

## HaiHua Wang, Ph.D.

### Postdoctoral Associate

Department of Plant & Soil Science, Texas Tech University

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### **PROFESSIONAL PREPARATIONS**

- 2025— **Postdoctoral Associate in Plant Biology, Omics, Bioinformatics** (Advisor: Mariam Berdeja)  
Department of Plant & Soil Science, Texas Tech University, TX, USA
- 2021—2025 **Postdoctoral Associate in Microbial Ecology** (Advisor: Hui-Ling Liao)  
Department of Soil, Water, and Ecosystem Sciences, University of Florida, FL, USA.
- 2020—2021 **Postdoctoral Research Scholar in Plant Pathology** (Advisor: Changkeun Sung)  
Department of Agriculture and Life Science, Chungnam National University, South Korea.
- 2016—2020 **Ph.D. in Plant Pathology** (Advisor: Changkeun Sung)  
Department of Agriculture and Life Science, Chungnam National University, South Korea  
*Dissertation: In vivo* interaction studies between pinewood nematode and nematophagous fungus *Esteya vermicola*.
- 2013—2016 **M.S. in Soil Microbiology** (Advisor: Chunyan Wang)  
Department of Forestry, Northwest Agriculture & Forest University, China  
*Thesis: Seasonal dynamics of rhizospheric and root endophytic microbial community of*  
*Pinus tabulaeformis* and *Pinus armandii* in Qinling Huoditang.
- 2009—2013 **B.S. in Biotechnology** (Advisor: ShiGuo Li)  
Department of Biological Science, Shandong Normal University, China

### **PROFESSIONAL APPOINTMENTS**

- 2024—2025 **Adjunct Lecturer**, Department of Pharmaceutical Botany, Linyi University, China.
- 2016—2020 **Graduate Research Assistant**  
Department of Agriculture and Life Science, Chungnam National University, South Korea.
- 2016—2016 **Research Assistant**  
Department of Forest Protection, Northwest Agriculture & Forest University, China.
- 2015—2016 **Visiting Scholar**  
Department of Agriculture and Life Science, Chungnam National University, South Korea.

## **PROFESSIONAL ASPIRATIONS**

I aim to advance microbiome-enabled strategies that improve the resilience and sustainability of agricultural and forest ecosystems. My long-term goal is to lead interdisciplinary research that translates mechanistic insight into practical microbial interventions for mitigating biotic stresses (pathogens, nematodes) and abiotic stresses (drought/heat, heavy metals, climate change). I value collaborative, data-driven science and am committed to communicating research outcomes clearly to accelerate adoption, reproducibility, and innovation across the microbiome community.

## **PROFESSIONAL INTERESTS**

My research is dedicated to advancing the understanding of microbial and ecological interactions to address critical challenges in agriculture and forest ecosystems. My work primarily focuses on **plant-microbial interactions**, with a particular emphasis on the roles of **mycorrhizal fungi** and **saprotroph** in enhancing plant health, nutrient uptake, and ecosystem sustainability. I investigate how these interactions influence **soil microbial ecology** and **biogeochemistry**, including processes like **soil organic matter decomposition** and **nutrient cycling** (carbon, nitrogen). In addition, my research focuses on the molecular mechanisms of symbiotic fungi regulate partner plant tolerance to environmental stresses (drought/heat, heavy metals, climate change). My research also explores the dynamics of microbial communities in soil and plant systems, aiming to develop microbial-based solutions for sustainable agriculture and forest management.

Another aspect of my work involves studying **plant pathogens** and **soil-borne diseases**, such as pine wilt disease, and developing **biological control** strategies using fungi like *Esteya vermicola* to control nematodes and other pathogens. Also, my research work focuses on the management of **soft rot disease** using plant rhizosphere microbiome. Through generating a **synthetic microbial community** (SynCom), using the microbes isolated from rhizosphere soil, to effectively reduce threats from soft rot disease.

To analyze these complex interactions at molecular and ecological scales, my work employs **multi-omics**, **bioinformatics**, and **geospatial modeling** approaches, including metagenomics, metatranscriptomics, and metabolomics. These tools help to explore how plants and microbes respond to environmental stress, such as heavy metal contamination and climate change. In addition, I developed a bioinformatic tool ([MicroFisher](#)) to classify the fungal communities from next generation sequencing datasets. Applying interdisciplinary approach also emphasizes collaboration and the development of innovative bioinformatic pipelines to advance microbiome applications.

My research is driven by a commitment to fostering sustainability in agricultural and forest systems, addressing both biotic stresses (e.g., pathogens, nematodes) and abiotic stresses (e.g., heavy metals, climate change). By integrating ecological, molecular, and computational methods, my work aims to contribute to the development of resilient ecosystems and sustainable land management practices.

## **KEYWORDS**

- Plant-microbial interactions
- Mycorrhizal fungi (EMF, AMF)
- Soil organic matter decomposition
- Biological control
- Soil-borne disease
- Geospatial modeling
- Environmental stress biology (drought, heavy metals, climate change)
- Soil microbial ecology
- Soil biogeochemistry
- Plant pathogens
- Agricultural and forest ecosystem sustainability
- Synthetic microbial community
- Bioinformatics
- Multi-omics (metagenomics, metatranscriptomics, metabolomics)

