PAUL KUSUMA

CURRICULUM VITAE

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EDUCATION

Utah State University – Ph.D. Candidate	August 2016 – Present
University of Florida – B. S. in Horticulture	December 2015

RESEARCH EXPERIENCE

Ph.D. Candidate – Crop Physiology Laboratory – Utah State University	August 2016 – Present
Lab Assistant & Research – Folta Laboratory – University of Florida	May 2015 – July 2016
Lab Assistant – Darnell Laboratory – University of Florida	Summer 2015, 2016

TEACHING EXPERIENCE

Teaching Assistant – PSC 5270/6270 – Environmental Plant Physiology – Utah State University	Spring 2018 – 2021
Guest Lecture – PSC 5430/6430 – Plant Nutrition – Utah State University	Fall 2018, 2020
Teaching Assistant – PSC 5000/6000 – Environmental Instrumentation – Utah State University	Fall 2017, 2019
Judge – SRS – Utah State University	Spring 2020
Judge – FSRS – Poster Presentations – Utah State University	Fall 2018
Reviewer – URCO – Proposals – Utah State University	Spring 2018, 2019, 2020

FUNDING RECIEVED

Presidential Doctoral Research Fellowship	$10,000/year (2018-2021)
Utah NASA Space Grant Consortium Fellowship	$15,000/year (2018-2021)
The center for the utilization of biological engineering in space (CUBES)	$5,000/year (2017-2021)
Lighting approaches to maximize profits (LAMP)	$5,000/year (2017-2021)

AWARDS

Doctoral Student Researcher of the Year for the College of Agriculture and Applied Sciences	2020
Doctoral Student Researcher of the Year for the department of Plants, Soils & Climate	2020
Graduate Oral Presentation Award for Life Sciences – Student Research Symposium	2019, 2020
Graduate Student Poster Award, 2nd Place – PSC Showcase	2019
NCERA Graduate Student Travel Grant	2017, 2018, 2020
Bastian Family Graduate Fellowship	2018
Apogee Instruments – Campbell Scientific Graduate Fellowship	2017, 2018
Bertrand D. Tanner/Campbell Scientific Graduate Fellowship	2017, 2018, 2019, 2020

PUBLICATIONS

PEER-REVIEWED PUBLICATIONS

Kusuma, P., B. Swan & B. Bugbee. (2021). Does green really mean go? Increasing the fraction of green photons promotes growth of tomato but not lettuce or cucumber (*Accepted in Plants)*

Westmoreland, F. M., P. Kusuma & B. Bugbee. (2021). Cannabis lighting: Efficacy is more important than spectra for yield and cannabinoids *PLoS ONE*, 16(3), e0248988.

Kusuma, P. & B. Bugbee. (2021). Far-red fraction: An improved metric for characterizing phytochrome effects on morphology. J*ournal of the American Society for Horticultural Science*, 146(1), 3-13.

Hardy, J. M., P. Kusuma, B. Bugbee, R. Wheeler & M. Ewert. (2020). Providing photons for food in regenerative life support: A comparative analysis of solar fiber optic and electrical light systems. *International Conference on Environmental Systems*. ICES-2020-523

Kusuma, P., P. M. Pattison & B. Bugbee. (2020). From physics to fixtures to food: Current and potential LED efficacy. *Horticulture Research,* 7(1), 1-9.

Song, S., P. Kusuma, S. D. Carvalho, Y. Li & K. M. Folta. (2019). Manipulation of seedling traits with pulsed light in closed controlled environments. *Environmental and Experimental Botany*, 166, 103803.

Soundararajan, M., R. Ledbetter, P. Kusuma, S. Zhen, P. Ludden, B. Bugbee, S. Ensign & L. Seefeldt. (2019). Phototrophic N_2 and CO_2 fixation using a Rhodopseudomonas palustris-H_2 mediated electrochemical system with infrared photons. *Frontiers in microbiology*, 10, 1817.

IN REVIEW

Kusuma, P. & B. Bugbee. (2021). Improving the predictive value of phytochrome photoequilibrium: Consideration of photon distortion within a leaf (*In review in Frontiers in Plant Science*)

Kusuma, P., M. Westmoreland, S. Zhen & B. Bugbee. (2021). Far-red photons above 750 nm can delay flowering in short-day soybean and *Cannabis*: Implications for the activity of phytochrome (*In review in PLoS ONE*)

Berliner, A., J. Hilzinger, A. Abel, M. McNulty, G. Makrygiorgos, N. Averesch, S. Gupta, A. Benvenuti, D. Caddell, S. Cestellos-Blanco, A. Doloman, S. Friedline, D. Ho, W. Gu, A. Hill, P. Kusuma, I. Lipsky, M. Mirkovic, J. Meraz, V. Pane, K. Sander, F. Shi, J. Skerker, A. Styer, K. Valgardson, K. Wetmore, S. Woo, Y. Xiong, K. Yates, C. Zhang, S. Zhen, B. Bugbee, D. Coleman-Derr, A. Mesbah, S. Nandi, R. Waymouth, P. Yang, C. Criddle, K. McDonald, A. Menezes, L. Seefeldt, D. Clark & A. Arkin. (2021) Towards a Biomanufactory on Mars (*In review in Nature Communications*)

