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

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1. New Facilities and equipment:
   - We installed 18 units of OSRAM LED Research Lights PHYTOFY RL. The AgriLife Research at Dallas Center currently has two repurposed shipping containers for plant science research in controlled environment. A new three-compartment shipping container with independent climate control will be built by the end of 2020.
   - Several NFT systems and deep-water culture systems for hydroponic research.
   - An Agilent LCMS was purchased and installed recently at the Dallas Center.

2. Accomplishments summaries

   - Texas A&M AgriLife Research continued research on optimizing indoor sole-source light environment on the growth and nutritional quality of sweet basil and leafy greens. Most recent completed research on supplemental ultraviolet-B (UV-B) radiation before harvest increased phytochemical concentrations up to 169% in green basil leaves but decreased plant yield, while lower UV-B radiation doses increased antioxidant capacity in *Brassica* species without yield reduction. Results showed that UV radiation has a potential to increase the concentration of bioactive compounds in leafy greens and herbs and its impact depends on dosage, timing and method of delivery the UV radiation, and species and cultivars.
   - Texas A&M AgriLife Research started research on organic hydroponics in NFT and deep-water culture systems. Organic CEA production methods are still in their infancy and there is extremely limited research-based information. The major challenge of organic hydroponics is lower yield due to slower plant growth compared to conventional farming. We have been conducting several experiments on comparing conventional vs. organic hydroponic lettuce production with or without microbial root inoculant using various propagation plug types. Preliminary results indicated that crop yield is lower in organic fertilizer treatment but crop quality is enhanced.
   - Texas A&M AgriLife Research collaborated with AgriLife Extension on organizing our first conference in urban controlled environment agriculture and attracted 60 participants in 2019.
   - Texas A&M University, Department of Horticultural Science on main campus, hired Dr. Shuyang Zhen who started August 2020. Dr. Zhen will teach and conduct research on controlled environment horticulture.

3. Impact Statements

The second edition of the book “Plant Factory – Indoor Vertical Farming System for Efficient Quality Food Production” (edited and co-authored) has received positive feedback from indoor farming industry and scientific community, which is why we were asked to work on the second edition. The first edition book was published in 2015.

Evaluation summaries of the first annual ‘controlled environment conference’ are: 92% of participants indicated gain in knowledge; 70% anticipate economic benefits as a direct result of what they learned; and 97% would recommend this activity to others.

4. Publications

Refereed journal articles

Yan, Z., D. He, **G. Niu**, Q. Zou, and Y. Qu. **2019**. Growth, nutritional quality, and energy use efficiency of hydroponic lettuce as influenced by daily light integrals exposed to white versus white plus red light-emitting diodes. HortScience 54(10): 1737-1744.

Dou, H., **G. Niu**, and M. Gu. **2019**. Photosynthesis, morphology, yield, and phytochemical accumulation in basil plants influenced by substituting green light for partial red and/or blue light. HortScience 54(10): 1769–1776. 2019. https://doi.org/10.21273/HORTSCI14282-19.

Cheng, Y., D. He, J. He, **G. Niu**, and R. Gao. **2019**. Effect of light/dark cycle on photosynthetic pathway switching and CO2 absorption in two Dendrobium species. Frontiers in Plant Science. Vol 10, article 659, doi: 10.3389/fpls.2019.00659

Yan, Z., D. He, **G. Niu**, and H. Zhai. **2019**. Evaluation of growth and quality of hydroponic lettuce at harvest as affected by the light intensity, photoperiod, and light quality at seedling stage. Scientia Horticulturae. 248: 138-144.

Books

Kozai, T., G. Niu, and M. Takagaki (eds.). 2019. Plant factory: An Indoor Farming System for Efficient Quality Food Production. Academic Press, Elsevier Publisher, Second Edition, pp. 487.

Book chapters

Dou, H. and G. Niu. 2019. Plant responses to light. In: Plant Factory: An Indoor Farming System for Efficient Quality Food Production, T. Kozai, G. Niu, and M. Takagaki (eds.), pp. 153-166. Academic Press, Elsevier Publisher, Second Edition.

Kozai, T. and G. Niu. 2019. Role of plant factory with artificial lighting (PAFL) in urban areas, In: Plant Factory: An Indoor Farming System for Efficient Quality Food

Production, T. Kozai, G. Niu, and M. Takagaki (eds.), pp. 7-34. Academic Press, Elsevier Publisher, Second Edition.

Kozai, T. and G. Niu. 2019. Plant factory as a resource-efficient closed plant production system. In: Plant Factory: An Indoor Farming System for Efficient Quality Food Production, T. Kozai, G. Niu, and M. Takagaki (eds.), pp. 93-115. Academic Press, Elsevier Publisher, Second Edition.

Niu, G., T. Kozai, and N. Sabeh. 2019. Physical environmental factors and their properties. In: Plant Factory: An Indoor Farming System for Efficient Quality Food Production, T. Kozai, G. Niu, and M. Takagaki (eds.), pp. 185-195. Academic Press, Elsevier Publisher, Second Edition.

Kozai, T. and G. Niu. 2019. Challenges for the next generation PFAL. In: Plant Factory: An Indoor Farming System for Efficient Quality Food Production, T. Kozai, G. Niu, and M. Takagaki (eds.), pp. 463-469. Academic Press, Elsevier Publisher

Kozai, T. and G. Niu. 2019. Conclusions: resource-saving and resource-consuming characteristics of PFALs. In: Plant Factory: An Indoor Farming System for Efficient Quality Food Production, T. Kozai, G. Niu, and M. Takagaki (eds.), pp. 471-475. Academic Press, Elsevier Publisher.

He, D., T. Kozai, G. Niu, X. Zhang. 2019. Light-emitting diodes for horticulture. In: Light-Emitting Diodes, Solid State Lighting Technology and Application Series 4, edited by Li, J and G.Q. Zhang, Springer International Publishing AG, part of Springer Nature.