**COMPETITIVE RESEARCH FUNDINGS AND GRANTS**

- 2025 **Wang H.H. (PI)**. Plant-mycorrhizal-decomposer interactions in forest ecosystems and their functions in soil organic matter decomposition (National Natural Science Foundation of China, # 32400097, ¥300,000 CNY).
- 2025 Tiffany V. (PI), **Wang, H.H. (co-PI)**, Tappero R., Liao, H.L., 2D XRF Imaging of Zinc in the *Pinus-Suillus* Mycorrhizal system (BNL/NSLS2, #GU-318492).
- 2025 Liao H.L. (PI) and **Wang H.H. (co-PI)**. How tree-symbiont-microbiome interactions mediate heavy metal tolerance and soil biogeochemistry. (BNL/NSLS2, #GU- 318951).
- 2024 Tiffany V. (PI), **Wang, H.H. (co-PI)**, Tappero R., Liao, H.L., Branco S., Vilgalys V. In Situ XRF Imaging of Zinc in the *Pinus-Suillus* Mycorrhizal system (BNL/NSLS2, #GU-315670).
- 2023–2024 Fletcher J (PI), **Wang H.H. (co-PI)**, Branco S., and Liao H.L. Zinc tolerance in the *Pinus contorta-Suillus tomentosus* ectomycorrhizal system (DOE Joint Genome Institute, #509348, \$50,000 USD).
- 2023 Liao H.L. (PI) and **Wang H.H. (co-PI)**. Leaf Endophytes & Mycotoxin Training, and Diagnostic Advancement Lab Demonstration (UF Unit Funds, #32196).
- 2023 Liao, H.L. (PI), **Wang, H.H. (co-PI)**. Roles of ectomycorrhizal fungi in regulating trace elements in host plants under heavy metal contamination scenarios (BNL/NSLS2, #GU-314340).
- 2023 Tiffany V. (PI), Tappero R., Liao, H.L., Branco S., Vilgalys V., **Wang, H.H. (co-PI)**, Zhang K. Multi-scale XRF Imaging of Zinc distribution in the *Pinus-Suillus* Mycorrhizal system (BNL/NSLS2, #GU-312722).
- 2022–2023 Liao H.L. (PI) and **Wang H.H. (co-PI)**, et. al. Interactions among *Pinus*, ectomycorrhizal fungi, and wood decomposer in regulating the dynamics of iron chemistry and soil nutrient fluxes (BNL/NSLS2, #GU-310849).
- 2017–2020 **Wang H.H. (PI)**. Apply the nematophagous fungi *Esteya vermicola* to protect susceptible pine from pinewood nematode invasion (China Scholarship Council, #201708260056, \$80,000 USD; Fellowship).

**In Preparation & Submission**

- 2025 **Wang, H.H. (co-PI)**. How community-level interactions among trees, their symbionts, and free-living microbiomes contribute to heavy metal tolerance in contaminated environments (NSF, not award)
- 2026 **Wang, H.H. (co-PI)**. Building a Soil Microbiome Atlas for the Texas High Plains AVA: Linking Microbial Terroir to Vine Health and Fruit Quality (USDA-NIFA, under review)
- 2026 **Wang, H.H. (PI)**. How biochar amendment influences functional microbial networks, soil health, and wine grape berry quality and yield in Texas viticulture systems (USDA-SARE, under review)

**ACADEMIC SERVICES*****Guest Editor***

2023–2024	Sustainable Forestry (Special Issue “Impact of Soil Microbe on Forest Vegetation Growth and Ecosystem Health”)
2024–2025	Forests (Special Issue “Plant Microbiome: Functional Roles and Implications for Forest Health”)
2026	Forests (Special Issue “Tree Health and Mycorrhizal Fungal Communities”)
2026	Jove (Special Issue “Methodological Advances in Microbial Ecology for Mechanistic Insights into Ecosystem Functions”)

***Membership***

American Forage & Grassland Council  
Genetics Society of America

***Conference Organizations***

2025	Chair for the Session " <i>Latest Methodologies for Fungal Studies</i> " at Mycological Society of America (MSA) 2025 Annual Meeting, Madison, Wisconsin, USA.
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***Peer Review***

2023	Frontiers in Microbiology (3), Molecular Ecology (1), Medicine (1).
2024	Forests (2), Global ecology and conservation (2), Science of the Total Environment (1), Biology (1), Rhizosphere (1).
2025	Forests (2), Plants (2), International journal of molecular sciences (2), Antioxidants (1), Microorganisms (1), Pharmaceuticals (1), Journal of Fungi (1), Diversity (1).
2026	Agriculture (1), Plants (1).

**SELECTED SCHOLARSHIPS AND AWARDS**

2024	Research workshop Award (Argonne National Laboratory, \$1,000 USD)
2017-2018	International Graduate Student Fellowship (\$60,000 USD, China Scholarship Council)
2016-2020	Outstanding Graduate Fellowship (~\$20,000 USD, Chungnam National University)
2019	Distinguished Doctoral Scholar Award (Chungnam National University)
2013-2016	Graduate Student Fellowship (~\$7,200 USD, Northwest A&F University)
2013	Outstanding Graduate Student Award (Shandong Normal University)
2011/2012	The Specialized Scholarship (\$400 USD, Shandong Normal University)
2012	Excellent Student Cadre (Shandong Normal University)
2012/2011	Outstanding Cadres of Student Union (Shandong Normal University)
2010	Outstanding Cadres of Student Union (Shandong Normal University)
2010	Outstanding Student (Shandong Normal University)
2010	The First Prize Scholarship (\$700 USD, Shandong Normal University)
2010	National Encouragement Scholarship (\$1,200 USD, Chinese Ministry of Education)

**PROFESSIONAL EXPERIENCE****Texas Tech University****Department of Plant & Soil Science, Texas Tech University, TX, US****Postdoctoral Associate in Plant Biology, Omics, Bioinformatics****2025 - Current****(Full-time)**

- Investigate AMF-mediated enhancement of grapevine tolerance to drought and heat stress in viticulture systems by integrating multi-omics and plant physiological phenotyping to define mechanisms of stress adaptation.
- Develop geospatial models to characterize plant root-associated fungal distributions across semi-arid ecosystems and identify environmental drivers shaping community structure.

