

Youyoun Moon
1307 Jamestown Dr.
Morgantown, WV 26508
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EDUCATION

Ph. D.

Title: Biochemical and functional analyses of type I and type II metacaspases during *Petunia ×hybrida* petal senescence
The Ohio State University, Wooster, Ohio 44691

Master of Science

Title: Isolation and characterization of Δ^9 stearoyl-acyl carrier protein desaturase gene from *Glycine max*
Department of Botany
Major: Molecular, Cellular and Developmental Biology
Iowa State University, Ames, IA 50010

Master of Science

Major: Plant Pathology
Seoul National University, Seoul, South Korea

Bachelor of Science

Major: Plant Pathology
Seoul National University, Seoul, South Korea

PROFESSIONAL EXPERIENCES

Teaching Associate Professor (2018-Current)

Research Assistant Professor (2012-2018)

Assignment Number: 76418-3

Start date: March 23, 2012

Davis College of Agricultural, Natural Resources and Design

Division of Plant and Soil Sciences

West Virginia University

Morgantown, WV 26506

Lecturer (2010 – 2012)

Eberly College of Arts and Sciences

Department of Biology

West Virginia University

Morgantown, WV 26506

Adjunct Assistant Professor (2010 – 2014)

Fairmont State University

College of Science and Technology

Biology, Chemistry and Geoscience Department

Fairmont, WV 26554

Graduate Research Associate (2005-2010)

Department of Horticulture and Crop Science

The Ohio State University, Wooster, OH 44691

Research Associate (2003-2005)

Department of Chemical Engineering

Iowa State University, Ames, IA 50010

Research Associate (2002-2003)

Department of Food Science and Technology

Iowa State University, Ames, IA 50010

Research Associate (2001-2002)

Department of Biochemistry and Biophysics

Iowa State University, Ames, IA 50010

Lecturer/Teaching Assistant (1986-2001)

Department of Botany

Department of Zoology and Genetics

Biology Program

Molecular, Cellular and Development Biology

Iowa State University, Ames, IA 50010

PUBLICATIONS

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

1. Suejin Park, Asela Wijeratne, **Youyoun Moon**, and Nicole L. Waterland (2021)
Time-course transcriptomic analysis of *Petunia ×hybrida* under water deficit stress by RNA sequencing.
PLOS ONE 16(4): e0250284
<https://doi.org/10.1371/journal.pone.0250284>
2. Laura J. Chapin, **Youyoun Moon**, and Michelle L. Jones (2017)
Downregulating a Type I Metacaspase in *Petunia* Accelerates Flower Senescence
J. AMER. SOC. HORT. SCI. 142(5):405–414
doi: 10.21273/JASHS04204-17
3. Yoo S-H, Lee B-H, **Moon Y**, Spalding MH, Jane J-L (2014).
Glycogen synthase Isoforms in *Synechocystis* sp. PCC6803: Identification of different Roles to Produce Glycogen by Targeted Mutagenesis.
PLoS ONE 9 (3): e91524
4. Jin-Ha Lee, Seung-Heon Yoon, Seung-Hee Nam, **You-Youn Moon** and Doman Kim (2006)
Molecular cloning of a gene encoding the sucrose phosphorylase from *Leuconostoc mesenteroides* B-1149 and the expression in *Escherichia coli*
Enzyme and Microbial Technology 39:612-620
DOI: 10.1016/j.enzmictec.2005.11.008
5. Hwa-Ja Ryu, Doman Kim, Do-Won Kim, **You-Youn Moon** & John F. Robyt (2000)
Cloning of a dextransucrase gene (fmcmds) from a constitutive dextransucrase hyper-producing *Leuconostoc mesenteroides* B-512FMCM developed using VUV
Biotechnology Letters 22: 421–425

PLANTS AND HUMAN NUTRITION

6. Rachel Newman, **Youyoun Moon**, Janet C. Tou, Terence McManus, and Nicole L. Waterland
Harvest stage and brewing conditions impact mineral content, phytochemical compounds, and antioxidant capacity of lemon balm (*Melissa officinalis* L.) herbal tea. *Plant Foods for Human Nutrition* (In Review)
7. Rachel G. Newman, **Youyoun Moon**, Carl E. Sams, Janet C. Tou, and Nicole L. Waterland (2021)

