Zong-Yan Liu

PLANT BREEDING AND GENETICS PHD CANDIDATE

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Education

Cornell University — Ithaca, New York

PH.D. IN PLANT BREEDING AND GENETICS — *August 2022 - Present*

- **Minors:** Computational Biology
- **Advisor:** Edward S. Buckler, Ph.D.

National Taiwan University — Taipei, Taiwan (R.O.C.)

M.S. IN PLANT BIOLOGY, GPA: 3.963/4.0 — *September 2018 - June 2020*

- **Thesis:** Analysis of *Ib*HypSys-mediated MicroRNAs upon Wounding in Sweet Potato (*Ipomoea batatas* cv. Tainung 57)
- **Advisor:** Shih-Tong Jeng, Ph.D., College of Life Science Dean

National Chung Hsing University — Taichung, Taiwan (R.O.C.)

B.S. IN AGRONOMY, GPA: 3.90/4.0 — *September 2014 - June 2018*

- **Minors:** Management Information Systems and Applied Economics
- **Advisor:** Chin-Ying Yang, Ph.D., Vice President for Student Affairs

Experience

Cornell University / USDA-ARS - Bucker Lab — Ithaca, New York

GRADUATE RESEARCH ASSISTANT — *August 2022 - Present*

- Developed deep learning pipeline to annotate Angiosperm genome for all plant community
- Contributed to the development of a DNA large language foundation model trained on 65 genomes, enabling broad application across all angiosperm plant species
- Utilized a DNA language model to identify and characterize all seed storage proteins across diverse plant species

Academia Sinica / Institute of Information Science - Bio-IT-Station — Taipei, Taiwan (R.O.C.)

GRADUATE RESEARCH ASSISTANT — *August 2021 – July 2022*

- Developed and integrated an extrachromosomal circular DNA (eccDNA) database to enable cancer risk score analysis and genomic feature modeling using high-throughput sequencing data.
- Maintained and updated a comprehensive long non-coding RNA (lncRNA) database and website, supporting genomic research and data accessibility for the scientific community.

National Taiwan University / Machine Learning and Bioinformatics Laboratory – c4Lab — Taipei, Taiwan (R.O.C.)

GRADUATE RESEARCH ASSISTANT — *January 2022 – July 2022*

- Developed a deep learning-based pipeline to predict human microRNA target genes by integrating sequencing data, transcriptome annotation, biological structure, and microRNA biogenesis features, achieving up to 98% accuracy and outperforming existing tools

National Taiwan University / Laboratory of Gene Regulation – Jeng Lab — Taipei, Taiwan (R.O.C.)

GRADUATE RESEARCH ASSISTANT — *September 2018 - June 2020*

- Applied computational and bioinformatics approaches to predict and analyze rice physiological traits regulated by small RNAs and hydrogen peroxide signaling.
- Developed and characterized transgenic sweet potato lines overexpressing primary microRNAs to investigate regulatory networks in stress response and crop improvement.
- Designed, cloned, and introduced target genes using Agrobacterium-mediated infiltration in tobacco for functional validation of predicted microRNA targets.
- Predicted and identified 17 novel and 15 conserved microRNAs in sweet potato by integrating small RNA sequencing, transcriptome, and degradome data, revealing their roles in stress and defense responses.

National Chung Hsing University / Laboratory of Crop Stress Physiology and Signal Delivery – Yang Lab — Taichung, Taiwan (R.O.C.)

UNDERGRADUATE RESEARCH ASSISTANT — *February 2017 - June 2018*

Topic: Ethylene Signaling and Physiological Trait Analysis in Rice (*Oryza sativa*) under Flooding Stress

- Conducted in-depth physiological and molecular analyses of rice under flooding stress, evaluating key traits such as growth, survival, energy conversion, antioxidant activity, and cellular injury
- Collaborated with the Agricultural Experiment Station at the College of Agriculture and Natural Resources, NCHU, to plant and manage four rice strains, and performed systematic sample collection for advanced research studies

National Cheng Kung University / Institute of Life Science – Huang Lab Tainan, Taiwan (R.O.C.)