**University of Florida****Soil, Water, and Ecosystem Sciences Department (NFREC), FL, US****Postdoctoral Research Associate****March 2021 – June 2025****(Full-time)**

- Designed and executed plant–ectomycorrhizal fungi–saprotroph bioassays coupled with soil respiration measurements and multi-omics (metagenomics, metatranscriptomics, metabolomics) to quantify impacts on soil carbon cycling and terrestrial biogeochemistry.
- Integrated fluorescence in situ hybridization (FISH), nanoscale secondary ion mass spectrometry (NanoSIMS), and synchrotron X-ray fluorescence microscopy (including high-resolution scanning/pink-beam XFM) with multi-omics to resolve how mycorrhizal symbiosis regulates micro- and macronutrient flux from molecular/atomic to cellular scales.
- Led studies in heavy metal–contaminated ecosystems to define the roles of ectomycorrhizal fungi in metal detoxification and host adaptation; combined ectomycorrhizal bioassays with XFM imaging and meta-omics to elucidate mechanisms of fungal-mediated stress alleviation.
- Lead Plant-ectomycorrhizal fungi bioassays, applied metatranscriptomic and plant physiologic to reveal the molecular interactions of plant-mycorrhizal fungi and changes in phyllosphere microbiomes in response to climate changes (warming, elevated O<sub>3</sub> and CO<sub>2</sub>), as well as their impacts on microbial decomposition of soil organic matter.
- Developed SynCom-based rhizosphere interventions to reduce soil-borne pathogen pressure in konjac grown under intercropping systems.
- Built and maintained reproducible bioinformatic pipelines for fungal community profiling from metagenomic and metatranscriptomic datasets; developed MicroFisher, a multi-marker hypervariable framework for fungal taxonomic classification from Illumina short reads (Tool/Package: MircroFisher, <https://github.com/NFREC-Liao-Lab/MicroFisher>).
- Lead mycotoxin study to explore the distribution of mycotoxins in grass and its threat to the development of forage industry, investigations were conducted at microbial community (metataxonomic), genetic gene (qPCR), and metabolic (HPLC, GC-MS) levels.
- Perform the field study to understand the effects of arbuscular mycorrhizal fungi and legume-grass integration on mycorrhizal network-mediated nutrient movement, soil respiration, soil microbial community, and plant net primary production.
- Perform bioassays and applied X-ray Fluorescence imaging to track spatial and temporal dynamics of micronutrient (iron) in Plant-ectomycorrhizal symbiont that regulated by soil organic matter decomposition.

**Chungnam National University**  
**Agriculture and Food Technology Department, Daejeon, South Korea**  
**Postdoctoral Research Associate; Senior Researcher**

**March 2020 - Feb 2021**  
**(Full-time)**

- Led the study on adaptation of nematophagous fungi *Esteya vermicola* to plant defense system. Metatranscriptomic was applied to explore the functional genes involved in cellular tolerance of nematophagous fungi *E. vermicola* to plant defense compounds.
- Investigated the biocontrol effects of nematophagous fungi *E. vermicola* protects pine forests from the invasion of pinewood nematode in the field. This work was funded by and collaborated with Korea Forest Service Institute, the biocontrol agent *E. vermicola* product (G810) was applied to control pine wilt disease at Jeju Island, Cheonan, and Tongyeong in South Korea.
- Multi-omics studies to understand how intercropping of *Amorphophallus konjac* reduces the damage of soft rot disease. This study collaborated with Northwest A & F University scientists, metagenomic and metataxonomic was carried out to reveal the key taxa and functional genes underlying intercropping to prevent the *A. konjac* from soft rot disease.

**Chungnam National University**  
**Agriculture and Food Technology Department, Daejeon, South Korea**  
**Graduate Research Assistant; Senior Researcher**  
**Supervisor: ChangKeun Sung**

**Sept 2016 - Feb 2020**  
**(Full-time)**

- Developed gene editing approach for nematophagous fungi *E. vermicola* using the CRISPR (clustered regularly interspaced short palindromic repeats) Cas9.
- Developed an absolute quantification technique for the accurate detection of target organisms in environmental samples. This technique applied real-time qPCR, TaqMan probe PCR, nested PCR, and spike-in standard addition, which can accurately detect the species-specific gene of target organisms at genomic DNA concentration as low as  $10^{-5}$  ng.
- Led the study on *in vivo* live-cell visualization of nematophagous fungi *E. vermicola* colonization in host pine xylem and infection against pinewood nematode. The green fluorescence protein (GFP)-labeled *E. vermicola* mutant was applied to inspect and visualize the fungal colonization patterns in the host of pine xylem and pinewood nematode.
- Led the study on the spatial and temporal colonization patterns of *E. vermicola* in the host pine xylem and its response to pinewood nematodes using the TaqMan probe PCR quantification technique.
- Applied the biocontrol fungus *E. vermicola* to control pine wilt disease in fields. This work was collaborated with scientists from the Korea Forest Service Institute, National Forestry and Grassland Administration of China, Chinese Academy of Forestry, and South China Agricultural University to The field application of the biocontrol agent was carried out at Jeju Island (Korea), Guangdong (China), and Shenyang (China).
- Collaborated with scientists from Northwest A & F University and Qujing Normal University to study how ectomycorrhizal fungi (EMF) and dark separated endophytes (DSE) improve the susceptible pine resistance to pinewood nematode invasion.