- Biofortification of sodium selenate improves dietary mineral content and antioxidant capacity of culinary herb microgreens
Frontiers in Plant Science 12:716437
<https://doi.org/10.3389/fpls.2021.716437>
8. Rachel Newman, Nicole Waterland, **Youyoun Moon** & Janet C. Tou (2019)
 Selenium biofortification of agricultural crops and effects on plant nutrients and bioactive compounds important for human health and disease prevention – a review
Plant Foods for Human Nutrition DOI 10.1007/s11130-019-00769-z
 September 14, 2019 online
 9. Waterland, N.L., **Moon, Y.**, Tou, J.C., Kopsell, D.A., Kim, M.J., Park, S. (2018)
 Differences in leaf color and stage of development at harvest influenced phytochemical content in three cultivars of kale (*Bassica oleracea* L. and *B. napus*) *Journal of Agricultural Sciences*, 11 (3).(online)
 10. Nicole L. Waterland, **Youyoun Moon**, Janet C. Tou, Moo Jung Kim, Eugenia M. Pena- Yewtukhiw, and Park Suejin (2017)
 Mineral content differs among microgreen, baby leaf and adult stages in three cultivars of kale. *HortScience* 52(4):566-571
<http://dx.doi.org/10.21273/HORTSCI11499-16>
 11. Moo Jung Kim, **Youyoun Moon**, Janet C. Tou, Beiquan Mou, and Nicole L. Waterland (2016)
 Nutritional value, bioactive compounds and health benefits of lettuce (*Lactuca sativa* L.). *Journal of Food Composition and Analysis* 49:19-34
<http://dx.doi.org/10.1016/j.jfca.2016.03.004>
 12. Moo Jung Kim, **Youyoun Moon**, Dean A. Kopsell, Suejin Park, Janet C. Tou, and Nicole L. Waterland (2016)
 Nutritional value of crisphead ‘Iceberg’ and romaine lettuces (*Lactuca sativa* L.). *Journal of Agricultural Science* 8(11):1-10
<http://dx.doi.org/10.5539/jas.v8n11p1>

ENVIRONMENT

13. Suejin Park, **Youyoun Moon** and Nicole L. Waterland (2020)
 Treatment with calcium chloride enhances water deficit stress tolerance in viola (*Viola cornuta*) *HortScience* 55(6):882-887
14. Suejin Park, Sarah A. Mills, **Youyoun Moon**, and Nicole L. Waterland (2016)
 Evaluation of antitranspirants for enhancing temporary water stress tolerance in bedding plants. *HortTechnology* 26(4):444-452

Manuscripts In Preparation

Sarah A. Mills, **Youyoun Moon** and Nicole L. Waterland*

The interactive effect of elevated CO₂, temperature and water deficit stress on flower development in *Petunia ×hybrida*

POSTER, ABSTRACT AND ORAL PRESENTATIONS SINCE 2011

Presentations

1. Tristan D. Sanders, **Youyoun Moon**, Brian Poel and Nicole L. Waterland (2022) Utilizing LEDs to enhance phytochemical content and mineral accumulation in kale. 119th Annual Meeting, American Society for Horticultural Science. Conference (oral).
2. Isabel Weeks, Tristan Sanders, Sven Verlinden, Nicole Waterland and **Youyoun Moon** (2022)
Far-red LED light increased shoot height and boron uptake in kale (*Brassica oleracea*). Spring Symposium at WVU (poster)
3. Tristan Sanders, **Youyoun Moon** and Nicole L. Waterland (2021)
The effect of narrow bandwidths of light on mineral uptake and secondary metabolite biosynthesis in kale. 118th Annual Meeting, American Society for Horticultural Science. Virtual Conference (oral).
4. Rachel Newman, **Youyoun Moon**, Janet C. Tou, and Nicole L. Waterland (2021).
Harvest stage and brewing conditions impact mineral content, phytochemical compounds, and antioxidant capacity of lemon balm (*Melissa officinalis*) herbal tea. Institute of Food Technologists. Virtual Conference (poster).
5. Isabel Weeks, Tristan Sanders, Sven Verlinden, **Nicole Waterland**, and **Youyoun Moon**.
Far-red LED light treatment increased shoot height and diminished root capacity in kale (*Brassica oleracea* L.) WVU Summer Undergraduate Research Symposium. Morgantown, WV (poster).
6. Tristan D. Sanders, Youyoun Moon and **Nicole L. Waterland** (2021)
Influence of light-emitting diodes on *Brassica oleracea* growth, metabolites, and antioxidant capacity. WVU 5th Annual Undergraduate Spring

Symposium. Morgantown, WV Virtual Conference (oral, 1st place Science and Technology oral presentation).