MINISTRY OF SCIENCE AND TECHNOLOGY STUDENT RESEARCH PROGRAM *December 2016 - January 2017*

Topic: Molecular Studies of the Phytotoxic Potential of *Tolypocladium inflatum* Volatiles on Rice and Weeds)

- Investigated the molecular and physiological effects of *Tolypocladium inflatum*-derived volatile organic compounds (VOCs) on monocot (rice, Poaceae) and dicot (vegetable crop) species, focusing on their potential for selective weed suppression and sustainable agriculture
- Conducted co-culture experiments using VOC-producing GT22 fungal strains with 12 different rice varieties to assess root inhibition, cell apoptosis, reactive oxygen species (ROS) accumulation, and physiological responses
- Applied molecular biology and biochemical assays to identify key genes and regulatory pathways involved in plant responses to fungal VOCs, elucidating the gene regulatory mechanisms behind monocot inhibition
- Collaborated on the development of innovative, nature-based weed management strategies to reduce reliance on chemical herbicides and promote organic farming practices

Ministry of Agriculture / Agricultural Research and Extension Station Tainan, Taiwan (R.O.C.)

UNDERGRAD INTERN PROGRAM *June 2016 - August 2016*

- Conducted field surveys and phenotypic trait analysis of rice, sesame, soybean, and peanut to support crop improvement and breeding programs

Achievements & Awards

Cornell Exemplary Leadership & Service Award – Early-Career Graduate Students 2024
Campus-wide honor recognizing just 1–3 pre-A-exam scholars each year for exceptional leadership, outreach and inclusion impact across Cornell's 10,000-plus graduate community

Phi Tau Phi Scholastic Honor Society (R.O.C.), Honorary Member 2020
Invitation-only induction reserved for the top 1 % of bachelor's, top 3 % of master's and top 10 % of doctoral graduates for combined academic and moral excellence

University "Excellent Performance in Labor Education" Award 2016
Selected as the highest service-learning scores in the university's compulsory experiential-labor curriculum

Ching-O Award – Outstanding Moral & Intellectual Performance 2015
Single nominee per class approved by college committee for all-round scholarship, leadership and service

China Youth Corps Exemplary Youth Representative 2013
Nationally selected cohort of emerging leaders invited to represent Taiwanese youth in cultural-exchange and public-service forums

National Energy Science & Technology Creative Design Contest – Bronze Medal Award 2012
Reached the national finals and secured a prize for an innovative renewable-energy prototype in the Ministry of Education competition

Scholarships & Fellowships

Government Fellowship for Studying Abroad, *Ministry of Education*, a national-level exam with < 1 % success rate 2022 – 2025
National Key Fields Fellowship for Studying Abroad, *Ministry of Education*, allotted just 23 places nationwide 2022 – 2026
Mu-Lin Scholarship, National Chung Hsing University, the Department of Agronomy selects just 4 students per semester 2017
Agricultural Association of Taiwan Scholarship, the Association caps most awards at ≤ 10 recipients per category annually 2016
Known-You Social Welfare Foundation Scholarship, each college may nominate just 2 – 3 students per term 2016
Prof. Hsin-Sheng Tsay Scholarship, 2 agronomy majors nationwide are chosen each year 2015
Tainan City Education Association Cultural & Educational Foundation Scholarship, limited to 12 awardees each year 2014
Taiwan Livestock Research Institute Scholarship, *Ministry of Agriculture*, high GPA scholarship 2015 - 2020

Publications

Peer-reviewed Articles

Zhai J, Gokaslan A, Schiff Y, Berthel A, **Liu Z-Y**, Lai W, Miller ZR, Scheben A, Stitzer MC, Romay MC, Buckler ES, & Kuleshov V (2025) **Cross-species modeling of plant genomes at single-nucleotide resolution using a pretrained DNA language model.** *Proceedings of the National Academy of Sciences of the United States of America* **122** (24): e2421738122. https://doi.org/10.1073/pnas.2421738122

Lin T-C, Liu Y-L, Liu Y-T, Liu W-H, **Liu Z-Y**, Chang K-L, Chang C-Y, Ni H-C, Huang J-H, & Tsai H-K (2023) **TRIPBASE: a database for identifying the human genomic DNA and lncRNA triplexes.** *NAR Genomics and Bioinformatics* **5** (2): lqad043. https://doi.org/10.1093/nargab/lqad043

Preprints

Stitzer MC, Seetharam AS, Scheben A, Hsu SK, Schulz AJ, AuBuchon-Elder TM, El-Walid M, Ferebee TH, Hale CO, La T, **Liu Z-Y**, McMorrow SJ, Minx P, Phillips AR, Syring ML, Wrightsman T, Zhai J, Pasquet R, McAllister CA, Malcomber ST, Traiperm P, Layton DJ, Zhong J, Costich DE, Dawe RK, Fengler K, Harris C, Irelan Z, Llaca V, Parakkal P, Zastrow-Hayes G, Woodhouse MR, Cannon EK, Portwood JL II, Andorf CM, Albert PS, Birchler JA, Siepel A,