**Chungnam National University**  
**Agriculture and Food Technology Department, Daejeon, South Korea**  
**Visiting Scholar**  
**Supervisor: ChangKeun Sung**

**Oct 2015 - April 2016**  
**(Full-time)**

- Developed a protective formula for *E. vermicola* spore storage to improve its germination and survival rate underlying extreme environments, such as drought, UV, low temperature, etc.

- Led the investigation on the tolerance of pinewood nematode to Abamectin toxicity, and adaption mechanisms of nematode in response to nematicide chemicals.

**Northwest Agriculture & Forest University**  
**Department of Forest Protection, Shaanxi, China**  
**Master Graduate Student**  
**Supervisor: ChunYan Wang**

**Sept 2013 - June 2016**  
**(Full-time)**

- Led the temporal and spatial distribution investigation of pine root and rhizosphere soil microbiome across seasons and altitudes, microbial community compositions using amplicon sequencing, and their correlation relationships with soil chemicals and enzyme activities were revealed.
- Performed the study on pine wilt disease alters soil properties and root-associated fungal communities in *Pinus tabulaeformis* forest. The impact of pine wilt disease on soil properties, root-associated fungal community and soil enzyme activity was conducted on three gradients of damaged stands (undisturbed, middle disturbed, and highly disturbed).
- Performed the studies on inoculation with dark septate endophytes (DSE) and ectomycorrhizal fungi (EMF) improve *Pinus tabulaeformis* Carr. seedling growth and resistance to pine wilt disease.

**TEACHING & MENTORSHIP*****Courses***

- 2024/Full **Lecture** at Linyi University (Department of Pharmaceutical Botany)  
**Course:** Plant and symbiotic microbe
- 2025/Spring **Guest Lecture** at Ohio State University (Department of Plant Pathology)  
 Delivered a lecture “Symbiome-Mediated Terrestrial Nutrient Processes and Environmental Adaptation in the Suillus-Pine Model: Highlighting X-ray Fluorescence Imaging Technology”.
- 2024/Spring **Guest Lecture** at Ohio State University (Department of Plant Pathology)  
 Delivered a lecture “Exploring symbiome-mediated terrestrial nutrient processes and environmental adaptation through the Suillus-pine model”.
- 2019/Spring **Teaching Assistant** at Chungnam National University (Plant Pathology)  
 Delivered a lecture “Soil microbiology and Plant Health”.

***Mentoring and Supervised Students***

- 2024-2025 Xiaotian Su (undergraduate student), Shanxi Agriculture University.  
**Publication:** Molecular mechanisms on the biological control of pine wilt disease using microorganisms
- 2024-2025 Panpan Meng (PhD student), Northwest Agriculture and Forest University.  
**Publication:** Intercropping with Robinia pseudoacacia Reduces Soft Rot Incidence in Konjac by Modulating Root Bacterial Community
- 2023-2025 Anna Iriarte (undergraduate student), University of Florida.  
 Mentor in DNA and RNA extraction and PCR procedures
- 2023 Pamella Sena (Visiting PhD student), Federal Rural University of Pernambuco, Brazil.  
 Mentor in DNA extraction and PCR procedures as well as processing raw sequencing data through Qiime2 and conducting data analyses in R
- 2022-2025 Benjamin Reimer (PhD student), University of Florida.  
 Mentor in bioassay studies to understand molecular response of pine-ectomycorrhizal fungi symbiosis to Cd contaminations.
- 2022 Simon Cole (undergraduate student; OPS); Embry-Riddle Aeronautical University  
 Mentor in developing a website server for users to link fungal sequences to their basic information (e.g., lifestyles and taxonomic information) and transporters
- 2019-2021 Jie Gao (Master student), Chungnam National University, Korea  
 Mentor in thesis study “Effect of environmental medium on the Growth of *Esteya vermicola* and Biocontrol of Pine Wilt Disease”.
- 2018-2019 Ran Tao (Master student), Chungnam National University, Korea  
 Mentor in thesis study “Apply nematophagous fungi *Esteya vermicola* to control pinewood nematode invasion in the field”.
- 2014-2015 Ting Nie (Undergraduate student), Northwest A & F University, China  
 Mentor in thesis study “Seasonal changes of the soil chemicals and enzymes in *Pinus tabuliformis* forests at Huoditang Forest Station, Qinling Mountains”.



## **OUTREACH AND SERVICES**

### ***Contributions to scientific outreach***

- 2023 Scout outdoor day: Boy Scouts Event. November 18, Local Scout Council, Quincy, FL.
- 2023 Forage Filed Day: Forage Microbes at Work. April 13, NFREC, Marianna, FL.
- 2022 Outreach presentation at the Tallahassee Science Festival. October 22, City of Tallahassee, Tallahassee, FL
- 2022 Outreach presentation at the Gadsden County 4H horticulture club. July 21, UF/IFAS Gadsden County Extension Office, Quincy, FL
- 2019 Outreach presentation at the Forest Pests and Pathogens Control Lab (Shenyang Institute of Technology, Shenyang, China) – Apply nematophagous fungi *Esteya vermicola* to control pine wilt disease in the field. July 20, International collaboration and communication.
- 2019 Outreach presentation at the Forest Protection Station (Forest Protection Department, Heyuan, China) – A field study of nematophagous fungi *Esteya vermicola* to biological control pine wilt disease. April 5, International collaboration and communication.
- 2018 Outreach presentation at the College of Forestry and Landscape Architecture (South China Agricultural University, Guangzhou, China) - Research advance of pine wilt disease and biological control of pinewood nematode using nematophagous fungi *Esteya vermicola*. April 16. International collaboration and communication.