IN PREPARATION

Kusuma, P. & B. Bugbee. (2021). Photon capture in lettuce is increased in early shade, but decreased in sever shade: far-red interactions with intensity (*In Preparation*)

Kusuma, P. & B. Bugbee. (2021). An analysis of photoconversion coefficients and the prediction of phytochrome dynamics (*In Preparation*)

Berliner, A., K. Yates, M. McNulty, P. Kusuma, S. Zhen, S. Gupta, G. Makrygiorgos, A. Mesbah, A. Menezes, B. Bugbee, A. Arkin, S. Nandi & K. McDonald. (2021). Nitrogen dependence and systems-based extension of the modified energy cascade model for human Martian exploration (*In Preparation*)

Langenfeld, N., P. Kusuma, C. Criddle, L. Seefeldt & B. Bugbee. (2021). Optimizing nitrogen recycling for food production in regenerative life support systems (*In Preparation*)

BOOK CHAPTERS

Kusuma, P., P. M. Pattison & B. Bugbee. (2021). Photon efficacy in horticulture. Turning LEDs packages into LED luminaires for indoor farming. In: *Plant factory: basics, applications and advanced research*, Eds. T. Kozai, G. Niu & J. Masabni. Elsevier - *Invited*

Zhen, S., P. Kusuma & B. Bugbee. (2021). Spectral optimizations for indoor plant growth and development. In: *Plant factory: basics, applications and advanced research*, Eds. T. Kozai, G. Niu & J. Masabni. Elsevier - *Invited*

OTHER PUBLICATIONS

MAGAZINE ARTICLES

Kusuma, P. & B. Bugbee. (January 7, 2021). Shedding light on LED Tech for Cannabis production. *Greenhouse Grower*

NASA TECHNICAL MEMO

Kusuma, P., B. Fatzinger, W. Soer, R. Wheeler & B. Bugbee. (*In preparation*). High efficacy LEDs for extra-terrestrial agriculture

DIGITAL COMMONS

Zhen, S. & P. Kusuma. (2020). Accuracy of the generic equation to convert CCI to chlorophyll concentration in the Apogee model MC-100 chlorophyll concentration meter. *Techniques and Instruments*. Paper 17. https://digitalcommons.usu.edu/cpl_techniquesinstruments/17/

Kusuma, P., M. Hardy & B. Bugbee. (2020). Growing food in Space: A comparison of LED and solar-fiber-optic technologies. *Utah Space Grant Consortium*. Papers - 16. *Available online on May 1, 2021*

Kusuma, P. & B. Bugbee. (2020). An automated multi-chamber system for quantifying biological oxygen demand. *Techniques and Instruments*. Paper 16. https://digitalcommons.usu.edu/cpl_techniquesinstruments/16/

Kusuma, P. & B. Bugbee. (2019). Optimizing concentrating mirrors and fiber optics for food production on Mars. *Utah Space Grant Consortium*. Session 2. https://digitalcommons.usu.edu/spacegrant/2019/Session_two/6/

Johnson, J., P. Kusuma & B. Bugbee. (2017). Efficacy of two HORTILED fixtures. *Controlled Environments*. Paper 11. https://digitalcommons.usu.edu/cpl_env/11

PRESENTATIONS AT NATIONAL MEETINGS

ORAL PRESENTATIONS

Kusuma, P. & B. Bugbee. Improving the predictive value of phytochrome photoequilibrium: Consideration of photon distortion within a leaf

Annual Meeting – LAMP, Online (February 2021)

Kusuma, P., N. Langenfeld, L. Seefeldt, C. Criddle & B. Bugbee. Optimization of nitrogen synthesis and recycling for food and pharmaceutical production
Biannual Meeting – CUBES, Online (December 2020)

Kusuma, P., S. Zhen & B. Bugbee. The value of ultra-violet photons for food quality
Biannual Meeting – CUBES, Online (May 2020)

Kusuma, P., P. M. Pattison & B. Bugbee. From physics to fixtures to food: Potential LED efficacy
Annual Meeting – LAMP, Riverhead NY (March 2020)
Biannual Meeting – CUBES, Logan UT (September 2019)

Kusuma, P., M. Westmoreland, W. Wheeler, S. Zhen & B. Bugbee. Is there a limit?
Annual Meeting – PHOTOx, Austin TX (October 2019) - *Invited Speaker*

Kusuma, P. & B. Bugbee. An improved method for estimating phytochrome photo-equilibrium
Annual Meeting Lightning Talk – ASHS, Las Vegas NV (July 2019)
Annual Meeting Lightning Talk – NCERA-101, Montreal QC, Canada (April 2019)

