

## ***Curriculum Vitae***

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### **Pooja Verma**

CSIR-Senior Research Associate (Scientists' Pool)

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### **Academic Qualification**

2008-2014 Ph.D. in Plant Molecular Biology and Biochemistry from National Institute of Plant Genome Research, Jawaharlal Nehru University, New Delhi (India),  
Supervisor: Dr Manoj Majee

2004-2006 M.Sc. (Biotechnology) from H.N.B. Garhwal University, Uttarakhand (India)

2001-2004 B.Sc. (Zoology and Chemistry) from M.J.P. Rohilkhand University, Bareilly (India)

### **Research Experiences**

September 2018 – Present: CSIR-Senior Research Associate (Scientists' Pool),

Department of Plant Molecular Biology, Delhi University South Campus, New Delhi (India),

Mentor: Prof. Girdhar K. Pandey

July 2016 – March 2018: NIPGR Postdoctoral Research Associate-III, NIPGR, New Delhi (India),  
Supervisor- Dr Manoj Majee

Dec 2014 – May 2016: Postdoctoral Research Associate, University of Nebraska-Lincoln, Lincoln, NE (USA), Supervisor- Dr Lirong Zeng

2010 – Nov 2014: Senior Research Fellow at NIPGR, New Delhi (India), Supervisor- Dr Manoj Majee

2008 – 2010: Junior Research Fellow at NIPGR, New Delhi (India), Supervisor- Dr Manoj Majee

M.Sc. Dissertation Project: "Isolation and Purification of Thioredoxin Reductase from malarial parasite *Plasmodium yoelii*" at Central Drug Research Institute, Lucknow (India), Supervisor- Dr J. K. Saxena

M.Sc. Summer-training Project: "*In vitro* micropropagation of Bamboo" at Forest Research Institute, Dehradun (India), Supervisor- Dr I. D. Arya

### **Academic Accomplishments and Fellowships**

- ✓ CSIR-Senior Research Associate Fellowship (CSIR-SRA under Scientists' Pool Scheme) Sept, 2018.
- ✓ Awarded Junior Research Fellowship in an All India National Eligibility Test (NET, 2007), conducted by Union Grant Commission-Council of Scientific and Industrial Research (UGC-CSIR), India for pursuing Ph.D.

- ✓ Awarded Senior Research Fellowship from University Grant Commission-Council of Industrial and Scientific Research (UGC-CSIR), India (2010-2014).
- ✓ Graduate Aptitude Test in Engineering (G.A.T.E.), 2007.

### **Teaching experience**

October, 2006 - August, 2007: Sai Institute, Dehradun, Uttarakhand (India)

Courses Taught: Under-Graduate- Enzymology, Biochemistry, Instrumentation  
Post-Graduate- Molecular Biology, Biochemistry, Biological Techniques