### ***Contributions to the extension program***

- 2020-2021 Biological control of pine wilt disease in the field. Field Extension at Tongyeong, South Korea
- 2018-2019 Biological control of pine wilt disease in the field. Field Extension at Shenyang, China.
- 2017-2019 Biological control of pine wilt disease in the field. Field Extension at Heyuan, China.
- 2016-2019 Biological control of pine wilt disease in the field. Field Extension at Jeju Island, South Korea.
- 2017-2018 Biological control of pine wilt disease in the field. Field Extension at Cheonan, South Korea.

## **Laboratory & Analytical Techniques**

**Programming:** R, Python, Shell, Linux

**Bioinformatics:** Pipeline development; Transcriptomics, Metatranscriptomics, Metagenomics, Amplicon Sequencing; Metabolomics, Proteomics.

**Modeling:** Geospatial modeling.

**Statistics:** Classic methods, Linear and mixed models, Gene co-expression analysis, etc.

**Molecular biology:** DNA/RNA/Protein extraction, NGS library construction (cDNA and amplicon libraries), qPCR, TaqMan probe PCR, LC-MS/HPLC.

**Genetic engineering:** Fungal genetic editing.

**Biochemistry:** Plant/Soil enzyme activity assessment, plant hormone measurement.

**Imaging:** Synchrotron X-ray Fluorescence imaging, NanoSIMS, FISH.

**PUBLICATIONS** (\*corresponding author, † co-first author)**Peer-Reviewed Publications (26 publications)**

- 2026 Wang H.H., Wu S., Zhang K., Chen K-H, Vilgalys R., Liao H.L. ([MicroFisher software](#)) Multiple hypervariable markers improve mycobiome classification in metatranscriptome and metagenome data. *Communications Biology*. (In Press).
- 2025 Wang H.H., Zhang K., Tappero, R., Victor T., Bhatnagar J., Vilgalys R., Liao H.L. Inorganic nitrogen and organic matter jointly regulate ectomycorrhizal fungi-mediated iron acquisition. *New Phytologist*, 2025. <https://doi.org/10.1111/nph.20394>
- Su X., Luo Y., Hu J., Xia Y., Liu M., Li Y., Wang H.H.\*. Molecular mechanisms on the biological control of pine wilt disease using microorganisms. *Microorganism*, 2025. <https://doi.org/10.3390/microorganisms13061215>
- 2024 Wang H.H., Yulou Sun, Can Yin, Jie Gao, Jingfei Hu, Chungkeun Sung, Chunyan Wang, Zhen Wang. Unraveling the Interactions of *Esteya vermicola*, the Pinewood Nematode, and Pine Hosts: Insights into Population Dynamics and Molecular Responses. *Chemosphere*, 2024. <https://doi.org/10.1016/j.chemosphere.2024.142948>
- Meng P.P., Xin K.X., et al., Wang H.H.\*, Wang C.Y. Intercropping with *Robinia pseudoacacia* Reduces Soft Rot Incidence in Konjac by Modulating Root Bacterial Community. *Pest Management Science*, 2024. <https://doi.org/10.1002/ps.8405>
- Lofgren, Lotus, Nhu H. Nguyen, Peter Kennedy, Eduardo Pérez-Pazos, Jessica Fletcher, Hui-Ling Liao, Wang H.H. et al. Suillus: an emerging model for the study of ectomycorrhizal ecology and evolution. *New Phytologist*, 2024. <https://doi.org/10.1111/nph.19700>
- Feng, H., Xin, K., Chen, W., Meng, P., Tang, X., Wang, H.H., & Wang, C. Transcriptome analysis reveals diverse *Curvularia tsudae* strategies in response to cadmium stress. *Chemosphere*, 2024. <https://doi.org/10.1016/j.chemosphere.2023.141093>
- 2023 Zhang, K. †, Wang, H.H. †, Tappero, R., Bhatnagar, J. M., Vilgalys, R., Liao, H. L. Ectomycorrhizal fungi enhance pine growth by stimulating iron-dependent mechanisms with trade-offs in symbiotic performance. *New Phytologist*, 2023. <https://doi.org/10.1111/nph.19449>
- Luo, H., Wang, C.Y., Zhang, K.L., Ming, L., Chu, H.L., Wang, H.H.\* Elevational changes in soil properties shaping fungal community assemblages in terrestrial forest. *Science of The Total Environment*, 2023. <https://doi.org/10.1016/j.scitotenv.2023.165840>
- Feng H., Meng P.P., Zhang S., Chen W., Wang H.H., Wang C.Y. Insights from comparative transcriptome analysis in the responses of Pb-tolerant fungi *Curvularia tsudae* to Pb stress. *Ecotoxicology and Environmental Safety*, 2023. <https://doi.org/10.1016/j.ecoenv.2022.114476>
- 2021 Wang, H. H., Wang, C. Y., Wang, Y. B., et al. Migration of pinewood nematode promotes the colonization of *Esteya vermicola* in pine tree. *Forest Pathology*, 2021. <https://doi.org/10.1111/efp.12668>
- Wang H. H., Chu H. L., Dou, Q., et al. Seasonal changes in *Pinus tabulaeformis* root-associated fungal microbiota drive N and P cycling in terrestrial ecosystem. *Frontiers in microbiology*, 2020. <https://doi.org/10.3389/fmicb.2020.526898>

