

Rahila Hafeez

Plant Pathologist, PhD

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RESEARCH PROFILE

Plant pathologist working on biologically derived alternatives to chemical fungicides. Research combines green synthesis of nanoparticles from plant extracts and bacteria with transcriptomic, metabolomic and metagenomic analysis of how those materials act on the pathogen, the crop and the surrounding microbial community. Target systems include rice blast, Fusarium head blight of wheat and postharvest anthracnose of strawberry. Author of 23 peer-reviewed papers and holder of one registered Chinese patent.

EDUCATION

PhD, Plant Pathology

Sep 2018 – 2024

Institute of Biotechnology, Zhejiang University, Hangzhou, China

Thesis: Synthesis and mechanism of a new chitosan nanoparticle formulation for the prevention and control of rice blast

Coursework: Molecular Plant Pathology; Physiological Plant Pathology; Epidemiology and Management of Plant Diseases; Bioinformatics; Physiology of Plant Pathogens; Scientific English in Plant Pathology

MSc (Hons), Agriculture (Plant Pathology)

2008 – 2010

Institute of Agricultural Sciences, University of the Punjab, Lahore, Pakistan

CGPA 3.43 / 4.00; aggregate 78.27%; 51 credit hours; research thesis graded A

Coursework: Host Pathogen Interaction; Microbial Ecology; Industrial Mycology; Fermentation Technology; Recombinant DNA Technology; Molecular Plant-Microbe Interaction; Microbial Physiology

RESEARCH POSITIONS

Postdoctoral Researcher

2024 – 2026

College of Life Sciences and Oceanography, Shenzhen University, Shenzhen, China

Shenzhen Key Laboratory of Marine Bioresource and Eco-Environmental Science; Center for Plant Environmental Sensing

- Developed a one-step green synthesis route for chitosan nanoparticles using mangrove rhizosphere *Bacillus velezensis*, achieving an EC₅₀ of 14.85 mg L⁻¹ against *Colletotrichum gloeosporioides*.
- Reduced strawberry anthracnose lesion area by 78% in leaves and 88% in fruit without phytotoxicity, while extending postharvest shelf life at 4 °C.
- Demonstrated improved environmental safety over azoxystrobin, raising *Artemia salina* survival from 28% to 66.6% at matched concentration.
- Contributed lactic acid bacteria screening and metabolite analysis to work on biogenic amine reduction in traditional fermented foods.

Doctoral Researcher

2018 – 2024

State Key Laboratory of Rice Biology and Breeding, Institute of Biotechnology, Zhejiang University

- Formulated moringa-chitosan nanoparticles at 46 nm and cut rice blast severity by 77.7% under greenhouse foliar application.
- Established mechanism through RNA sequencing and LC-MS metabolomics, identifying disruption of membrane biosynthesis and transcription in *Magnaporthe oryzae* alongside apoptosis-like cell death.
- Showed via metagenomic sequencing that treatment reduced *Magnaporthe* abundance by 93.5% while increasing microbial diversity in both rhizosphere and phyllosphere.
- Co-invented the resulting preparation method, registered in China as patent CN117024785A.

RESEARCH AREAS

Plant pathology; plant-microbe interactions; biological control; mycology; agricultural nanobiotechnology; plant microbiome; molecular plant pathology; microbial genomics; multi-omics; postharvest biology and disease management; sustainable crop protection; environmental microbiology.

TECHNICAL SKILLS

Nanomaterials. Green and biogenic synthesis; ionic gelation; UV-Vis spectroscopy; transmission and scanning electron microscopy; XRD; FTIR; dynamic light scattering; zeta potential.

Omics and bioinformatics. RNA sequencing and differential expression analysis; LC-MS metabolomics; MetaboAnalyst; 16S amplicon and shotgun metagenomics; comparative genome mining.

Molecular and cellular. Targeted gene deletion and mutant validation; transposon mutagenesis screening; qPCR; ITS and multilocus fungal identification; confocal microscopy; flow cytometry.

Plant and safety assays. Greenhouse and detached-organ disease assays; antioxidant enzyme profiling; photosynthesis and gas exchange measurement; postharvest quality trials; mammalian cytotoxicity; *Artemia salina* ecotoxicity.

