Muhammad Farooq, PhD

Bioinformatics Scientist

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Biography:

I am a multidisciplinary science lover and eager to learn newer skills all the time. Now a days, I mostly work in developing and applying bioinformatics tools to explore quantitative genetics problem of linking genotypes and phenotypes (e.g., Genomic Predictions and Genome-wide Association Studies) using both statistical and machine learning / deep learning. For this, I am interested in improving methodologies by incorporating prior biological knowledge. Additionally, I am eager to develop innovative solutions for precise crop breeding and management by utilizing in-field high-throughput phenotyping. For this, I am actively utilizing spectral indices calculated through drone-based remote sensing datasets.

Keywords:

Bioinformatics, Remote Sensing, Artificial Intelligence, Image Processing, Machine learning, Genomic prediction, Phenomics

Employment:

- **National Institute for Biotechnology and Genetic Engineering (NIBGE), Faisalabad, Pakistan**

  2014-01-03 to present | Principal Scientist (Bioinformatics / Precision Agriculture) (Agricultural Biotechnology Division) Employment

- **National Institute of Lasers and Optronics (NILOP): Islamabad, Pakistan**

  2009-10-26 to 2014-01-02 | Sr. Scientist (IT)

Education and Qualifications:

- PhD in Bioinformatics
  2018-11-26 to 2023-09-20 | Wageningen University & Research: Wageningen, The Netherlands (Department of Plant Sciences, Chair group: Bioinformatics)
- MS Systems Engineering
  2007-11-05 to 2009-10-26 | Pakistan Institute of Engineering and Applied Sciences: Islamabad, PK (Department of Electrical Engineering)
- Bachelor's in computer science (Honors)
  2002 to 2006 | University of the Punjab: Lahore, Punjab, PK (PUCIT)

Honors and Awards:

- Wageningen University & Research: Wageningen, Wageningen, NL
  2018 | PhD scholarship (Department of Plant Sciences, Chair group: Bioinformatics)
- Awarded Norman E. Borlaug Fellowship at Starkville, Mississippi State University, Mississippi, USA
  2015 | bioinformatics training (Mississippi State University)
- Pakistan Institute of Engineering and Applied Sciences: Islamabad, Punjab, PK
  2007 | MS Fellowship (Systems Engineering)
- PUCIT: Lahore, Punjab, PK
  2006 | 1st Position (Computer Science)

Professional Activities:

- One day International Symposium on Recent developments in applied bioinformatics using Artificial Intelligence (AI) at NIBGE: Faisalabad, Pakistan, PK
  2024-06-05 | Organizer & Resource Person (PRIORNET: a deep learning framework for genomic prediction in plants)
- COMSTECH: Islamabad, Pakistan, PK
  2022-09-13 to 2022-09-15 | Invited Speaker (Genomic Selection in Plants from the Bioinformatics Perspective)
- BioSB Conference, Lunteren, The Netherlands
  2021 | Poster presentation (Genomic Prediction in plants: opportunities for ensemble machine learning methods)
- Virtual University: Lahore, Punjab, PK
  2021 | Invited Speaker (Applied Artificial Intelligence for Genomic Prediction)
- International Nathiagali Summer College (INSC): Islamabad, Punjab, PK
  2016 to 2017 | Technical Committee Member (Computational Biology Activity)
- University of Agriculture: Faisalabad, Punjab, PK
  2015 | Invited Speaker (Bioinformatics)

Funding / Grants:

- **Implementation of Variable Rate Application of Nitrogenous Fertilizers in crops**
  Institutional Grant by SPD R&D Board Project
  2023-10 to 2026-03| PKR 5.00 million
- **Analysis of alternative splicing events in cotton (*Gossypium arboreum*) transcriptome using high throughput sequencing**
  Higher Education Commission, Pakistan (Islamabad, Punjab)
  2018-07 to 2021-06| GRANT_NUMBER: 8172 | PKR 1.45 million

Publications by research directions:

A. Precision agriculture / Technology-driven breeding

a. **Muhammad Farooq**. "Knowledge-driven approaches to improve genomic prediction in plants.", PhD dissertation., Wageningen University, ISBN: 978-94-6447-794-8, DOI: https://doi.org/10.18174/634641, 2023.
b. RZ Naqvi, **Muhammad Farooq**, Rida Zahid, Ifrah Imran, Muhammad Arslan Mahmood, Muhammad Jawad Akbar Awan, Shahid Mansoor, Imran Amin, and Muhammad Asif. "Recent Advances in Plant Phenomics and Speed Breeding for Climate-Smart Agriculture." Plant Speed Breeding and High-throughput Technologies (2024): 82-103.
c. RZ Naqvi, **Muhammad Farooq**, Syed Ali Asad Naqvi, Hamid Anees Siddiqui, Imran Amin, Muhammad Asif, Shahid Mansoor. "Big Data Analytics and Advanced Technologies for Sustainable Agriculture." In Handbook of Smart Materials, Technologies, and Devices, pp 1-27: Springer, Cham, 2021.
d. **Muhammad Farooq**, Aalt DJ van Dijk, Harm Nijveen, Shahid Mansoor, and Dick de Ridder. "Genomic Prediction in Plants: Opportunities for Ensemble Machine Learning Based Approaches." F1000Research 11 (2022).
e. **Muhammad Farooq**, Aalt DJ Van Dijk, Harm Nijveen, Mark GM Aarts, Willem Kruijer, Thu-Phuong Nguyen, Shahid Mansoor, and Dick de Ridder. "Prior Biological Knowledge Improves Genomic Prediction of Growth-Related Traits in Arabidopsis Thaliana." Frontiers in genetics 11 (2021): 609117.

