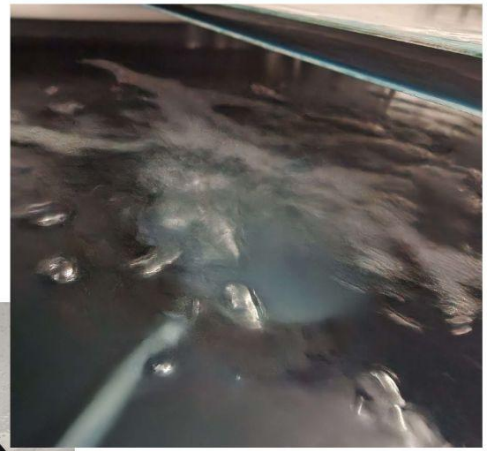
What is the role of light in CEA:

Oxygen dissolved in water must be available to plants for plant respiration (breathing), root health and nutrient uptake.



If its too high or too low:

If too high, can damage plant roots and thus produce unhealthy plants. If too low plant growth will be slower and nutrient deficiencies could appear, as well as pathogens.

Range we maintain:

6-8 ppm

Summary Environmental Conditions

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Environmental	Range
Temperature	18-22°C
Relative Humidity	55-75% RH
Light amount	20.7 mol/day
Canopy airflow	0.3-1.2 m/s
CO2 supply	Ambient
Oxygen	6-8ppm

Each crop has its own specific optimal environmental conditions

Herbs, like basil, like **higher temperatures,** whereas **leafy greens,** like spinach, need **lower temperatures**. **Lettuces** are somewhere **in between**.

The conditions here have been vigorously tested and found to be working great for growing most plants with great yields **together**!

Summary - Environmental Parameters

- The environmental conditions we monitor need to stay within a certain range since they are crucial for plant processes.
- Optimal environmental conditions are plant specific.
- Symptoms like increased pest pressure, longer time to maturity, bolting, or changes in appearance, texture or taste may indicate the environment is less than ideal.