Strawberry Production in Controlled Environments – Optimizing CO_2 to Enhance Yield and Fruit Quality

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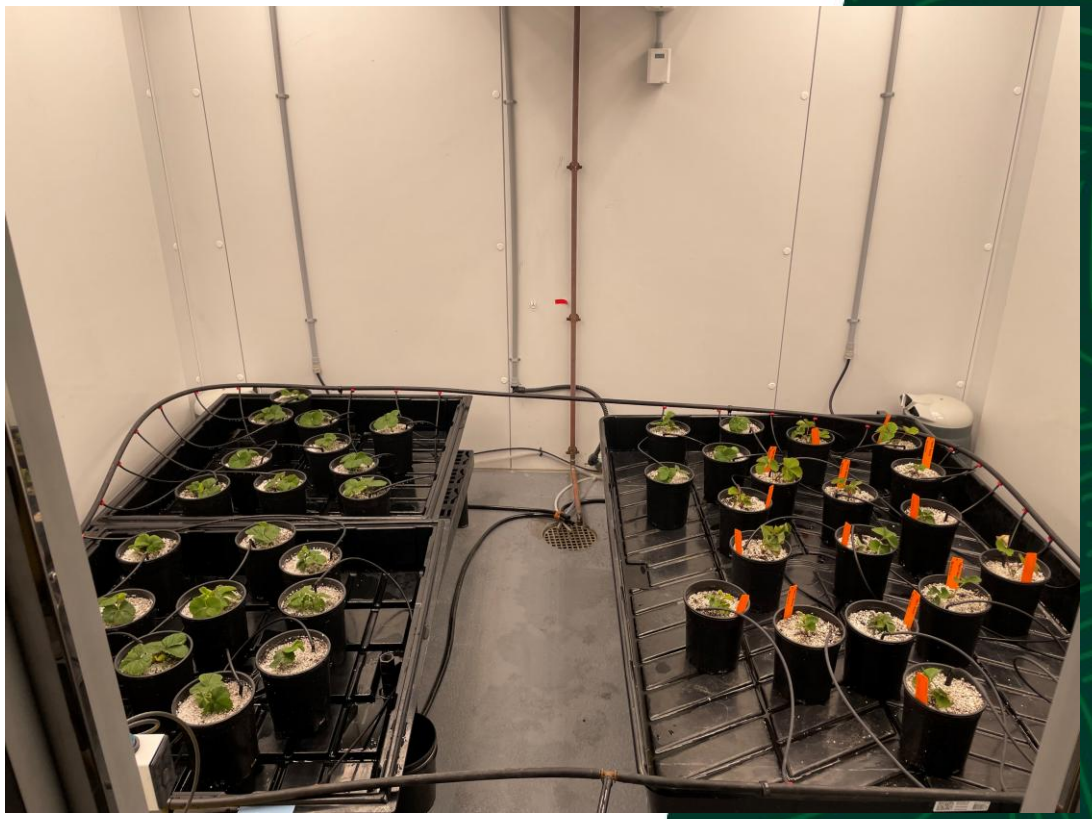

Carbon Dioxide (CO_2) Enrichment in CEA

- CO_2 is necessary for photosynthesis
- CO_2 drawdown in CEA can stunt plant growth
- Benefits have been observed when enriching CO_2 over what is normally found in the ambient air (>419 parts per million)

Top Left: Petunia grown at 450 ppm CO_2

Bottom Left: Petunia grown at 900 ppm CO_2

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Strawberries

- Top consumed and produced berry in the U.S.
- Demand has increased interest in CEA production
- CO_2 enrichment has shown increased yields and value-added qualities

Limited information is available regarding crop-specific CO_2 optimization, particularly for emerging CEA crops like strawberry.

Objective 1: Develop and disseminate specific CO_2 protocols for controlled environment production of everbearing strawberries that will enhance yield and fruit quality.

Objective 2: Coordinate and lead educational activities that promote interest and engagement in controlled environment strawberry production in Denver, Colorado.

Chamber Production

- Two everbearing cultivars ‘Albion’ and ‘Ozark Beauty’
- CO_2 Treatments separated by chamber (450 ppm and 900 ppm)
- Weekly fruit harvests

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What we've seen so far after enriching for 7 weeks after flower initiation:

	Fruit Number	Average Fruit Weight (grams)	Average Fruit Width (inches)	% USDA Grade 1	Average Firmness ($N \cdot m^{-2}$)
Albion					
Ambient	233	23.0	1.4	82%	200.0
Enriched	280	25.6	1.4	84%	199.2
Ozark Beauty					
Ambient	242	10.1	1.1	81%	136.1
Enriched	386	10.3	1.2	78%	135.9

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Continuous CO_2 enrichment at 900 ppm at flower initiation appears to be beneficial for increasing fruit yield of these two cultivars of everbearing strawberries.

Sensory Trials Just Concluded

- How does CO_2 enrichment effect tasting/sensory quality of fruits?
- Example Attributes:
  - Sweet
  - Sour
  - Fruity
  - Floral

Next Steps: Phytochemical Analysis

- How does CO_2 enrichment effect nutritional quality?

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Products of This Research

Educational Outreach at Spur

Producer Protocols (available after this presentation)

Grower's Guide to Strawberries

Temperature: 20/12 °C day/night (optimal range 20-24 °C/10-12 °C)

Relative Humidity: 55/65% day/night (optimal range 40-60%)

Light: A 16-hour photoperiod of 348 µmol·m–2·s–1 [daily light integral (DLI) ≈ 20 mol·m–2·d–1] (optimal range 20-25 mol·m–2·d–1); everbearing cultivars are facultative long day plants. The photoperiod optimum is 16 hours.

Fertigation: Water-soluble fertilizer providing 100 mg·L–1 N (Jack's 8-10-26 K Strawberry Part A and Jack's 15-0-0 Calcium Nitrate Part B) drying down between waterings. Nutrient solution was maintained with an EC target: 1.0 and pH target: 5.5-6.0.

Pollination: Hand-pollinated daily using a soft-bristled brush

Harvesting: From the time of planting, our first berries were ready for harvest after 10 weeks of growth. Plants were harvested thereafter weekly for the next 7 weeks.

Pest:
Spider Mites, Thrips, Aphids, Fungus Gnats

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Western Region Sustainable Agriculture & Education Program Outreach Survey

https://forms.office.com/r/SdcxchbEE8

Thank You

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