PATENT

Wang Y, You Y, Zhang Z, Guo J, Gao J, Chai R, Qiu H, **Hafeez R**, Li B (2023). Moringa-chitosan nanoparticles: preparation method and application. CN117024785A, registered in China.

PUBLICATIONS

23 peer-reviewed papers; four as first or joint first author. Full record at Google Scholar.

First and joint first author

1. **Hafeez R**, Ye X, Raza M, Peng L, Hao L (2026). The potential of novel biogenic chitosan nanoparticles in strawberry anthracnose suppression and postharvest quality conservation. *Postharvest Biology and Technology* 239, 114362.
2. Luo Z, Yuan Y, **Hafeez R**, Wang S, Pei Z, Hao L (2026). Enhancing safety and flavor of traditional Yucha: autochthonous starters from Hainan fermented foods reduce biogenic amines and promote taste-active metabolites. *Food Chemistry* 510, 148614. (Joint first author.)
3. **Hafeez R**, Guo J, Ahmed T, Jiang H, Raza M, Shahid M, Ibrahim E, Wang Y, Wang J, Yan C, An Q, White JC, Li B (2024). Bio-formulated chitosan nanoparticles enhance disease resistance against rice blast by physiomorphic, transcriptional, and microbiome modulation of rice (*Oryza sativa* L.). *Carbohydrate Polymers* 334, 122023.
4. **Hafeez R**, Guo J, Ahmed T, Ibrahim E, Ali MA, Rizwan M, Ijaz M, An Q, Wang Y, Wang J, Li B (2024). Integrative transcriptomic and metabolomic analyses reveals the toxicity and mechanistic insights of bioformulated chitosan nanoparticles against *Magnaporthe oryzae*. *Chemosphere* 356, 141904.
5. **Hafeez R**, Akhtar N, Shoaib A, Bashir U, Haider MS, Awan ZA (2015). First report of *Geotrichum candidum* from Pakistan causing postharvest sour rot in loquat (*Eriobotrya japonica*). *Journal of Animal and Plant Sciences* 25(6), 1737–1740.

Co-authored

6. Hao L, Li Y, **Hafeez R**, Xie N, Li S, Li S, Ye X, Aboagye ET (2026). Mangrove-derived *Bacillus velezensis* J69 lipopeptides control strawberry anthracnose and maintain postharvest quality. *Postharvest Biology and Technology* 242, 114583.
7. Ibrahim E, Nasser R, Zhang J, Ayoade SO, Chen L, Yu H, Sang L, **Hafeez R**, Luo J, Lu J, Li B (2026). Gut microbiota communities and their multifaceted roles in immune defense and social behavior of the red imported fire ant (*Solenopsis invicta*). *Microbiological Research* 306, 128438.
8. Islam MS, Noman M, Zhang Z, Ahmed T, Cai Y, Wang J, Ali MA, **Hafeez R**, Qiu H, Hao Z, Chai R, Ijaz M, Wang Y, Li B, Wang J (2025). Advanced bifunctional nanotherapeutics display multi-tiered defense against *Magnaporthe oryzae* through targeted fungal inhibition and rice immunity enhancement. *Materials Today Bio* 35, 102275.