B. Omics data analysis

a. Rubab Ramzan, Asad Ali, **Muhammad Farooq**, Hazrat Ali, Shazia Khaliq, and Muhammad Hamid Rashid. "Draft Genome Sequence of Extracellular Enzyme-Producing Bacillus Paralicheniformis Strain Nbg-07." Microbiology Resource Announcements (2024): e00096-24.
b. Muhammad Anas, **Muhammad Farooq**, Asif, Waqas Rafique Ali, and Shahid Mansoor. "A Novel Insight into the Identification of Potential Snp Markers for the Genomic Characterization of Buffalo Breeds in Pakistan." Animals 13, no. 15 (2023): 2543.
c. Salma Mukhtar, **Muhammad Farooq**, Deeba Noreen Baig, Imran Amin, George Lazarovits, Kauser Abdulla Malik, Ze-Chun Yuan, and Samina Mehnaz. "Whole Genome Analysis of *Gluconacetobacter Azotocaptans* Ds1 and Its Beneficial Effects on Plant Growth." 3 Biotech 11 (2021): 1-12.
d. Nasim Ahmed, Imran Amin, Syed Shan-e-Ali Zaidi, Saleem Ur Rahman, **Muhammad Farooq**, Claude Maurice Fauquet, and Shahid Mansoor. "Circular DNA Enrichment Sequencing Reveals the Viral/Satellites Genetic Diversity Associated with the Third Epidemic of Cotton Leaf Curl Disease." Biology Methods and Protocols 6, no. 1 (2021): bpab005.
e. Athar Hussain, **Muhammad Farooq**, RZ Naqvi, Imran Amin, Khalid Pervaiz, Muhammad Saeed, Muhammad Asif, M Shahid Mukhtar, and Shahid Mansoor. "Genome-Wide

Identification and Classification of Resistance Genes Predicted Several Decoy Domains in Gossypium Sp." Plant gene 24 (2020): 100250.