- Chu, H.L., **Wang, H.H.**, Zhang, Y., et al. Inoculation With Ectomycorrhizal Fungi and Dark Septate Endophytes Contributes to the Resistance of Pinus spp. to Pine Wilt Disease. *Frontiers in microbiology*, 2021. <https://doi.org/10.3389/fmicb.2021.687304>
- Feng, H., Dou, Q., Yang, C., Xie, Q.Z., **Wang, H.H.**, & Wang, C.Y. Sexual Differences in Growth and Physiological Characteristics of *Populus cathayana* under Pb Stress and *Leucoagaricus* sp. Colonization. *Polish Journal of Environmental Studies*, 2021. <https://doi.org/10.15244/pjoes/125768>
- 2020 **Wang, H. H.**, Wang, Y. B., Yin, C., et al. *In vivo* infection of *Bursaphelenchus xylophilus* by the fungus *Esteya vermicola*. *Pest Management Science*, 2020. <https://doi.org/10.1002/ps.5839>
- Wang H. H.**, Yin C, Gao J, et al. Development of a real-time TaqMan PCR method for absolute quantification of the biocontrol agent *Esteya vermicola* [J]. *Plant Disease*, 2020. <https://doi.org/10.1094/PDIS-10-19-2076-RE>
- Yin, C., Wang, Y.B., Zhang, Y. A., **Wang, H.H.**, Duan, B.B., Tao, R., & Sung, C. K. Hypothesized mechanism of biocontrol against pine wilt disease by the nematophagous fungus *Esteya vermicola*. *European Journal of Plant Pathology*, 2020. <https://doi.org/10.1007/s10658-019-01930-9>
- 2019 Yin, C., Wang, Y. B, Zhang, Y. A, **Wang, H. H.**, Sung, C. K. A pine wood sample preparation method for high target and quality DNA extraction for detection of *Esteya vermicola* by PCR from living pine. *Journal of basic microbiology*, 2019. <https://doi.org/10.1002/jobm.201800522>
- Chu, H. L, Wang, C. Y, Li, Z. M, **Wang, H. H.**, Tang, M. The Dark Septate Endophytes and Ectomycorrhizal Fungi Effect on *Pinus tabuliformis* Carr. Seedling Growth and their Potential Effects to Pine Wilt Disease Resistance. *Forests*, 2019. <https://doi.org/10.3390/f10020140>
- Feng H., Meng P.P., Dou Q., Zhang S.X., **Wang H.H.**, Wang C.Y. Advances in mechanisms of nutrient exchange between mycorrhizal fungi and host plants. *The Journal of Applied Ecology* 30 (10), 3596-3604, 2019. <https://doi.org/10.13287/j.1001-9332.201910.034>
- 2018 **Wang, H. H.**, Chu, H. L., Dou, Q., et al. Phosphorus and nitrogen drive the seasonal dynamics of bacterial communities in *Pinus* Forest rhizospheric soil of the Qinling Mountains. *Frontiers in microbiology*, 2018, 9. <https://doi.org/10.3389/fmicb.2018.01930>
- Chu, H. L, Tang, M., **Wang, H. H.**, & Wang, C. Y. (2018). Pinewood nematode infection alters root mycoflora of *Pinus tabuliformis* Carr. *Journal of applied microbiology*, 2018. <https://doi.org/10.1111/jam.13883>
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- 2016 **Wang H. H.**, Chu H. L., Xie Q. Z., et al. Variation in Sporulation of Four *Esteya vermicola* Isolates and their Infectivity Against Pinewood Nematode[J]. *Scientia Silvae Sinicae*, 2016. <https://doi.org/10.11707/j.1001-7488.20160917>
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### **Books and Chapters (1 publications)**

- 2025 **Wang, H. H.** \* “Advanced bioinformatics explores mycological composition and function from metatranscriptomic sequencing” in "Mycorrhiza - Research, Practical Application and Future Prospects". IntechOpen, 2025. DOI: 10.5772/intechopen.1012591

### **Extension publications (2 publications)**

- 2025 Hui-Ling Liao, Kaile Zhang, Vijay Verma, **Haihua Wang**, Brittany Justesen, et al. Survey of Mycotoxins Present in Florida Pastures Across Time, Locations, and Grass Species. EDIS, 2025. <https://doi.org/10.32473/edis-ss744-2025>
- 2024 Liao, H.L, **Wang, H.H.**, Zhang, K., Reimer B., et al. Preliminary update of rust disease in Florida warm season grasses. EDIS, 2024. (In Press)

### **Patents (2 approved)**

- 2021 **Wang, H. H.**, Yin C., Wang, Y. B., TAO, R., Gao, J., Duan B. B., Wang, C. Y., Wang, Z., Sung, C. K., A novel method to control pine wilt disease with solid culture products of *Esteya vermicola*. CN109370949A
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### **Manuscripts in Preparation**

- [1] **Haihua Wang**, Steven Wu, Khalid Hameed, Alan Kuo, Kerrie Barry, Igor V. Grigoriev and Rytas Vilgalys, Hui-Ling Liao. Ectomycorrhizal fungi rewire plant-fungal molecular networks to enhance plant resilience under heavy metal stress. (*Microbiome*, Under Review)
- [2] Wen-Xing Hu, Zhen Wang, **Haihua Wang\***. Metatranscriptomics for Mycobiome: Advances and Challenges in Bioinformatic Analysis. (IMA Fungus, Under Review)
- [3] Panpan Meng, Chunyan Wang, **Haihua Wang\***. Intercropping with a leguminous tree suppresses konjac soft rot disease by enhancing rhizosphere microbial stability and functional robustness. (*Microbiome*, Under Review)
- [4] **Haihua Wang**, Kaile Zhang, Sara Bronco, Hui-Ling Liao. Intraspecific variation in *Suillus tomentosus* drives threshold-dependent ectomycorrhizal regulation of nutrient homeostasis and plant tolerance under metal stress. (Preparing)
- [5] Panpan Meng, Chunyan Wang, **Haihua Wang\***. AMF-mediated transcriptional reprogramming of cell wall genes rewires *Catalpa bungei* drought resistance. (Preparing)