9. Ibrahim E, Fang Y, Nasser R, Wang D, Kafsheer DAEK, Ayoade SO, **Hafeez R**, Al-Megrin WAI, Li B, Lin H (2025). Biogenic synthesis of selenium nanoparticles by *Bacillus amyloliquefaciens*: a promising method for mitigating mycotoxin contamination and fighting *Fusarium graminearum*. *Journal of Hazardous Materials* 499, 140267.
10. Li B, Xu L, Ijaz M, **Hafeez R**, Ayoade SO, Shen Y, Yang F, Wang X, Liu Q, Li X, Gu C, Zhang J, Li B (2025). Effective mitigation of sclerotium rot in lettuce cultivation by two soil fungi *Aspergillus terreus* and *Albifimbria verrucaria*. *Pest Management Science*.
11. Fei L, **Hafeez R**, Zhang J, Fu S, Xu Y, Hao L (2025). Investigation of the mechanisms involved in the biocontrol activities of natural products from a marine soil bacterium against rice blast. *Pest Management Science* 81, 3122–3135.
12. Ijaz M, Lv L, Ahmed T, Noman M, Manan A, Ijaz R, **Hafeez R**, Shahid MS, Wang D, Ondrasek G, Li B (2024). Immunomodulating melatonin-decorated silica nanoparticles suppress bacterial wilt (*Ralstonia solanacearum*) in tomato (*Solanum lycopersicum* L.) through fine-tuning of oxidative signaling and rhizosphere bacterial community. *Journal of Nanobiotechnology* 22, 617.
13. Xu X, Liu L, Xu L, Zhang Y, **Hafeez R**, Ijaz M, Ali HM, Shahid MS, Ahmed T, Ondrasek G, Li B (2024). Regulatory mechanism of C4-dicarboxylates in cyclo (Phe-Pro) production. *Microbial Cell Factories* 23, 255.
14. Yu R, **Hafeez R**, Ibrahim M, Alonazi WB, Li B (2024). The complex interplay between autism spectrum disorder and gut microbiota in children: a comprehensive review. *Behavioural Brain Research* 473, 115177.
15. Guo J, Li G, Ijaz M, **Hafeez R**, Ibrahim E, Ahmed T, Qi X, Zhang S, Ali HM, Li B, Ren H (2024). Transcriptomic and metabolomic analyses reveal that lignin biosynthesis contributes to bayberry (*Myrica rubra*) defence responses against twig blight. *Plant Stress* 13, 100514.
16. Ibrahim E, Xu L, Nasser R, Adel A-SM, **Hafeez R**, Ogunyemi SO, Abdallah Y, Zhang Z, Shou L, Wang D, Li B (2024). Utilizing zinc oxide nanoparticles as an environmentally safe biosystem to mitigate mycotoxicity and suppress *Fusarium graminearum* colonization in wheat. *Sustainable Materials and Technologies* 41, e01028.
17. Li X, Lu Q, **Hafeez R**, Ogunyemi SO, Ibrahim E, Ren X, Tian Z, Ruan S, Mohany M, Al-Rejaie SS, Li B, Yan J (2024). The response of root-zone soil bacterial community, metabolites, and soil properties of Sanyeqing medicinal plant varieties to anthracnose disease in reclaimed land, China. *Heliyon* 10, e36602.
18. Li G, Wang Z, Ren H, Qi X, Han H, Ding X, Sun L, **Hafeez R**, Wang Q, Li B (2024). Ancient bayberry increased stress resistance by enriching tissue-specific microbiome and metabolites. *Physiologia Plantarum*.
19. Ibrahim E, Nasser R, **Hafeez R**, Ogunyemi SO, Abdallah Y, Khattak AA, Shou L, Zhang Y, Ahmed T, Hatamleh AA, Al-Dosary MA, Ali HM, Luo J, Li B (2023). Biocontrol efficacy of endophyte *Pseudomonas poae* to alleviate *Fusarium* seedling blight by refining the morpho-physiological attributes of wheat. *Plants* 12, 2277.
20. Ali MA, Lou Y, **Hafeez R**, Li X, Hossain A, Xie T, Lin L, Li B, Yin Y, Yan J, An Q (2021). Functional analysis and genome mining reveal high potential of biocontrol and plant growth promotion in nodule-inhabiting bacteria within *Paenibacillus polymyxa* complex. *Frontiers in Microbiology* 11, 618601.
21. Ali MA, Ahmed T, Wu W, Hossain A, **Hafeez R**, Masum MMI, Wang Y, An Q, Sun G, Li B (2020). Advancements in plant and microbe-based synthesis of metallic nanoparticles and their antimicrobial activity against plant pathogens. *Nanomaterials* 10, 1146.
22. Hanif S, Anjum T, **Hafeez R**, Akram W, Ali A, Hassan F (2016). First report of *Alternaria mali* causing core rot of apple in Pakistan. *Plant Disease* 100(8).
23. Shoaib A, Akhtar N, Akhtar S, **Hafeez R** (2014). First report of *Alternaria longipes* causing leaf spot of potato cultivar Sante in Pakistan. *Plant Disease* 98(12).