7. Sarah A. Mills, **Youyou Moon**, Michael Gutensohn, and Nicole L. Waterland (2020) Abiotic stressors influence the emission of petunia flower volatiles. 117th Annual Meeting, American Society for Horticultural Science. Virtual Conference (oral).
8. Rachel G. Newman, **Youyou Moon**, Janet C. Tou, and Nicole L. Waterland (2020) The antioxidant capacity of fresh and dry lemon balm (*Melissa officinalis*) and lime basil (*Ocimum basilicum*) prepared as herbal teas. 117th Annual Meeting, American Society for Horticultural Science. Virtual Conference (poster).
9. Tristan D. Sanders, **Youyou Moon** and Nicole L. Waterland (2020) Narrow bandwidths of light alter a plant's secondary metabolism. WVU Summer Undergraduate Research Symposium. Morgantown, WV (poster).
10. Suejin Park, Asela J. Wiferatne, **Youyou Moon** and Nicole L. Waterland (2019) Time-course transcriptome analysis of *Petunia ×hybrida* 'Mitchell Diploid' under water deficit stress using RNA sequencing. 2019 Annual Meeting Midwestern Section American Society of Plant Biologists. Morgantown, WV (poster).
11. Rachel G. Newman, **Youyou Moon**, Carl E. Sams, Janet C. Tou, and Nicole L. Waterland (2019) Enhanced nutrient profiles of culinary herb microgreens after sodium selenate biofortification in hydroponic conditions. 116th Annual Meeting, American Society for Horticultural Science. Las Vegas, NV (poster).
12. Rachel G. Newman, **Youyou Moon**, Carl E. Sams, Janet C. Tou, and Nicole L. Waterland (2019) Effect of sodium selenate biofortification on plant yield, mineral content, and antioxidant capacity of culinary herb microgreens. International Food Technology 19. New Orleans, LA (poster).
13. Rachel G. Newman, **Youyou Moon**, Carl E. Sams, Janet C. Tou, and Nicole L. Waterland (2019) Sodium selenate biofortification affects nutrient profiles of culinary herb microgreens. West Virginia Academy of Nutrition and Dietetics Annual Conference 2019. Bridgeport, WV (poster).
14. Rachel G. Newman, **Youyou Moon**, Carl E. Sams, Janet C. Tou, and Nicole L. Waterland (2019) Sodium selenate biofortification affects plant yield, mineral content, and antioxidant capacity of culinary herb microgreens. WVU Davis College Graduate Student Research and Creative Project Day. Morgantown, WV (oral, 1st place M.S.).