**PRESENTATIONS AND POSTERS**

- 2025 **Haihua Wang**, Steven Wu, Kaile Zhang, Ko-Hsuan Chen, Rytas Vilgalys, Hui-Ling Liao. MicroFisher: Fungal taxonomic classification for metatranscriptomic and metagenomic data using hypervariable markers. Mycological Society of America (MSA) 2025 Annual Meeting, Madison, Wisconsin, USA. (Oral presentation)
- 2025 **Haihua Wang**, Kaile Zhang, Steven Wu, Khalid Hameed, Alan Kuo, Kerrie Barry, Igor V. Grigoriev, Rytas Vilgalys, Hui-Ling Liao. Symbiont-mediated mechanisms of *Pinus taeda* and its root mycobiome in response to soil heavy metal contamination. Mycological Society of America (MSA) 2025 Annual Meeting, Madison, Wisconsin, USA. (Oral presentation)
- 2025 **Haihua Wang**, Kaile Zhang, Jennifer Bhatnagar, Rytas Vilgalys, Kerrie Barry, John Cliff, Jeremy Bougoure, Dehong Hu, Sarah Leichty, Hui-Ling Liao. How do inorganic nitrogen and organic matter regulate plant-mycorrhiza-saprotroph interactions and soil biogeochemistry? Mycological Society of America (MSA) 2025 Annual Meeting, Madison, Wisconsin, USA. (Oral presentation)
- 2025 Benjamin Reimer, Kaile Zhang, **Haihua Wang**, Jessica Fletcher, Sara Branco, Hui-Ling (Sunny) Liao. Tolerance of North American Pine-Fungal Symbiosis to Cadmium Contaminated Soils. Mycological Society of America (MSA) 2025 Annual Meeting, Madison, Wisconsin, USA. (Oral presentation)
- 2025 **Haihua Wang**, Kaile Zhang, et al. Mycotoxin detection methods at chemical and molecular levels. 2025 American Forage and Grassland Council Annual Conference. January 13, FL, USA. (Poster Presentation).
- 2025 **Haihua Wang**, Kaile Zhang, Hui-Ling Liao. Inorganic nitrogen and organic matter jointly regulate ectomycorrhizal fungi-mediated iron acquisition. SWES Research Forum, University of Florida. January 25, FL, USA. (Poster Presentation)
- 2025 Benjamin Reimer, **Haihua Wang**, Kaile Zhang, et al. Ergot-Infested Seed heads in Florida Bahiagrass Pastures. 2025 American Forage and Grassland Council Annual Conference. January 13, FL, USA. (Poster Presentation).
- 2025 Kaile Zhang, Hui-Ling Liao, **Haihua Wang**, et al. Endophyte and mycotoxin advancement laboratory: Research and Service update. 2025 American Forage and Grassland Council Annual Conference. January 13, FL, USA. (Poster Presentation).
- 2024 **Haihua Wang**, Kaile Zhang, Ryan Tapper, et. al. The availability of inorganic nitrogen and organic carbon manipulates ectomycorrhizal fungi-mediated iron acquisition in the forest ecosystem. 2024 DOE PI meeting, April, DC, USA (Poster presentation)
- 2024 Steven Wu, **Haihua Wang**, Kaile Zhang, Ko-Hsuan Chen, Rytas Vilgalys, Hui-Ling Liao. 2024. MicroFisher: Fungal taxonomic classification for metatranscriptomic and metagenomic data using multiple short hypervariable markers. Joint meeting of the IASC-ARS Interim Conference 2024 and CSAT 2024. December 13, Taiwan.

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- 2024 Kaile Zhang, Hui-Ling Liao, **Haihua Wang**, Ben Reimer, Vijay Verma, et al. Endophyte and Mycotoxin Advancement Laboratory: Research and service updates. 2024 FCA convention (Poster presentation).
- 2024 Hui-Ling (Sunny) Liao, Kaile Zhang, Valeria Mendez, **Haihua Wang**, et al. Grass endophytes and mycotoxins in Florida pastures. American Forage and Grassland Council Annual Conference. Selected Presenter.
- 2024 Blount, A., Chen, K.H., Liao, H.L., Jones, R., Justesen, B., Mackowiak, C., Mayo, D., Mendez, V., Reimer, B., Verma, V., Wallau, M., Walter, J., **Wang, Haihua**, Zhang, K.. Grass endophytes and mycotoxins in Florida pastures. American Forage and Grassland Council Annual Conference. Selected Presenter.
- 2023 **Haihua Wang**. Symbionts-mediated mechanisms of Pinus teada and its root microbiome grown in heavy metal-contaminated soils. 2023 FALL VIRTUAL POSTDOC SEMINAR SERIES, December, University of Florida, Gainesville, FL. (oral presentation)
- 2023 Chikae Tatsumi, **Haihua Wang**, Ko-Hsuan Chen, Hui-Ling Liao, Lucy R. Hutyrá, Pamela H. Templer, Jennifer M. Bhatnagar. Impact of Urbanization and Forest Fragmentation on Fungal Community Composition and Activity: A Focus on Functions for Maintaining Tree-Symbiosis and Driving Biogeochemical Cycles. AGU23, December, San Francisco, CA.
- 2023 **Haihua Wang**; Kaile Zhang; Valerie Mendez; Ko-Hsuan Chen; Sunny Liao. Applying qPCR to detect the mycotoxin-producing gene at molecular levels. 2023 NFREC, April, Quincy, FL.
- 2023 Kaile Zhang, **Haihua Wang**, Hui-Ling (Sunny) Liao. Identifying and quantifying mycotoxins through molecular techniques. NFREC, April, Quincy, FL. (oral presentation)
- 2023 Liao H-L, **Wang H.H.**, Vijay C Verma, Reimer Benjamin. Forage Microbes at Work. 2023 NFREC, April, Marianna, FL.
- 2023 Policelli N., Averill C., Brzöstek E., **Wang H.H.**, Liao H-L, Vijay C Verma, Tappero R., Corinne Vietorisz, Jake Nash, Rytas Vilgalys, Jennifer Bhatnagar. Would the increase in CO<sub>2</sub> emissions change the way microbes behave underground? 2023 ESA, August, Portland, Oregon.