Ross-Ibarra J, Romay MC, Kellogg EA, Buckler ES, & Hufford MB (2025) **Extensive genome evolution distinguishes maize within a stable tribe of grasses.** *bioRxiv* (preprint) 2025.01.22.633974. https://doi.org/10.1101/2025.01.22.633974

In press

Ojeda-Rivera JO, Barnes AC, Ainsworth EA, Angelovici R, Basso B, Brindisi LJ, Brooks MD, Busch W, Buttelmann GL, Castellano MJ, Chen J, Costich DE, de Leon N, Emmett BD, Ertl D, Fitzsimmons SL, Flint-Garcia SA, Gore MA, Guan K, Hale CO, Herr S, Hirsch CN, Holding DH, Holland JB, Hsu SK, Hua J, Hufford MB, Kaeppler SM, Leary EN, **Liu Z-Y**, Mahama AA, McCubbin TJ, Messina CD, Michael TP, Miller SJ, Murray SC, Okumoto S, Oren E, Park AN, Piñeros MA, Pugh NA, Raboy V, Rellán-Álvarez R, Romay MC, Rooney T, Roston RL, Sawers RJH, Schnable JC, Schulz AJ, Scott MP, Springer NM, Washburn JD, Zambrano MA, Zhai J, Zou J, & Buckler ES. **Designing Nitrogen-Efficient, Cold-Tolerant Maize for Modern Agricultural Systems.**

Manuscripts in Preparation / Under Review

Liu Z-Y, Berthel A, Czech E, Stitzer MC, Hsu SK, Buckler ES, & Zhai J. **ReelAnno: A Large Language Model for Single Base Pair Precision Gene Annotation in Diverse Plant Genomes.**

Zhai J, Gokaslan A, Czech E, Chen S-P, Berthel A, **Liu Z-Y**, Romay MC, Kuleshov V, & Buckler ES. **PlantCAD2: a long-context genomic language model for functional annotation from DNA to protein across angiosperms.**

Journal Referee Service / Manuscript Reviewing

Nature Communication Biology

Patent

Yang C-Y, Lee C-A, **Liu Z-Y.** Method for Improving the Accuracy of Plant Leaf Temperature Measurement via Thermal Image Analysis. *Republic of China (Taiwan) Invention Patent* ***I873511****. National Chung Hsing University (assignee). Granted 21 Feb 2025; valid until 15 Jan 2043.*

Presentations

Presentations

Liu Z-Y, Berthel A, Gokaslan A, Kuleshov V, & Buckler ES, Zhai J. 2025. **ReelGene2: a large-language-model framework for single–base-pair gene annotation across diverse plant genomes.** Presentation at the *67th Annual Maize Genetics Conference*, St Louis, MO, USA, 6–9 March 2025.

Liu Z-Y, Zhai J, Stitzer MC, Miller ZR, & Buckler ES. 2024. **Enhancing plant genome annotation with a DNA language model: case studies in Arabidopsis and maize.** Presentation at the *66th Annual Maize Genetics Meeting*, Raleigh, NC, USA, 29 February–3 March 2024.

Liu Z-Y, & Buckler ES. 2023. **Using machine learning to represent proteins: an example from seed-storage proteins.** *Cornell Plant Breeding & Genetics Seminar*, Cornell University, Ithaca, NY, USA, 17 October 2023.

Conference posters

Liu Z-Y, Berthel A, Gokaslan A, Kuleshov V, Buckler ES, & Zhai J. **ReelGene2: a large-language-model framework for single-base-pair gene annotation in diverse plant genomes**. Poster presented at the *67th Annual Maize Genetics Conference*; St Louis, MO, USA; 6 – 9 March 2025.

Liu Z-Y, Zhai J, Stitzer MC, Miller ZR, & Buckler ES. **Enhancing plant genome annotation with a DNA language model: case studies in Arabidopsis and maize**. Poster presented at the *66th Annual Maize Genetics Meeting*; Raleigh, NC, USA; 29 February – 3 March 2024.

Liu Z-Y, Berthel A, Zhai J, & Buckler ES. **Transforming plant gene annotation through a DNA foundation model.** Poster presented at the *34th International Conference on Arabidopsis Research*; San Diego, CA, USA; 15 – 19 July 2024.