Kusuma, P. & B. Bugbee. Phytochrome photo-conversion: From etiolated to green tissue
Annual Meeting Lightning Talk – NCERA-101, Raleigh NC (April 2018)

Kusuma, P. & B. Bugbee. On the challenge of iron nutrition in hydroponics
Annual Meeting Lightning Talk – NCERA-101, Pacific Grove CA (April 2017)

POSTER PRESENTATIONS

McNulty, M., P. Kusuma, K. Wetmore, A. Abel, A. Berliner, D. Clark, B. Bugbee, A. Arkin & K. McDonald. The center for the utilization of biological engineering in space (CUBES) – Using synthetic biology to support humans for deep space exploration
STRG Tech Day on the Hill – Washington D.C. (December 2019)

Kusuma, P., P. M. Pattison & B. Bugbee. From physics to fixtures to food: Potential LED efficacy
Biannual Meeting, CUBES – Utah State University (September 2019)

Kusuma, P., S. Zhen & B. Bugbee. Food production of Mars: Ultra-violet & Far-red
Biannual Meeting, CUBES – University of California, Davis (May 2019)

Zhen, S., P. Kusuma & B Bugbee. Far-red photons enhance photosynthesis and alter plant shape
Biannual Meeting, CUBES – University of California, Berkeley (October 2018)

Kusuma, P. & Bugbee, B. The FAR-PAR index is a better predictor of stem and leaf expansion than phytochrome photo-equilibrium
Annual Meeting, NCERA-101 – Raleigh NC (April 2018)

PRESENTATIONS AT REGIONAL/LOCAL MEETINGS

ORAL PRESENTATIONS

Kusuma, P. & B. Bugbee. Environmental effects on flowering
Graduate Seminar – Utah State University (September 2020)

Doloman, A., P. Kusuma, N. Langenfeld, L. Banner, L. Seefeldt & B. Bugbee. Biological fertilizer for manned missions to deep space
Hansen Retreat – Utah State University (September 2020)

Kusuma, P. & B. Bugbee. The optimal light spectra: Food production on Mars
Student Research Symposium – Utah State University (April 2020) - *Graduate Oral Presentation Award for Life Sciences*

Kusuma, P., P. M. Pattison & B. Bugbee. From physics to fixtures to food: Potential LED efficacy
Graduate Seminar – Utah State University (October 2019)

Kusuma, P. & B. Bugbee. Food production on Mars: Optimizing sunlight
Utah NASA Space Grant Consortium Symposium – Brigham Young University (May 2019)
Student Research Symposium – Utah State University (April 2019) - *Graduate Oral Presentation Award for Life Sciences*

Kusuma, P. Far-red & ultra-violet radiation for plant growth
PSC Showcase – Utah State University (March 2019)

Kusuma, P. & B. Bugbee. Far-Red, phytochrome & physiology: A century of research and the rise of the LED age
Graduate Seminar – Utah State University (October 2018)

Kusuma, P. Color of light as a signal for plant development: Far-red and phytochrome
Student Research Symposium – Utah State University (April 2018)

Kusuma, P. Greenhouse lighting
Utah Green Industry Conference & Trade Show – UNLA, Sandy UT (January 2018) - *Invited Speaker*

Kusuma, P. & B. Bugbee. Far-Red: The forgotten photons
Graduate Seminar – Utah State University (October 2017)

POSTER PRESENTATIONS

Kusuma, P. Optimizing blue photons for efficient plant growth
Graduate Seminar Poster Session – Online (November 2020)

Kusuma, P., M. Pattison & B. Bugbee. From physics to fixtures to food: Potential LED efficacy
Student Research Symposium – Utah State University (April 2020)

Kusuma, P. & B. Bugbee. Optimizing concentrating mirrors and fiber optics for food production on Mars: Ultra-violet & Far-red
Student Research Symposium – Utah State University (April 2019)
PSC Showcase – Utah State University (March 2019) - *won 2nd place*

Kusuma, P. & Bugbee, B. The FAR-PAR index is a better predictor of stem and leaf expansion than phytochrome photo-equilibrium
Student Research Symposium – Utah State University (April 2018)
PSC Showcase – Utah State University (March 2018)

Kusuma, P. & Bugbee, B. Reduced chelate strength increases iron bioavailability for monocots in hydroponic culture
Graduate Seminar Poster Session – Utah State University (October 2017)
PSC Showcase – Utah State University (March 2017)

UNDERGRADUATES MENTORED

Logan Banner - Expected Graduation: 2022
Kahlin Wacker - Expected Graduation: 2021
Wyatt Johnson - Graduated: 2019
Boston Swan - Graduated: 2018

PUBIC OUTREACH / INTERVIEWS

This scientist grows plants for Mars – Food & Farming Technology — February 2020
https://www.foodandfarmingtechnology.com/features/this-scientist-grows-plants-for-mars.html

STRG Tech Day on the Hill – Met with congressional staffers — December 2019

Cultivate Magazine — Summer 2019