### **List of Publications in Referred Journals**

1. **Verma P**, Kaur H, Petla BP, Rao V, Saxena SC, Majee M (2013) Protein L-isoaspartyl methyltransferase2 gene is differentially expressed in chickpea and enhances seed vigor and longevity by reducing abnormal isoaspartyl accumulation predominantly in seed nuclear proteins. *Plant Physiology* 161: 1141-1157
2. Saxena SC, Salvi P, Kaur H, **Verma P**, Petla BP, Rao V, Kamble N, Majee M (2013) Differentially expressed inositol monophosphatase gene (CaIMP) in chickpea (*Cicer arietinum* L.) encodes a lithium sensitive phosphatase enzyme with broad substrate specificity and improves seed germination and seedling growth under abiotic stresses. *Journal of Experimental Botany* 64:5623-5639
3. Kaur H, **Verma P**, Petla BP, Rao V, Saxena SC, Majee M (2013) Ectopic expression of the ABA inducible dehydration responsive chickpea L-myo-inositol 1-phosphate synthase 2 (CaMIPS2) in Arabidopsis enhances tolerance to salinity and dehydration stress. *Planta* 237: 321-335
4. **Verma P**, Singh A, Kaur H, Majee M (2010) Protein L-Isoaspartyl Methyltransferase1 (CaPIMT1) from chickpea mitigates oxidative stress induced growth inhibition of *Escherichia coli*. *Planta* 231: 329-336
5. Petla BP, Kamble N, Meenu, **Verma P**, Ghosh S, Singh A, Rao V, Salvi P, Kaur H, Saxena S, Majee M (2016) Rice PROTEIN L-ISOASPARTYL METHYLTRANSFERASE isoforms differentially accumulate during seed maturation to restrict deleterious isoAsp and ROS accumulation and implicate in seed vigor and longevity. *New Phytologist* (doi:10.1111/nph.13923)
6. Salvi P, Saxena SC, Petla BP, Kamble N, Kaur H, **Verma P**, Rao V, Ghosh S, Majee M (2016) Differentially expressed galactinol synthase(s) in chickpea are implicated in seed vigor and longevity by limiting the age induced ROS accumulation. *Scientific Reports* (6:35088 DOI: 10.1038/srep35088)
7. Rao V, Petla BP, **Verma P**, Salvi P, Kamble N, Ghosh S, Kaur H, Saxena SC, and Majee M (2018) Arabidopsis SKP1-like protein 13 (ASK13) positively regulates seed germination and seedling growth under abiotic stresses. *Journal of Experimental Botany* (doi.org/10.1093/jxb/ery191)
8. Ghosh S, **Verma P**, Kamble NU, Salvi P, Petla BP, Roy S, Rao V, Hazra A, Varshney V, Kaur H, Majee M (2018) PROTEIN L-ISOASPARTYL METHYLTRANSFERASES (PIMTs) play an important role

in stress tolerance by protecting stress-induced isoAsp mediated protein damage in *Arabidopsis thaliana*. (Communicated)

### **Invited Protocol**

**Pooja Verma** and Manoj Majee (2013) Seed Germination and Viability Test in Tetrazolium (TZ) Assay. (available at <http://www.bioprotocol.org/wenzhang.aspx?id=884>)

### **Patent Filed**

Indian patent application #23/DEL/2012 (January 4<sup>th</sup> 2012) “SEED VIGOR ASSOCIATED POLYNUCLEOTIDE SEQUENCES FROM CHICKPEA AND USES THEREOF” (Inventors: Manoj Majee and **Pooja Verma**, NIPGR, New Delhi, India)

### **Invited Book Chapter**

Saxena SC, Kaur H, **Verma P**, Petla B P, Rao V, Majee M (2013) Osmoprotectants: Potential for Crop Improvement under Adverse Conditions. In Plant Acclimation to Environmental Stress, ed. by Tuteja & Gill. Springer Science + Business Media, LLC 233 Spring Street, New York, 10013, USA, pp197-232

### **Conference Presentation and Workshop Attended**

- Participated in 5-day Genome editing workshop on “CRISPR/Cas9-mediated Genome editing in Plants: Applications, Tools and Experimental Design-” from May 27-31, 2019 sponsored by DBT and IUSSTF at University of Delhi-South Campus, New Delhi India.
- Participated in 2-day workshop in “Next Generation Sequencing Data Analysis” from July 2<sup>nd</sup> to July 3<sup>rd</sup>, 2018 conducted by BioDiscovery Group at New Delhi, India.
- Participated in 7-day e-Workshop in Genome Editing by CRISPR/Cas9- from July 8<sup>th</sup> to July 14<sup>th</sup>, 2017, conducted by BioDiscovery Group, India.
- Mass Spectrometry-based Proteomics Workshop – May, 2016, Center for Biotechnology, University of Nebraska-Lincoln (UNL), NE (USA)
- Systems Biology Workshop – October, 2015, Center for Biotechnology & Computational Sciences Initiative, University of Nebraska-Lincoln (UNL), NE (USA)
- Advanced BioImaging Workshop – March, 2015, Beadle Center, University of Nebraska-Lincoln (UNL), NE (USA)
- Presented poster entitled “Protein L-Isoaspartyl Methyltransferase1 (CaPIMT1) from Chickpea Mitigates Oxidative Stress Induced Growth Inhibition of *Escherichia coli* and Enhances Seed Vigor in *Arabidopsis thaliana*.” In International Conference on Plant Biotechnology for Food Security: New Frontiers (2012) NASC, New Delhi (India)
- Two days National Workshop on "Use of Bioinformatics in Plant Biology" (2010) held at NIPGR, New Delhi (India)
- Participated in Biotikos' 11, a workshop organized by TERI University, New Delhi, India (2011)
- Participated in International Symposium on Plant Signaling and Behavior (2014), New Delhi (India)

