NCERA-101 Station Report 2018 – The Ohio State University

Chieri Kubota, Department of Horticulture and Crop Science (kubota.10@osu.edu)

Peter Ling, Department of Food, Agricultural and Biological Engineering (ling.23@osu.edu)

Mark Kroggel, Department of Horticulture and Crop Science (Kroggel.4@osu.edu)

Reporting period: April 2017 – March 2018

1. New Facilities and Equipment (including sensors, instruments, and control systems purchased/installed)

- A 2000 ft^2 greenhouse compartment was set up for teaching hydroponic crop production courses by Dr. Chieri Kubota, new professor of Controlled Environment Agriculture at the Ohio State University. This facility includes six 6-m double rows of high-wire crop production (tomato, cucumber and pepper), two sets of 4-channel (8-ft each) NFT systems for leafy greens, and two sets of 4 ft x 4 ft DWC (deep water culture) systems leafy greens. 60% of lights (metal halide) were replaced with LEDs provided by GE (intra-canopy LED lighting) and SpecGrade LEDs (overhead LED lighting).
- A 1000 ft^2 greenhouse compartment was set up for conducting a research/extension project of soilless strawberry production. Eight five meter raised gutters were installed with a below-gutter misting system for tip-burn control. Custom-designed LED lights (SpecGrade LEDs) were installed to provide approximately ~10 mol m^{-2} d^{-1}.
- New growth chambers (two walk-in rooms each with 90 ft^2) are approved to be installed by July 2018 in the basement of Howlett Hall Greenhouse Complex, Department of Horticulture and Crop Science. Inside each growth chamber, there will be four independent units of movable growing systems with three tiers with selected lighting system. This facility will provide ample space to examine different experiments studying light qualities, intensities, CO_2 as well as relative humidity.
- A mini VF unit 'Veggie Box' was transferred to the Columbus Campus in August, 2017. This is a modular, all-in-one, commercial unit originally imported from Japan (Sankyo Frontier, Japan). This 60 ft^2 footprint, highly insulated and contained structure is equipped with a four-tiered re-circulating hydroponic production system (total production area 50 ft2), LED lighting (300 or 600 μmol m^{-2} s^{-1}), nutrient pH and EC controller, CO_2 controller, as well as A/C condensation water recovery system. A new A/C system will be installed and the unit will be operational by September 2018.
- Two reach-in sub-freezing temperature control chambers (Thermo Scientific, Precision series) are installed in Howlett Hall for storage of strawberry tray plants.

2. Unique Plant Responses

- A minimum daily dose of UV-B light to prevent intumescence injury was found as 7-12 mmol m^{-2} d^{-1} (3-5 kJ m^{-2} d^{-1} at 0.1-0.2 W/m^2). This UV-B supplementation was applied during the nighttime.

3. Accomplishment Summaries

- Ohio Winter Strawberry Day and Open House was organized on January 6, 2018 with 52 participants from Ohio and neighboring states.
- The 2018 Greenhouse Management Workshop was organized by Peter Ling with 88 participants. This year's focus was hydroponics and the program included controlled environment production practices of different crops (tomato, lettuce, and strawberry), lighting technologies, as well as humidity management, pest/disease management, as well as food safety.

4. Impact Statements

- The custom LEDs designed for targeting photons over short crops grown in a fixed narrow row configuration (such as strawberry plants on raised gutters or table top systems) were found effective to reduce the electricity costs. In a small greenhouse application (1,000 sq ft), we could replace six 1000-W metal halide lamps with 24 155-W LEDs (38% energy saving) while increasing the PPFD by nearly 100%.

5. Published Written Works

Books/Book Chapters

Kubota, C., A. de Gelder, and M. Peet. 2018. Greenhouse tomato production. In: (E. Heuvelink, ed.) Tomatoes, 2nd Edition. CAB International. (in press)

Kubota, C., M. Chao, S. Masoud, Y.J. Son, R. Tronstad. 2018. Advanced technologies for large-scale plant factories – integration of industrial and systems engineering approach in controlled environment crop production. In: (M. Anpo, H. Fukuda, and T. Wada, eds.) Plant factory using artificial light. Elsevier (in press)

Refereed Journal Articles

Kubota, C.*, T. Eguchi*, and M. Kroggel. 2017. UV-B radiation dose requirement for suppressing intumescence injury on tomato plants. Scientia Horticulturae 226:366-371. [*equally contributing to the work]

A.J. Both, B. Bugbee, **C. Kubota**, R.G. Lopez, C. Mitchell, E.S. Runkle, and C. Wallace. 2017. Proposed product label for electric lamps used in the plant sciences. HortTechnology 27:544-549.

Kubota, C., C. Meng, Y.J. Son, M. Lewis, H. Spalholz, and R. Tronstad. 2017. Horticultural, systems-engineering and economic evaluations of short-term plant storage techniques as a labor management tool for vegetable grafting nurseries. PLOS ONE http://dx.doi.org/10.1371/journal.pone.0170614

Spalholz, H. and **C. Kubota**. 2017. Rootstock affected in- and post storage performance of grafted watermelon seedlings at low temperature. HortTechnology 27:93-98

Refereed Conference Proceedings Articles

Garcia, K. and **C. Kubota.** 2017. Physiology of strawberry plants under controlled environment: Diurnal change in leaf net photosynthetic rate. Acta Horticulturae 1156:445-452. (Peer reviewed)

Garcia, K. and **C. Kubota**. 2017. Flowering responses of North American strawberry cultivars. Acta Horticulturae 1156:483-490. (Peer reviewed)

Kroggel, M. and **C. Kubota**. 2017. Controlled environment strategies for tipburn management in greenhouse strawberry production. Acta Horticulturae 1156:529-536. (Peer reviewed)

Other Creative Works

Website and social media

Kubota Lab (Controlled Environment Plant Physiology and Technology): http://u.osu.edu/cepptlab

Facebook for Controlled Environment Plant Physiology and Technology Lab: https://www.facebook.com/CEPPTLAB/