f. Athar Hussain, Rabbia Tanveer, Farrukh Azeem, Ghulam Mustafa, **Muhammad Farooq**, Imran Amin, and Shahid Mansoor. "Erratum To'comparative Phylogenetic Analysis of Aquaporins Provides Insight into the Gene Family Expansion and Evolution in Plants and Their Role in Drought Tolerant and Susceptible Chickpea Cultivars'[Genomics, Volume 112, Issue 1 (2020) Pages 263-275]." Genomics 112, no. 2 (2020): 2106.
g. Sonia Hussain, **Muhammad Farooq**, Hassan Jamil Malik, Imran Amin, Brian E Scheffler, Jodi A Scheffler, Shu-Sheng Liu, and Shahid Mansoor. "Whole Genome Sequencing of Asia Ii 1 Species of Whitefly Reveals That Genes Involved in Virus Transmission and Insecticide Resistance Have Genetic Variances between Asia Ii 1 and Meam1 Species." BMC genomics 20 (2019): 1-13.
h. Hira Kamal, Fayyaz-ul-Amir Afsar Minhas, **Muhammad Farooq**, Diwaker Tripathi, Muhammad Hamza, Roma Mustafa, Muhammad Zuhaib Khan, Shahid Mansoor, Hanu R Pappu, and Imran Amin. "In Silico Prediction and Validations of Domains Involved in Gossypium Hirsutum Snrk1 Protein Interaction with Cotton Leaf Curl Multan Betasatellite Encoded Bc1." Frontiers in Plant Science 10 (2019): 656.
i. Sara Shakir, Syed Shan-e-Ali Zaidi, **Muhammad Farooq**, Imran Amin, Jodi Scheffler, Brian Scheffler, Muhammad Shah Nawaz-ul-Rehman, and Shahid Mansoor. "Non-Cultivated Cotton Species (Gossypium Spp.) Act as a Reservoir for Cotton Leaf Curl Begomoviruses and Associated Satellites." Plants 8, no. 5 (2019): 127.
j. Nasrin Akhtar, Muhammad A Ghauri, Kalsoom Akhtar, Sana Parveen, **Muhammad Farooq**, Aamir Ali, and Peter Schierack. "Comparative Analysis of Draft Genome Sequence of Rhodococcus Sp. Eu-32 with Other Rhodococcus Species for Its Taxonomic Status and Sulfur Metabolism Potential." Current Microbiology 76 (2019): 1207-14.
k. Athar Hussain, Rabbia Tanveer, Ghulam Mustafa, **Muhammad Farooq**, Imran Amin, Shahid Mansoor. "Comparative Phylogenetic Analysis of Aquaporins Provides Insight into the Gene Family Expansion and Evolution in Plants and Their Role in Drought Tolerant and Susceptible Chickpea Cultivars." Genomics (2019).
l. Amna Bari, **Muhammad Farooq**, A Hussain, M Tahirul Qamar, MW Abbas, G Mustafa, A Karim, I Ahmed, and T Hussain. "Genome-Wide Bioinformatics Analysis of Aquaporin Gene Family in Maize (Zea Mays L.)." J. Phylogenet. Evol. Biol 6, no. 197 (2018): 10.4172.
m. Quratulain Hanif, **Muhammad Farooq**, Imran Amin, Shahid Mansoor, Yi Zhang, and Qaiser Mahmood Khan. "In Silico Identification of Conserved Mirnas and Their Selective Target Gene Prediction in Indicine (Bos Indicus) Cattle." PLoS One 13, no. 10 (2018): e0206154.
n. Sadia Liaquat, Yasra Sarwar, Aamir Ali, Abdul Haque, **Muhammad Farooq**, Ilargi Martinez-Ballesteros, Lorena Laorden, Javier Garaizar, and Joseba Bikandi. "Virulotyping of Salmonella Enterica Serovar Typhi Isolates from Pakistan: Absence of Complete Spi-10 in Vi Negative Isolates." PLoS Neglected Tropical Diseases 12, no. 11 (2018): e0006839.
o. Athar Hussain, Aqsa Anwer Khan, Muhammad Qasim Aslam, Aquib Nazar, Nadir Zaman, Ayesha Amin, Muhammad Arslan Mahmood, M Shahid Mukhtar, Hafiz Ubaid Ur Rahman, and **Muhammed Farooq**. "Comparative Analysis, Diversification, and Functional Validation of Plant Nucleotide-Binding Site Domain Genes." Scientific Reports 14, no. 1 (2024): 11930.
p. Corrinne E Grover, Mark A Arick, Justin L Conover, Adam Thrash, Guanjing Hu, William S Sanders, Chuan-Yu Hsu, RZ Naqvi, **Muhammad Farooq**, and Xiaochong Li. "Comparative Genomics of an Unusual Biogeographic Disjunction in the Cotton Tribe (*Gossypieae*) Yields Insights into Genome Downsizing." Genome Biology and Evolution 9, no. 12 (2017): 3328-44.

q. Syed Shan-e-Ali Zaidi, Sara Shakir, Hassan Jameel Malik, **Muhammad Farooq**, Imran Amin, Shahid Mansoor. "First Report of Tomato Leaf Curl New Delhi Virus on *Calotropis Procera*, a Weed as Potential Reservoir Begomovirus Host in Pakistan." Plant Disease (2017).

r. Syed Shan-e-Ali Zaidi, Darren P. Martin, Imran Amin, **Muhammad Farooq**, Shahid Mansoor. "Tomato Leaf Curl New Delhi Virus; a Widespread Bipartite Begomovirus in the Territory of Monopartite Begomoviruses." Molecular Plant Pathology, no. 10.1111/mpp.12481 (2016).

s. Syed Shan-e-Ali Zaidi, Sara Shakir, Imran Amin, **Muhammad Farooq**, Shahid Mansoor. "First Report of Alternanthera Yellow Vein Virus from *Eclipta Prostrata* in Pakistan." Plant Disease (2016): doi: 10.1094/PDIS-08-16-164-PDN.

t. **Muhammad Farooq**, RZ Naqvi, Imran Amin, Atiq Ur Rehman, Muhammad Asif, and Shahid Mansoor. "Transcriptome Diversity Assessment of *Gossypium arboreum* (Fdh228) Leaves under Control, Drought and Whitefly Infestation Using Pacbio Long Reads." Gene 852 (2023): 147065.

u. Syeda Maryam Zahid, **Muhammad Farooq**, Memona Yasmin, Muhammad Qasim Aslam, Shahid Mansoor, and Imran Amin. "Alternative Splicing Plays a Vital Role in Regulating Pollen Allergen (Ole E 1) P19963 Protein in Gossypium Arboreum." Plant Gene 31 (2022): 100362.

v. **Muhammad Farooq** et al., "Identification and Characterization of miRNA Transcriptome in Asiatic Cotton (Gossypium Arboreum) Using High Throughput Sequencing." Frontiers in Plant Science 8, no. DOI=10.3389/fpls.2017.00969 (2017).

C. Image processing

a. **Muhammad Farooq**, Aasma Aslam, Babar Hussain, Ghazanfar Hussain, and Masroor Ikram. "A Comparison of Image Processing Techniques for Optical Interference Fringe Analysis." Photonic Sensors 5 (2015): 304-11.