### **Knowledge and experience of Lab Techniques**

**Protein Biochemistry:** Proficiency in over-expression, isolation and purification of proteins from bacterial systems, Enzyme characterization, Enzyme Kinetics, Western blot analysis and immunodetection, *In planta* protein expression, Ubiquitination assay, GST-pull down, extraction of subcellular organelle and their proteome, Protein and peptide separations using one- and two-dimensional gel electrophoresis, Silver, Coomassie & fluorescent dye staining of polyacrylamide gels, Protein proteolysis using endoproteolytic enzymes or chemical reagents in gel or in solution, liquid chromatography based systems (ion exchange, affinity), Bioanalytical chemistry techniques like HPLC, spectrophotometry.

**Molecular biology techniques:** CRISPR/Cas9 technology, DNA and RNA isolation, 5' and 3' RACE, genome walking, gene expression analysis, qRT-PCR, Real time PCR, primer extension, immunochemistry, gene cloning, gene characterization, vector construction, Yeast two hybrid, protoplast isolation and transformation, BiFC, microtomy and immuno-histolocalization.

**Plant Immunity Assays:** VIGS-silencing in *Nicotiana benthamiana* and tomato, Cell death suppression assay, Callose deposition assay, ROS assay, bacterial growth assay and other plant immunity-associated experiments.

**Imaging:** Use of phase contrast, Fluorescence Microscopy and Confocal microscope (Leica) imaging, Use of imaging instruments like Gel-Doc, Typhoon.

**Plant transformation and tissue culture:** *Agrobacterium*-mediated plant transformation (Rice, Tobacco, Arabidopsis), Transient plant transformation using biolistic (gene-gun bombardment) particle delivery system, common plant tissue culture techniques (bamboo).

## **Computer Skills**

Knowledge of using MS-Office (Word, Excel, Power-point, Paint, Photo editor) and Photoshop. Bioinformatics tools (DNA and protein sequence analysis and use of NCBI, Uniprot, Pubget/Pubmed, SWISSPROT, Soft-berry and related databases, and Oligo software usage, multiple sequence alignment tools, phylogenetic analysis and others.

## **Extra-Curricular Activities and Hobbies**

- Serving as a reviewer for international journals like Plos One, Scientific Reports
- Serving as a reviewer for Bio-protocol from the year 2013 to present, which is a peer-reviewed open access journal (ISSN: 2331-8325) in CA, USA.
- Served as a reviewer for University of Nebraska-Lincoln (UNL) Undergraduate Creative Activities and Research (UCARE) proposals for the academic years 2015-2016 and 2016-2017.
- Winner and participant of cover page designing, singing, dancing and writing competitions.
- Active organiser of academic, sports and cultural activities throughout the academic session.
- Served as hostel secretary and mess secretary throughout the PhD tenure.

## **References**

**Dr. Manoj Majee**  
(PhD Supervisor)  
Staff Scientist IV,

**Dr. Naveen C. Bisht**  
(Faculty)  
Staff Scientist IV,

**Dr. Ashverya Laxmi**  
(Faculty)  
Staff Scientist IV,

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#### **Declaration:**

I hereby declare that all the above information given is true.