- 2022 Zhang K., **Wang H.H.**, Tappero, R., Bhatnagar, J., Vilgalys R., Barry K., Keymanesh K., Tejomurthula S., Grigoriev I., Liao H.L., Mycorrhizae stimulate plant mechanisms for iron processes at the cost of symbiotic benefits. 2022 ASA, CSSA and SSSA Annual Meeting, Baltimore (MD)-Nov. 6-9 (oral presentation)
- 2022 Liao H-L, **Wang H.H.**, Tappero R., Zhang K., Wu S., Hameed K., Branco S., Ruytinx J., Bhatnagar J., Rojas A., Miao E., Maciejewski A., Kuo A., Barry K., Grigoriev I., Vilgalys R. Ectomycorrhizal fungi regulate rhizosphere metal ion processes and plant ion uptake under high heavy metals. 2021 JGI Annual Meeting, Aug. 29-Sep. 1. (Oral presentation)
- 2022 Zhang K., **Wang H.H.**, Liao H.L., How do carbon and nitrogen affect ectomycorrhizal fungi-mediated iron processes. 2022 Brookhaven National Lab NSLS II Workbench, Upton (NY)-Aug. 8-12, 2022 (Oral presentation)
- 2022 Zhang K., **Wang H.H.**, Hameed K., Bonito G., Vilgalys R., Liao H-L. Metatranscriptomics identifying a core gene set of *Linnemannia elongata* involved in chitin process in media, rhizosphere, and planta. 31st Fungal Genetic Conference, Pacific Grove (CA)-Mar. 14-20 (Poster presentation)
- 2022 **Wang H.H.**, Wu S., Hameed K., Vilgalys R., Kuo A., Barry K., Grigoriev I., Liao H-L, Regulation of fungal gene expression in ectomycorrhizal roots underlying heavy metal soil stress. 31st Fungal Genetic Conference, Pacific Grove (CA)-Mar. 14-20 (Poster presentation)
- 2022 Policelli N., Averill C., Brzöstek E., Liao H-L, **Wang H.H.**, Tappero R., Vietorisz C., Nash J., Vilgalys R., Bhatnagar. J. Plant-Mycorrhizal-Decomposer Interactions: The role of shifting plant and soil carbon. MSA Annual Meeting, July 11-14 (Oral presentation)
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- 2022 Tu L., Shipra K., Yin C., **Wang H.H.**, Wang Z., Sung C.K., Using nematophagous *Esteya correana* to control the pine wilt disease. IUFRO, September 6-10, IUFRO (Poster presentation)
- 2022 Tu L., Yin C., **Wang H.H.**, Wang Z., Sung C.K., Mode of pine wood nematode infection by GFP-labeled *Esteya vermicola correana* and the fungus growth in living pine tree. IUFRO, September 6-10 (Poster presentation)
- 2021 **Wang H.H.** RNA sequencing data analysis pipeline and data safety in command line operating system. NFREC, University of Florida, August.
- 2020 **Wang H.H.** Effect of nematophagous fungi *Esteya vermicola* to control pinewood nematode invasion in field test, Chungnam National University, June.

- 2020 **Wang H.H.**, Yin C., Tao R., Gao J., Sung C.K. Visualization of the mode of pinewood nematode infection by GFP-labeled *Esteya vermicola* and the fungus growth in the living pine tree. IUFRO, March (Poster presentation)
- 2020 Yin C., **Wang H.H.**, Tao R., Gao J., Sung C.K. Hypothesized mechanism of biocontrol against pine wilt disease by the nematophagous fungus *Esteya vermicola*. IUFRO, March.
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- 2019 **Wang H.H.** Development of an absolute quantification technique for fungi *Esteya vermicola*. Chungnam National University, April.
- 2018 **Wang H.H.** Patterns of nematophagous fungi *Esteya vermicola* infect pinewood nematode using GFP-labelled strains. Chungnam National University, September.
- 2018 **Wang H.H.** Fungal colonization patterns of nematophagous fungi *Esteya vermicola* in host pine xylem with a TaqMan probe PCR technique. Chungnam National University, March.
- 2017 **Wang, H. H.**, Duan, B.B., Yin C., et al. The difference between conidia and blastospores of *Esteya* sp., a biocontrol agent fungus for pine wilt disease. ICFES, February.
- 2017 Duan, B.B., **Wang, H.H.**, Li Y. Effect of protective agent to *Esteya vermicola* blastospore germination and hyphal growth. ICFES, February.
- 2017 Yin C., Wang Y.B., Duan B.B., **Wang H.H.** Effects of injection of *Esteya* sp. to control pine wilt disease. ICFES, February.