15. Sarah A. Mills, **Youyou Moon** and Nicole L. Waterland (2019) Impact of simulated climate change on the flower development of petunia. 2019 Annual Meeting Midwestern Section American Society of Plant Biologists. Morgantown, WV (poster).
16. Olivia J. Friel, **Youyou Moon** and Nicole L. Waterland (2019) Nutrient uptake analysis of light and hormone insensitive *Arabidopsis thaliana* mutants. 16th Annual Undergraduate Research Day at the Capitol. Charleston, WV (poster).
17. Suejin Park, **Youyou Moon**, Nicole L Waterland (2018) Treatment of calcium chloride enhanced water deficit stress tolerance in viola (*Viola cornuta*) 115th Annual Meeting, American Society for Horticultural Science (oral)
18. Olivia J. Friel, Youyou Moon, Nicole L Waterland (2018) Nutrient uptake analysis of light and hormone insensitive *Arabidopsis thaliana* mutants 2018 Summer Undergraduate Research Symposium at Morgantown, WV (poster)
19. Rachel G. Newman, Youyou Moon, Janet C. Tou, Nicole L Waterland (2018) Sodium selenite biofortification affects selenium content, yield, and toxicity in culinary herb microgreens grown in hydroponic conditions West Virginia Academy of Nutrition and Dietetics Annual Conference at Morgantown, WV (poster)
20. Dylan W. Miller, **Youyou Moon** and Nicole L. Waterland (2018) The effect of far-red on mineral uptake in Basil (*Ocimum basilicum* 'Italian Large Leaf') 2nd Annual WVU Undergraduate Spring symposium at Morgantown, WV (poster)
21. Suejin Park, **Youyou Moon** and Nicole L. Waterland (2017) Functional analysis of transcription factor *PhERF039* for enhancing water stress tolerance in *Petunia ×hybrida* 'Mitchell Diploid'. 114th Annual Meeting, American Society for Horticultural Science. Waikoloa, HI (oral).
22. Sarah A. Mills, **Youyou Moon** and Nicole L. Waterland (2017) Effect of simulated climate change on flower development of petunia. 114th Annual Meeting, American Society for Horticultural Science. Waikoloa, HI (oral).
23. Ariana R. Newton, **Youyou Moon**, and Nicole L. Waterland (2017) Biological control of whiteflies (*Aleyrodidae* family) using carnivorous plants (*Drosera* spp.). 2017 Summer Undergraduate Research Symposium at WVU. Morgantown, WV (poster).
24. Sarah A. Mills, **Youyou Moon**, and Nicole L. Waterland (2017) The effects of abiotic stresses on floral development of petunia. Davis Student Research

and Creative Scholarship Day at WVU. Morgantown, WV (oral, 1st place M.S.).

25. Suejin Park, **Youyoun Moon** and Nicole L. Waterland (2017) Transcriptome analysis to identify genes responsible for water deficit stress response in *Petunia ×hybrida* using RNA sequencing. Institute of Water Security and Science Symposium at WVU. Morgantown, WV (poster).
26. Sarah Mills, **Youyoun Moon** and Nicole L. Waterland (2017) Effects of elevated carbon dioxide, temperature and water deficit stress on floral development of petunia. Institute of Water Security and Science Symposium at WVU. Morgantown, WV (poster).
27. Suejin Park, **Youyoun Moon**, and Nicole L. Waterland, (2016) The effect of exogenous calcium and osmotic stress on temporary water stress tolerance in bedding plant seedlings. 113th Annual Meeting, American Society of Horticultural Science (poster, number 391)
28. Sarah A. Mills, **Youyoun Moon**, and Nicole L. Waterland (2016) The interactive effect of elevated carbon dioxide, temperature, and water deficit stress on growth and flower development of petunia (*Petunia ×hybrida*). 113th Annual Meeting, American Society of Horticultural Science (poster, number 390).
29. Sarah A. Mills, **Youyoun Moon**, and Nicole L. Waterland (2016) Effect of CO₂, temperature, and water deficit on petunia flowering. 5th International Controlled Environment Conference/AusPheno (oral).
30. Sarah A Mills, **Youyoun Moon**, and Nicole L. Waterland (2015) The interactive effect of CO₂, temperature, and water on growth and flowering of *Petunia ×hybrida*. 112th Annual Meeting, American Society for Horticultural Science (poster, number 212)
31. Park, S., **Moon Y.** and Waterland N. L. (2015) Transcriptome Analysis of *Petunia xhybrida* under Water Stress using RNA Sequencing. 112th Annual Meeting, American Society of Horticultural Science (Oral)
32. Suejin Park, Sarah Mills, **Youyoun Moon**, and Nicole L. Waterland (2014) Effects of antitranspirants of enhancing temporary drought tolerance in bedding plants. 111th Annual Meeting, American Society for Horticultural Science (poster, number 002)
33. Madelynn Harwell, Janet Tou, **Youyoun Moon**, and Nicole Waterland (2014) Lettuce is more than just a salad: An analysis of antioxidants and phylogenetics. 2014 Summer Undergraduate Research Symposium (poster)