Liu Z-Y, Zhai J, & Buckler ES. **Identification of seed-storage proteins across *Andropogoneae* genomes with machine learning.** Poster presented at the *65th Annual Maize Genetics Meeting*; St Louis, MO, USA; 16 – 19 March 2023.

Liu Z-Y, & Jeng S-T. **Identification and functional characterization of *Ib*HypSys-mediated microRNAs upon wounding in sweet potato**. Poster presented at *Plant Biology 2020 (American Society of Plant Biologists)*; Washington, DC, USA; 25 – 29 July 2020. doi: 10.46678/PB.20.1007170

Teaching and Service

Teaching Experience

CONVERSATION FACILITATOR, Language Resource Center – **Cornell University** 2024 – present
Design weekly speaking drills, cultural modules, and formative assessments for beginning and intermediate learners

INSTRUCTOR, "Biomedical Data Mining" – **National Taiwan University** Summer 2021
Delivered lectures on conda environment management, RNA-seq pipelines, BLAST searches, Galaxy workflows, and building sequence databases.

INSTRUCTOR, "Methods in Plant Molecular Biology Research" – **National Taiwan University** Spring 2020
Taught a module on gene-feature discovery and functional annotation in plants; developed problem sets and graded practical reports.

Professional & Academic Service

ADVISORY BOARD MEMBER - Cornell International Services Advisory Board, **Cornell University** 2025 – present
- Advise on policy and programming for international scholars; coordinate feedback between academic units and International Services.

SYSTEM MAINTENANCE ENGINEER - Institute of Plant Biology, **National Taiwan University** 2018 – 2022
- Designed and maintained the institute's official website
- Administered Google Business profiles for the institute and NTU cafeterias, ensuring up-to-date public information

EXECUTIVE OFFICER - NCHU project "The Effects of Climate Change and the Analysis of Possible Adaptation Strategies" 2017 – 2018
- Assisted Asst. Prof. Yi-Yuan Su in course logistics and student support

- Drafted official correspondence with Taiwan's Ministry of Education to invite international scholars and coordinate project reporting

Student Organizations

Cornell Graduate and Professional Student Assembly (GPSA)

Ithaca, New York

BIOLOGICAL SCIENCES REPRESENTATIVE (2024 – PRESENT) · FINANCE COMMISSION SECRETARY (2025 – PRESENT) · GRADUATE SCHOOL DEAN-SEARCH COMMITTEE MEMBER (2025) · SECRETARY, DIVERSITY & INTERNATIONAL STUDENTS COMMITTEE (2024 – 2025)

- Act as liaison between the GPSA, Cornell Graduate School, and university administration, circulating policy updates and gathering feedback from graduate and professional students across the sciences
- As Finance Commission Secretary, review and approve yearly GPSA budgets and grant requests—including support for Cornell Cinema and Anabel's Grocery—ensuring transparent allocation of student activity funds
- Organized campus-wide cultural programs and information sessions that ease the transition of international students and address their concerns
- Represented the graduate student body on the Cornell Graduate School Dean-Search Committee, helping evaluate candidates and formulate selection recommendations

Synapsis (Cornell Plant Breeding Graduate Student Association)

Ithaca, New York

MEMBER, CO-PRESIDENT (2024 – 2025) · INVITED SPEAKER CO-LEADER (2023 – 2024) · SYMPOSIUM COMMITTEE (2022 – 2023) *2022 – present*

- Direct overall programming for the association, coordinating cultural events, NAPB-2024 outreach, and professional-development workshops.
- Co-led the annual graduate-student recruitment weekend, managing logistics and peer-mentoring activities.
- Served on the 2022 Symposium committee, delivering a seamless hybrid (in-person + virtual) experience for presenters and attendees.
- Organized seminar visits—handling speaker invitations, schedules, and on-campus hosting—to expand departmental networking and learning opportunities.

Cornell Taiwanese Student Association (CTSA)

Ithaca, New York

PRESIDENT (2023 – 2024)

- Acted as the official liaison linking Taiwan's Ministry of Foreign Affairs, Cornell Taiwanese alumni, and graduate students.
- Guided new Taiwanese students through visa applications, housing, banking, phone service, and mental-health resources.
- Coordinated campus-wide cultural and networking events in partnership with the undergraduate chapter and the Ithaca Taiwanese Association.
- Developed the CTSA website and a comprehensive student handbook in collaboration with Cornell International Services and the Office of Global Learning.