NCERA-101 Station Report 2020 – Texas A&M University

Genhua Niu, Texas A&M AgriLife Research at Dallas (gniu@ag.tamu.edu)

Shuyang Zhen, Depart. Horticultural Sciences, Texas A&M University, College Station

Reporting period: April 2020-March 2021

1. New Facilities and equipment:
   - We installed a new shipping container with three compartments (equivalent to growth chambers) at Dallas Center
   - We are establishing and equipping a new research laboratory in Controlled Environment Agriculture/Horticulture at College Station.

2. Accomplishment summary

   - Organic hydroponic research briefing: We conducted organic hydroponic research in two systems (NFT and deep-water culture system, DWC). In the NFT system, we used a Pre-Empt liquid organic fertilizer and a bacteria-based microbial product called TerraBella, a total of three treatments with three replications. For propagation, we used several organic several plugs: closed bottom organic plug (organic coco coir), Ellepot (peat-based plug) Jiffy plug, and control (Rockwool plug). Among them, Jiffy plug performed the best. Results indicate that lettuce organic treatments with microbial product have the potential to achieve similar yield as the control. For longer term production (reusing the organic solution for multiple cycles), additional potassium fertilizer may be needed. In the DWC systems, we used an organic fertilizer from JHB with or without TerraBella with three treatments and repeated three times. We found that organically grown lettuce yield was slightly lower than the control and TerraBella did not make any difference in this organic fertilizer. Similarly, leaf tissue potassium level was lower than that in the control.
   - Research on light spectrum and temperature interactions: We conducted the first of a series of studies to examine the interactive effects among environmental factors, especially between light spectra and temperature, on crop growth and physiology in controlled environment production. In this first study we characterized how red/far-red ratios interacted with temperature (constant and dynamic day/night gradients) to control photo- and thermo-morphogenesis in lettuce and basil. We found that the light spectral effects on yield and morphology of lettuce and basil were dependent on the temperature regimes, and vice versa. Our results indicate that interactions among environmental factors should be better characterized and taken into consideration in production system optimization.
   - Texas A&M AgriLife Research collaborated with AgriLife Extension organized the second conference in urban controlled environment agriculture (virtual) attended by more than 100 participants in December 2020.

3. Impact Statements

The book "Plant Factory – Indoor Vertical Farming System for Efficient Quality Food Production" (published in 2019) was well received and positively impact the indoor farming industry and scientific community.

Our second controlled environment conference held virtually in December 2020 also was well received and attended by the industry.

4. Publications

Refereed journal articles

1. Dou, H., G. Niu, M. Gu, and J. Masabni. 2020. Morphological and physiological responses in basil and *Brassica* species to different proportions of red, blue, and green wavelengths in indoor vertical farming. JASHS 145(4): 267-278. https://doi.org/10.21273/JASHS04927-20.
2. Hooks, Triston, Joe Masabni, Ling Sun, Genhua Niu. 2021. Effect of pre-harvest supplemental UV-A/blue and red/blue LED lighting on lettuce growth and nutritional quality. Horticulturae 7
3. Kusuma, P., Westmoreland, F. M., Zhen, S., and Bugbee, B. (2021). Photons from NIR LEDs can delay flowering in short-day soybean and Cannabis: Implications for phytochrome activity. *PLOS ONE*, *16*, e0255232.
4. Zhen, S., van Iersel, M., & Bugbee, B. (2021). Why far-red photons should be included in the definition of photosynthetic photons and the measurement of horticultural fixture efficacy. *Frontiers in Plant Science* https://doi.org/10.3389/fpls.2021.693445
5. Berliner, A.J. *et al.* (2021) Towards a biomanufactory on Mars. *Frontiers in Astronomy and Space Sciences* https://doi.org/10.3389/fspas.2021.711550
6. Chen, J. J., Zhen, S., & Sun, Y. (2021). Estimating Leaf Chlorophyll Content of Buffaloberry Using Normalized Difference Vegetation Index Sensors. *HortTechnology*, *31*, 297-303.

Books

Kozai, T., G. Niu, and J. Masabni (eds.). 2021. Plant factory: Basics, Applications, and Advances. Academic Press, Elsevier Publisher (in press).

Book chapters

Genhua Niu and Joseph Masabni. Hydroponics. 2021. In *Plant factory: Basics, Applications and Advanced Research*, Eds. T. Kozai, G. Niu & J. Masabni. Academic Press, Elsevier Publisher (in press).

Joseph Masabni and Genhua Niu. Aquaponics. 2021. In *Plant factory: Basics, Applications and Advanced Research*, Eds. T. Kozai, G. Niu & J. Masabni. Academic Press, Elsevier Publisher (in press).

Zhen S., Kusuma P., and Bugbee B. (2021). Toward an optimal spectrum for photosynthesis and plant morphology in LED-based crop cultivation. In *Plant factory: Basics, Applications and Advanced Research*, Eds. T. Kozai, G. Niu & J. Masabni. Academic Press, Elsevier Publisher (in press).