34. Nicole Waterland and **Youyou Moon** (2013) Plant biotechnology to increase drought and/or heat tolerance. LIINC (Linking Innovation, Industry and Commercialization), focused on environmental sciences (poster)
35. Haley Dugan, **Youyou Moon**, and Nicole L. Waterland (2012) Characterization of ethylene-responsive transcription factors (*ERFs*) in *Petunia ×hybrida*. 2012 Summer Undergraduate Research Symposium (poster); 2nd place
36. Vincent A. Brazelton, Jr., **Youyou Moon**, and Nicole L. Waterland (2012) Transcript abundance of calcium-dependent-protein kinase under drought and heat stress in *Petunia ×hybrida*. 2012 Summer Undergraduate Research Symposium (poster)
37. Jenny Druckrey, **Youyou Moon**, Nicole L. Waterland, and William Anderson (2011) Surviving climate change: Development of heat and drought tolerant crops using petunia as a model system. ASA, CSSA, and SSSA Annual Meetings (oral)
38. Jenny Druckrey, **Youyou Moon**, and Nicole L. Waterland (2011) Improved drought tolerance using transient over-expression in Petunia (*Petunia ×hybrida* ‘Mitchell’). 2011 Summer Undergraduate Research Symposium (poster)

PREVIOUS AND CURRENT INDUSTRY SPONSORS

Philips Co., The Netherlands
 Fluence, Texas USA
 Roscolux®, New York USA
 iGrow lighting Co., Ohio USA
 Venntis Technologies, LLC, Michigan USA
 LumiGrow, California USA
 Revolution Lighting Technologies, Connecticut USA
 Heliospectra, Sweden
 RainSoil Nevada, USA
 Charcoball, Tokyo Japan

AWARDS AND HONORS

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| Sigma Xi | at West Virginia University |
| Phi Kappa Phi inductee | at The Ohio State University (GPA 3.95/4.0 scale) |
| Gamma Sigma Delta inductee | at The Ohio State University |
| Pi Alpha Xi inductee | at The Ohio State University |
| Travel Grant Award for 2008 ASHS meeting | at The Ohio State University |

Oral presentation (1st place) at Horticulture and Crop Science Graduate Retreat
 at The Ohio State University
 Minority Scholar Award at Iowa State University
 Teaching Excellence Award at Iowa State University
 PACE (Pre ACademic Excellence) award at Iowa State University
 Academic Excellence Award at Seoul National University
 (GPA 4.02/4.3 scale)

MEMBERSHIPS AND ACTIVITIES

Review board member of the International Journal of
 Environmental Research and Public Health (2022 – Current)
 Editorial member of the Journal of Ginseng Culture (2020 – Current)
 HortTech Reviewer (2010-Current)
 Poster Judge at American Society for Horticultural Sciences (2017)
 ISEF (International Science and Engineering Fair) sponsored by Intel. Co.
 Judge at Pittsburg (2015)
 Member of AmericanHort
 Member of The American Association for the Advancement of Science (AAAS)
 Member of American Society of Horticultural Science (ASHS)
 Translator for International Agriculture Workshop for Korean Delegates, Columbus Ohio
 Graduate Seminar Committee Member at The Ohio State University (2007-2009)
 Teaching Assistant Orientation Panel member at Iowa State University
 Teaching Assistant Orientation Organization Member at Iowa State University
 Volunteer at the Mary Greeley Medical Center in Ames, Iowa (Department of Oncology)

ACADEMIC ADVISING ACTIVITIES AT WVU

As Graduate Committee Member:

| | | |
|-----------------|--------------------|----------------|
| Marlo Vandiver | (Horticulture) | (2022-Current) |
| Savana Nead | (Horticulture) | (2022-Current) |
| Tristan Sanders | (Biochemistry) | (2021-Current) |
| Suejin Park | (Horticulture) | (2016-2019) |
| Sarah Mills | (Horticulture) | (2017-2021) |
| Rachel Newman | (Dietetic Program) | (2017-2021) |
| Rhiannon Newton | (Horticulture) | (2020-2021) |
| Emilie Burgess | (Dietetic Program) | (2016-2017) |
| Emily Bauman | (Dietetic Program) | (2016-2017) |

As Advisor:

Biochemistry major undergraduate (17 students) since 2020

SURE

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|--------------|----------------|-------------|
| Isabel Weeks | (Biochemistry) | (2021-2022) |
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Far-red LED light increased shoot height and boron uptake in kale
(*Brassica oleracea*)

RAP

Abby Ruth (Biochemistry) (2023-2024)
The effects of green LED light on plant growth and development

Capstone Advisor/Supervisor

Destiny Jackson (Biochemistry) (2021-2022)
The effects of AntiOxi® on heat resistant tolerance in kale
Juan Casas Doza (Biochemistry) (2021-2022)
The effects of HeatRis® on heat resistant tolerance in spinach

