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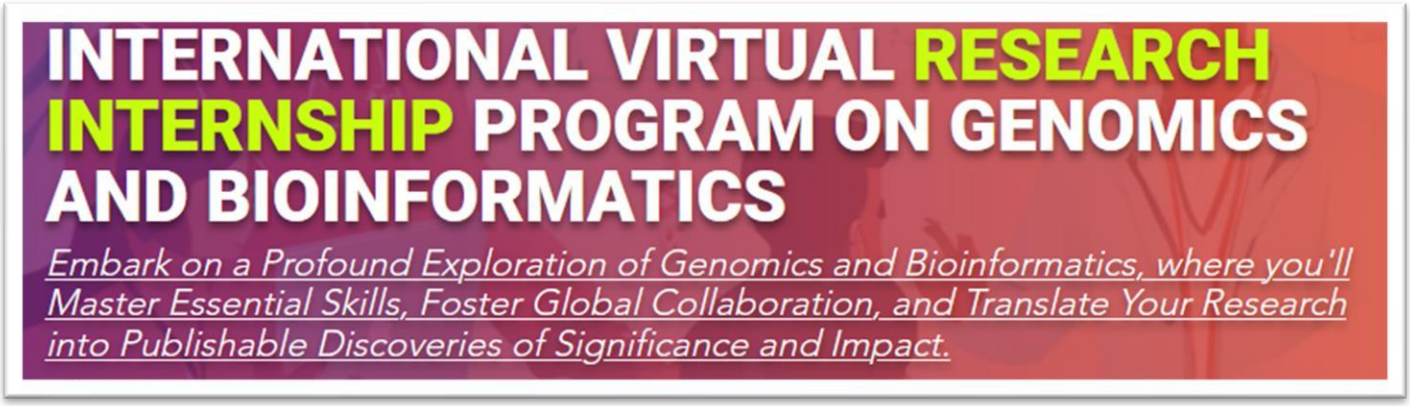

*We envision inspiring and empowering life scientists to leverage **GENOMICS AND BIOINFORMATICS** to tackle critical challenges, drive innovation, and promote sustainable progress across the globe.*

Research Domain: Plant Genomics

Research Focus: Plant Stress-Response Genomics

Research Topic: Genome-Wide Variant Profiling and Pathway Analysis in Plants Under Environmental Stress

Investigating genetic variants and biosynthetic pathway adaptations that enhance plant resilience under drought, salinity, and pest stress conditions.

Research Aim: To investigate genetic variants in plants that contribute to stress resistance, with the objective of understanding molecular mechanisms and evolutionary adaptations that enhance plant resilience under environmental stress conditions.

Research Objectives:

- **Profile Stress-Associated Genomic Variants and Functional Impact:** Perform whole-genome sequencing and variant analysis to identify SNPs and INDELs associated with drought, salinity, and pest resistance, and predict their functional effects on genes, proteins, and regulatory elements within stress-response pathways.
- **Correlate Genomic Variants with Plant Adaptation and Phenotypes:** Investigate how stress environments reshape plant genomes and biosynthetic pathways, and link genomic changes to phenotypic traits such as stress tolerance, yield, and metabolite production to identify markers for breeding and crop improvement.

LEARNING OBJECTIVES

- **Master Plant Genomic Sequencing Techniques: Gain proficiency in using whole-genome sequencing to identify genetic variants in plant genomes.**
- **Interpret Stress-Response Genomic Signatures: Develop skills in analyzing and interpreting mutational and stress-response signatures, understanding their roles in plant adaptation.**

- **Evaluate Functional Impact of Plant Variants: Assess the functional consequences of variants on gene expression, protein function, metabolic pathways, and stress resilience.**
- **Integrate Multidimensional Plant Data: Develop expertise in integrating genomic, phenotypic, and environmental data to derive insights into plant stress adaptation.**
- **Prepare Research Manuscripts for Publication: Learn to synthesize findings into a coherent scientific report suitable for publication in plant genomics journals.**

EXPECTATIONS WHILE UNDERTAKING THIS FELLOWSHIP PROGRAM:

- **Knowledge of Genomics and Bioinformatics:** Develop a solid foundation in genomics and bioinformatics, including an understanding of key concepts, methodologies, and technologies used in the program
- **Proficiency in Data Analysis:** Gain proficiency in analyzing genomic data using bioinformatics tools and software. This includes skills in data preprocessing, quality control, data visualization, and statistical analysis.
- **Research Skills:** Acquire research skills necessary for conducting genomics and bioinformatics studies. This includes formulating research questions, designing experiments, collecting and analyzing data, and interpreting research findings.
- **Critical Thinking and Problem-Solving:** Develop critical thinking skills to analyze complex genomic and bioinformatics problems and propose creative solutions. You would be able to evaluate scientific literature, identify research gaps, and contribute to the advancement of knowledge in the field.
- **Computational Skills:** Gain proficiency in software and applications commonly used in bioinformatics, such as Geneious software, web servers etc. to analyze genomics data and interpret results
- **Communication Skills:** You would be able to effectively communicate your research findings and scientific concepts to both technical and non-technical audiences. This includes writing scientific reports, presenting research orally, and participating in scientific discussions and collaborations.
- **Collaboration and Teamwork:** Be able to develop skills in collaborating with peers and professionals in multidisciplinary research teams. This includes effective communication, teamwork, and the ability to contribute constructively to group projects.
- **Professional Development:** You would be able to develop a professional mindset, including skills in time management, organization, and project management. They should also be aware of current trends and advancements in genomics and bioinformatics, and actively seek opportunities for professional growth and development.
- **Publication and Dissemination:** Contribute to the scientific community by publishing their research findings in peer-reviewed journals

PROGRAM OUTLINE AND SCHEDULE

CLASSES	TOPICS/FOCUS	SCHEDULE & DELIVERABLES
General Classes	Overview of genomics, bioinformatics, and their applications in various fields	**Week 1**
	Understanding the central dogma of molecular biology	
	Introduction to genomics technologies and data generation	
	Data formats in Genomics and Bioinformatics (Practical)	
	Internet tools and Databases (Practical on data retrieval, Blast etc.)	
	Introduction to software tools and their installation, web servers, and pipeline tools (Practical), Basic Linux Command Line Interface	
	Genomics Data and its Analysis using cutting-edge tools (Practical DNA, RNA and Protein samples)	
Specialized Classes	Introduction to plant stress genomics (drought, salinity, pest stress)	
	Applications in agriculture, industrial biotechnology, and environmental sustainability	
	Problem identification and hypothesis design in plant stress research	
	The use of critical thinking and problem-solving tools to design a hypothesis in solving identified problems	
PRACTICAL SESSIONS		
Data Acquisition and Preprocessing	**Collection of plant whole genome sequencing datasets (Reference and Query)**	**Week 2**
	Table 1: Construction of General Sequence Properties: via data table based on genome information which includes accession number, raw data size, sources, geographical regions platform, genome type, layout, file types, etc.	
	Write Up 1: Data Collections	
DNA Sequence Alignment	**Mapping to Reference:** Aligning Reads to Reference Sample	**Week 3**
	Write Up 2: Mapping to Reference	

Comprehensive Genome Analysis	**Variant Calling Analysis:** Call variants (SNPs and INDELs) by comparing sequenced reads to the reference genome i.e., performing variant analysis to identify variants specific to identify relevant SNP-associated variations of the disease in the patients **Effect Prediction and Functional Analysis:** Annotate SNP variants to determine their genomic location, potential functional effects, and allele frequencies (i.e., focus on variants affecting protein-coding genes, regulatory elements, and non-coding RNAs).	
	Write Up 3: Variant Calling Analysis, Effect Prediction and Functional Analysis	**Week 4**
	• **Table 3:** Construction of SNPs or Indels • **Figure 1:** Mapping View • **Figure 2:** Variant Calling View	
	Comparative Variant Analysis: • Compare the identified variants between samples • Identify unique and shared variants, as well as those specific to each sample	**Week 5**
	Statistical Analysis: • **Table 4:** General information on all predicted SNPs • **Table 5:** Unique and shared variants	
	Write Up 4: Variant Annotation and Functional Prediction	**Week 6**
	Statistical Analysis: • **Table 6:** Annotated SNPs and their functions • **Figure 3:** Mapping view. • **Figure 4:** Variant calling view • **Figure 5:** SNP distribution across genomic regions • **Figure 6:** Proportion of variants affecting stress-response genes • **Figure 7:** Classification by effect type • **Figure 8:** Enriched pathways and gene network • **Figure 9:** Pathway enrichment analysis	
RESEARCH PROJECT OUTLINE FOR PUBLICATION		
Research Outline	Finalizing Materials and Method	**Week 7 - 8**
	Result Writing	
	Discussion and Conclusion	
	References and Abstract	
Round Up	Certification and Recommendation Letter	**Week 9**
	Follow-up and Publication	