Date: 11<sup>th</sup> September, 2019



(Pooja Verma)

#### **Personal Information**

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338, Vikas Colony, Near Vishal Mega Mart,  
Ranipur More,  
Haridwar - 249401,  
Uttarakhand, INDIA

Date of Birth :

21<sup>st</sup> April 1984

Place of Birth :

Moradabad, U.P., India

Gender :

Female

## Appendix – I

### **Post-doctoral Research (September 2018 to Present)**

Research Project: **Development of abiotic stress tolerant rice by targeted genome editing of calcium signalling components, *CIPK9* and *CIPK23*.**

Principal Investigator: **Dr. Pooja Verma**

Mentor: Prof Girdhar K. Pandey, University of Delhi-South Campus, New Delhi, India

Calcium is the ubiquitous signalling molecule in eukaryotes including plants. On exposure to extreme environmental and nutrient deficiency,  $\text{Ca}^{2+}$  (calcium ion) levels are elevated in the cytosol. Such fluctuations trigger  $\text{Ca}^{2+}$  signatures; activate  $\text{Ca}^{2+}$  signalling components including  $\text{Ca}^{2+}$ -binding proteins for example CBL proteins (Calcineurin B-like). CBLs regulate auto-phosphorylation of CBL-interacting protein kinases (CIPKs) which further phosphorylate the downstream target proteins under specific altered conditions. *CIPK9* and *CIPK23* have been important for abiotic stress tolerance and nutrient uptake pathways as studied in Arabidopsis. Hence, the current research aims at targeting *CIPK9* and *CIPK23* in rice at genomic levels using CRISPR/Cas9 based genome editing technology, to decipher their roles in stress tolerance. The kinase activity of the CIPKs would be analysed in both loss-of-function and gain-of-function genotypes. Henceforth, this study would develop tolerant phenotypes in rice and other monocot crop species and would accomplish the demand of better crops at agro-economic scale in a developing country like India.

### **Post-doctoral Research (July 2016 to March 2018)**

Research Project 1: **Functional characterization of protein repair enzyme Methionine Sulfoxide Reductases (MSRs) in plants**

Principal Investigator: **Dr. Manoj Majee**, Scientist-IV, National Institute of Plant Genome Research, New Delhi, India

Proteins are large biomolecules, which are essential for various cellular processes although are damaged by reactive oxygen species under storage and environmental conditions. Methionine (Met), an amino acid residue, is most susceptible to oxidation. Methionine oxidation leads to the generation of Methionine sulfoxide (MetSO) which ultimately results in structural and functional alterations of many proteins. Such oxidation is repairable by a protein-repairing enzyme known as Methionine Sulfoxide Reductase. Methionine sulfoxide reductases (MSRs) are ubiquitous enzymes which repair oxidized proteins by reducing MetSO to Met. Aging seeds are susceptible to such protein oxidation which eventually affects longevity. The research work involves identification and characterization of two types of MSRs (MsrA EC:1.8.4.11 and MsrB EC:1.8.4.12) from major food crops (chickpea and rice) and their seed-specific role(s). Identification of role of MSRs in seed vigor and longevity would prove beneficial for the agro-economically important plants.

## Research Project 2: **Role of Protein L-isoAspartyl Methyltransferase (PIMT) in stress tolerance**

Principal Investigator: **Dr. Manoj Majee**, Scientist-IV, National Institute of Plant Genome Research,  
New Delhi, India

The research work involves the identification of role PIMTs from chickpea (*Cicer arietinum*) in seed developmental stages and in stress tolerance. The role of PIMTs in enhancing seed vigor and longevity during aging has already been proven in my doctoral research. As an extension to the previous findings, the role of PIMTs in stress tolerance is under investigation. Also, substrate identification of chickpea PIMTs is another objective of the project for supporting additional functional aspects of this protein repairing enzyme in chickpea.