Independent Study (Undergraduate Students):

Amanda Hamilton (Horticulture)
Utilization of Roscolux® filters to enhance secondary
metabolites in Lettuce (*Lactuca sativa*)(2014 - 2015)
Madelyn Harwell
(Animal Science, now in School of Dentistry)(2014)
Lettuce phylogenetic analysis
Lindsey Elswick (Animal Science) (2014)
Cloning genes associated with drought stress in petunia
Erin Young (Agroecology) (2013-2014)
Effect of monospectrum light on lettuce germination and
seedling development
Erin Jahnes (Biology) (2013-2014)
Volatile profile during drought stress in petunia
Richard Farmer (Agronomy) (2013 Spring)
Growing media comparison for medicinal plants

Course: (Graduate Students)

Heather Heaster (School of Dentistry) (2013-2014)
Jackie Johnson (School of Dentistry) (2013-2014)
Effect of various secondary metabolites obtained from
ornamental plants on microflora in human mouth
Jake Goldner (Entomology) (2014-2015)
Matthew McKinney (Entomology) (2014-2015)
Generating RNAi petunia to evaluate pollinator behavior

As Mentor:

Undergraduate Research Experience

Tristan Sander (Biochemistry) (2018-Current)
Hannah Petronek (Biochemistry) (2018-2020)
Olivia Friel (Biochemistry) (2017-2019)

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|-----------------|----------------|--------|
| Nathan Howell | (Biochemistry) | (2017) |
| Dylan Miller | (Biochemistry) | (2017) |
| Tanuj Nanda | (Biochemistry) | (2017) |
| Morgan Schuerch | (Biochemistry) | (2017) |
| Matt Pyster | (Biology) | (2016) |

Undergraduate Honor Thesis Research Program:

| | | |
|--------------|-----------|-------------|
| Erin Jahnes | (Biology) | (2013-2014) |
| John Lindsay | (Biology) | (2012-2013) |

Characterization of transcription factors associated with drought stress in petunia

NSF Research Experiences for Undergraduates Summer:

Jenny Druckrey, Biotechnology,
University of Wisconsin, River Falls, WI (2011)
Haley Dugan, Neuroscience, (Currently at U. of Chicago, Neuroscience)
Kenyon College, Gambier, OH (2012)
Vincent Brazelton, Jr., (Currently MS student in Iowa State University)
Tuskegee University, Tuskegee, AL (2012)

As Teaching Assistants Supervisor:

| | | |
|---|--|-------------|
| Bikash Deo | | (2022) |
| Amanda Hamilton (Horticulture) | | (2015) |
| Tiffany Fess (Agricultural Sciences) | | (2013-2015) |
| Robert Bills (Plant Pathology) | | (2013) |
| Aaron Lutz (Forestry and Natural Resources) | | (2013) |
| Joni Myers (Animal Science) | | (2014) |

RESEARCH EXPERIENCE

Current and Future Research Projects at West Virginia University

- Optimization of crop production in controlled environment utilizing automated irrigation system and programmable LEDs**
- Effect of ten different single light spectrum on mineral uptake in kale and lettuce in controlled environment**
- Construction of over expression vector for high throughput screening using TMV based cloning vector pJL36**
- Proteome and metabolome analyses; Effect of light spectra generated by light emitting diode (LED) on secondary metabolite production using phytochromes, cryptochromes, and hormone mutants of Arabidopsis**
- Optimization of transcription activator-like effector nuclease (TALEN) and CRISPR-Cas9 cloning**
- Increased production of ginsenosides and saponins in *Panax ginseng* root using *Agrobacterium rhizogens* mediated transformation**
- Generation of phytochromes (PHYs), cryptochromes (CRYs), and hormone (ABA, GA, AUX, CK, ETR, JA, SA and BR) mutants of Lettuce (*Lactus sativa*) and kale (*Brassica oleracea*) using clustered regularly interspaced short palindromic repeats/CRISPR associate 9 (CRISPR/Cas9) technology**
- Discovery of new pharmaceutical molecules (antibiotics, and antiobesity) utilizing combination of computer simulation and high throughput metabolome and proteome data from GC/LC-MS**

Other Research Projects at West Virginia University

- Medicinal Plants** (collaboration with USDA, Ames, IA)
 - Ginseng seed germination** – to enhance germination rates of ginseng seeds using combinations of fluridone, norflurazon and GA
 - Mint** – to evaluate efficacy of mints on antibacterial property
 - Artemisia** – to increase production of artemisinin utilizing stress and monochrome light spectrum (Collaborated with Dr. Vagner Benedito at WVU)
- Effect of full spectrum lighting systems and photography filters on horticultural crop production and enhancement of secondary metabolites**

Roscolux® filters

To evaluate feasibility of photography filters on agricultural crop production as different light spectral sources (sponsored by Roscolux Co., USA)

Full spectrum lighting system

To evaluate induction lighting system, solid state volumetric lighting system, and plasma lighting system (sponsored by iGrow Lighting Co., Total Grow Solid State Volumetric Lighting Co. Michigan, and Chameleon Plasma Grow Lighting Co., Florida USA, respectively) on flowering time (petunia and tomato), and secondary metabolites (lettuce, kale, arugula and tomato)

LED

To evaluate single or combinations of monochrome light spectrum using following LED lighting systems (sponsored by LumiGrow, California USA; Revolution Lighting Technologies Connecticut USA; Heliospectra Co. Sweden; Philips Co. The Netherlands) on seed germination, flowering time, biomass, biotic stresses, abiotic stresses, root and shoot generation during tissue culture

Previous Research Experience

at The Ohio State University

Graduate Research Associate (Department of Horticulture and Crop Science)
(Dr. Michelle Jones laboratory)

Ph. D. thesis project involved, 1) cloning of metacaspases from *Petunia ×hybrida* petal tissue using 5' and 3' RACE and bioinformatics tools, 2) expression study using qRT-PCR and semi quantitative RT-PCR, 3) enzymatic assay using fluorogenic substrates, 4) generation of point mutation using overlapping PCR strategy, 5) expression in *E. coli* strains and tobacco plants for recombinant protein production, 6) abundance and processing study using Western blot assay, 7) immunolocalization assay and image analysis using epifluorescent and confocal microscopes, 8) functional study using overexpression and underexpression of metacaspases utilizing Virus Induced Gene Silencing technique and RNAi lines generated by tissue culture, 9) two dimensional SDS-PAGE to identify differentially expressed proteins during petal senescence and putative substrates for metacaspases.

at Iowa State University

Research Associate (Department of Chemical Engineering)
(Dr. Ramon Gonzalez laboratory, currently at Department of Chemical & Biomolecular Engineering, Rice University)

Research project involved, 1) developing *E. coli* strains for higher production of ethanol for bio-fuel utilizing homologous recombination technique, 2) developing efficient transformation methodology with linearized DNA, 3) construction of plasmid clones for knockout mutation, 4) evaluation of organic products and ethanol using fermentation

techniques, and 5) training graduate and undergraduate students with molecular biology techniques.

I played a pivotal role to establish the first genetic engineering laboratory in the Department of Chemical Engineering and USDA grant was awarded to this project.

Research Associate (Department of Biochemistry and Biophysics)

(Dr. Robyt laboratory and collaboration with Dr. Doman Kim at School of Biological Sciences and Technology, Chonnam National University, South Korea)

Research project involved, 1) cloning of sucrose phosphorylase from *Leuconostoc mesenteroides* B-1149 and the expression in *E. coli*, 2) cloning of a dextransucrase from *Leuconostoc mesenteroides*, and 3) training graduate and undergraduate students with molecular biology techniques.

Two peer reviewed articles were published.

Research Associate (Department of Food Science and Technology)

(Dr. Jaylin Jane laboratory)

Research project involved, 1) developing projects to elucidate starch biosynthesis pathway utilizing cyanobacteria *Synechocystis* sp. PCC6803, 2) developing cyanobacterial strains to produce various forms of glycogens by transforming glycogen synthase and other branching enzymes, 3) developing efficient cyanobacterial transformation and insertional mutagenesis methods, 4) developing effective glycogen isolation method, 4) performing reducing sugar analysis, and 5) training a graduate student and undergraduate students with molecular techniques.

I played a key role to develop this project utilizing molecular biology technology. The results from this project were reported in 2 chapters of a Ph. D. dissertation.