### **Post-doctoral Research (Dec 2014 to May 2016)**

Research Project: **Role of a Lys63-Specific E2 Ubiquitin-Conjugating Enzyme/Variant and interacting proteins in Plant Innate Immunity**

Principal Investigator: **Dr. Lirong Zeng**, Associate Professor, Department of Plant Pathology, University of Nebraska-Lincoln, NE, USA.

The study explores the molecular mechanism and biochemistry of ubiquitination system and its involvement in regulating tomato immunity against the pathogen *Pseudomonas syringae*. The Lys63-specific ubiquitin-conjugating enzyme and its cognate E2 variant, Fen-interacting (Fni) protein 3 (Fni3) and *Solanum lycopersicum* Uev (Suv) and two tomato E3 ligases, Fti1 and Fti1B, (identified in yeast two hybrid screening) were characterized for their role in plant immunity.

### **PhD Program (2008-2014)**

Course work completed in PhD Program:      Molecular Cell Biology and Genetics, Genomics, Plant Biology, Emerging Trends in Plant Sciences, Research Methodology.

Supervisor: **Dr. Manoj Majee**, Scientist-IV, National Institute of Plant Genome Research, India.

Research Project: **Molecular Analysis and Functional Characterization of Protein L-Isoaspartyl Methyltransferase from Chickpea.**

### **Synopsis of the PhD Work**

Protein L-isoaspartyl methyltransferase (PIMT; EC 2.1.1.77) is a protein-repair enzyme ubiquitously distributed among prokaryotes and eukaryotes. PIMT plays an efficient role in identifying and catalysing the repair of abnormal isoaspartyl residues in cellular proteins. Aging during storage leads to accumulation of isoaspartyl residue causing reduced seed vigor and viability, inefficient germination

and a decreased tolerance towards environmental stresses. Unlike animals, plants possess two genes for PIMT, already reported in *Arabidopsis thaliana*.

My PhD research work deals with the unexplored aspects of PIMTs from a leguminous crop chickpea (*Cicer arietinum*). Two genes, *CaPIMT1* and *CaPIMT2*, were successfully isolated and characterized from chickpea. In addition, a transcript variant of *CaPIMT2* was identified which lacks two important amino acids from active site region. Highest PIMT enzyme activity and transcript accumulations were observed in dry seed which declined during germination. Also, an induction was observed in transcript levels of both the *PIMTs* in stress conditions and phytohormone treatments. *CaPIMT1* and *CaPIMT2* displayed differential sub-cellular localization with cytosolic and nuclear distribution, respectively, to repair target proteins in separate compartments. *CaPIMT1* showed maximum activity at 50°C and at pH 9.0. *CaPIMT2* also displayed similar properties with 50°C as optimum temperature and pH 8.0 as optimal pH value. These findings correlate with the accumulation of higher isoAsp content during high temperatures and in alkaline conditions, also chickpea confronts high temperature and declining soil moisture throughout its life cycle. The *CaPIMT1* and *CaPIMT2* accumulating *Arabidopsis* seeds showed enhanced seed vigor and viability when exposed to control deterioration test (CDT) and abiotic stresses (Verma et al., *Plant Physiology*, 2013). *CaPIMT1* and *CaPIMT2* overexpressing *E. coli* cells mitigated oxidative stress generated growth inhibition in paraquat generated oxidative stress (Verma et al., *Planta*, 2010). Similarly, *CaPIMT1* and *CaPIMT2* transgenic plants displayed tolerance towards different abiotic stresses.

The above findings promise a substantial role of both the genes in enhancement of seed vigor and longevity and in stress adaptation. These roles to *CaPIMTs* can be of great agricultural interest and might be exploited for long-term seed storage, germplasm conservation and improvement of stress tolerance among crops.