Master of Science thesis (Molecular Cellular and Developmental Biology/Genetics Department)

(Dr. Alan Atherly laboratory, retired)

Research project involved, 1) cloning of delta 9 stearoyl-acyl carrier protein desaturase from soybean (*Glycine max*) utilizing cDNA and genomic DNA library, 2) construction of cDNA and genomic DNA libraries, 3) generating point mutations, and 4) enzymatic assay.

Other research experiences (Department of Botany/Genetics)

(Dr. Steven Gendel laboratory, currently at FDA at Chicago)

Research project involved; cloning and characterization of nitrate reductase in nitrogen fixing cyanobacteria *Anabaena nostoc*; performing Southern hybridization, sequencing and gene expression study under various nitrogen sources.

(Dr. Martin Spalding laboratory)

Research project involved; isolation, cloning and functional analysis of CO₂ concentrating proteins in *Chlamydomonas reinhardtii*; performing SDS-PAGE to identify differentially expressed proteins, protein sequencing, design degenerative primers to clone differentially expressed genes, and developing transformation methodology.

TEACHING EXPERIENCES

at West Virginia University

Division of Plant and Soil Sciences

Applied Biochemistry Literature Capstone Experience (2020)
Developing “Medical Agriculture” on-line minor (Current)
Medicinal Plants on-line under development (Current)
Plant Science (PLSC206) on-line (2015 - Current)
Beginner’s Guide (Genetics 101) on-line (2016 - Current)
Plant Science (PLSC206) for 3 semesters (2013-2015 and 2018-Current)
Principles of Genetics (Gen371) for 3 semesters (2013-2015, 2019-Current)

Department of Biology

General Biology (Bio101 & 102) for 3 semesters (2010 – 2012)
Plant Physiology (Bio350) for 3 semesters (2011 – 2012, Current)

at Fairmont State University

Science That Matters for 1 semester (2010-2011)
Human Biology 1000 for 3 semester (2010-2011)

at The Ohio State University

Science of Growing Plants (Horticulture and Crop Science 200) for 1 quarter
Study of environmental, genetic, and cultural factors which influence the cultivation of plants for food, fiber, ornamental and landscape uses

Issues in Biotechnology (Horticulture and Crop Science 597) for 1 quarter
Senior level class about what biotechnology is, how it works, and discuss issues in biotechnology utilizing plants, microorganisms and animals

at Iowa State University

(course descriptions are cited from the corresponding course websites)

General Biology (Biology 110) for 2 years

Life considered at cellular, organism, and population levels. Function and diversity of the living world. Presentation of basic biological principles as well as topics and issues of current human interest
(later became Biology 201/202)

General Biology (Biology 201/202 and laboratory) for 5 years

Text Book: Biology by Campbell & Reece 5 & 6th Edition

Biology 201: Introduction to the nature of life, including the cellular basis of life; the nature of heredity; evolution; diversity of microbial, plant, and animal life; and principles of ecology.

Biology 202: Introduction to the nature of life, including the cellular basis of life; energy relationships; the nature of heredity; evolution; form and function of microbial, plant, and animal life.

General Botany (Botany 207) for 2 years

Taxonomy and Characteristics of cell and tissue types in non-vascular and vascular plants. Anatomy of developing and mature stems, roots, and leaves, including secondary (woody) growth. Introduction to the special anatomy of flowers and seeds

(later merged into Bio201/202)

Plant Physiology (Botany 330 laboratory) for 1 year

Text Book: Plant Physiology by Taiz & Zeiger (2nd edition)

Application of physical and biological principles involved to the understanding of plant processes involved in assimilation, metabolism, and regulation of growth and development.

Genetics (Genetics 320) for 3 years

Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics
(currently Principles of Genetics Bio313)

Genetic Engineering (Genetics 520) for 1 year

Strategies and methods of gene cloning, restriction endonuclease mapping, southern hybridization, isolation and manipulation of plasmid DNA, and detection of specific genes in bacteria.

TEACHING ENHANCEMENT ACTIVITIES

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| Participant, Quality Matters Workshop, Morgantown | (2015, 2016) |
| Participant, CELEBRATE at WVU | (2014, 2015) |
| Participant, National Academies Summer Institute at WVU | (2012) |
| Participant, West Virginia Great Teachers Seminar, | (2011) |