Profile

Jagadis Gupta Kapuganti

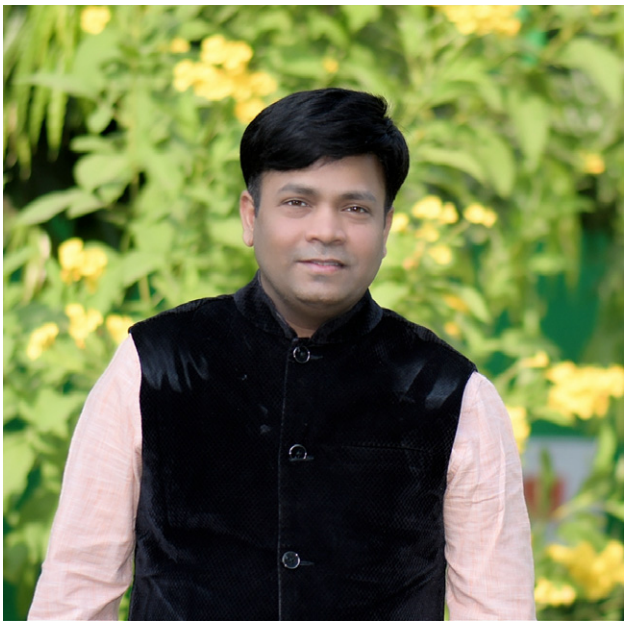
What inspired your interest in plant science?

I consider plants to be the most important and beautiful living things on the Earth. I grew up in the southern part of India, in the countryside village of Dharmavaram which is in the Andhra Pradesh state. During my school years, I was aware of various varieties of plants such as mango, custard apple and several exotic palms. When I was a child, I would grow vegetables and observe their development, and my family members still remember those days. Some of my school friends were from farming communities and I used to go to their fields and observe their crops and trees. Plants provide us with food, fodder, medicines, textiles, timber, oxygen. In a nutshell, they are ever-present in our daily lives! Starting from germination through to maturity, flowering and senescence, all plant science research is very interesting. Since plants are an integral part of our lives and give us so much, we need to protect them from biotic and abiotic stresses and improve them. Plant science is fascinating as it deals with a vast amount of biology and there is huge scope to develop crop plants to obtain high yielding varieties to ensure food security. Since my PhD, the analysis of plant metabolism, and of adaptive responses to hypoxia, has been my long lasting interest in plant science.

Why did you decide to pursue a career in research?

A sequence of events drove me to pursue my career in plant science. During my Masters study, I was fascinated by the lectures of many of the professors of Plant Sciences at the University of Hyderabad (India), and I had an opportunity to do a summer internship in Professor A. S. Raghavendra's laboratory. I spent three months training in his laboratory where I learned about the plant response to osmotic stress and the role of mitochondrial alternative respiratory pathways, and this motivated me to pursue research in advanced plant biology. This interest was further boosted by the lectures on biochemical plant pathology from Professor Apparao Podile. Luckily, I joined the laboratory of Professor Werner Kaiser at the Julius von Sachs Institute of Plant Science, University of Wurzburg (Germany), an amazing place for doing research in molecular plant physiology. Professor Kaiser became my PhD supervisor and introduced me to nitric oxide (NO) research, which at that time was a 'hot topic'. I learned about essential biochemical pathways and how to investigate them. I was very lucky that Professor Kaiser directly joined in the experiments with me and we participated in long and fruitful discussions. I developed a great interest in plant NO and started exploring novel roles for NO in both basic and applied plant science research.

Box 1



Jagadis Gupta Kapuganti is currently working as Scientist V at the National Institute of Plant Genome Research (NIPGR, New Delhi, India). He obtained his MSc degree from the University of Hyderabad (India), and his PhD from the University of Wuerzburg (Germany) in 2007. From 2007 to 2010, he worked as a postdoctoral researcher at the Max Planck Institute of Molecular Plant Physiology (Potsdam, Germany), on regulation of respiration in plants. Subsequently, he worked as a postdoctoral researcher at the University of Rostock (Germany) on serine hydroxymethyltransferases. From 2012 to 2014, he was a Marie Curie Fellow at the Department of Plant Sciences, University of Oxford (UK) working on the role of nitric oxide in the low oxygen stress response in plants. In 2014, he established his group at NIPGR, an autonomous Institute of the Department of Biotechnology (Government of India). His main research interests are nitric oxide signalling, understanding nitrogen use efficiency to meet the food security agenda, identification of novel roles of nitric oxide in the adaptive response of plants to flooding stress, improving germination of crops such as rice and chickpea, improving nitrosative stress tolerance, and improving postharvest loss of fruits and vegetables. He has received prestigious awards and fellowships, including a Marie Curie Fellowship, a Max Planck Fellowship, a Ramalingaswami Fellowship, a Ramanujan Fellowship, an Innovative Young Biotechnology Award, and a Biotechnology Ignition Grant from the Government of India. His group has international collaborations with groups in the UK, Germany, Portugal, Canada, Switzerland, France, Russia, and elsewhere. He serves as an Associate Editor of *Food & Energy Security*, Editorial review board member of *Journal of Experimental Botany*, and *Plant, Cell & Environment* and he is an Editor of *Planta*.

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What motivates you on a day-to-day basis?

Every day is a great day! New ideas, novel methods, eagerness to try new things and thinking about new hypotheses and experiments motivate me. I like scientific interactions with students and engaging them in experiments, and I am happy to see their passion to try new things. Connecting previous experiments to the next experiments and following the direction towards novel findings really motivates me. It is important to think how to elaborate basic findings into applied aspects which can have great impact. One recent example is that I have taken a basic finding from my research and applied it to increase the longevity of fruits. When it worked it was a big 'Wow!', and I developed this technology into an innovation supported by the Biotechnology Industry Research Assistance Council (BIRAC), an enterprise of the Department of Biotechnology, Government of India. We are in the process of device development for increasing the shelf life of fruits, which will provide a direct benefit to farmers to protect their production. When I heard from the European Patent Office that this technology has 100% industrial applicability, this motivated me further. Another memorable incident occurred recently when Kolbert *et al.* (2019) listed 15 important milestone publications in 40 years of plant NO research and I was very happy to see two of my co-authored papers among them. Achievements of this kind really motivate me and keep me very active in the pursuit of my passion. I have international collaborators in the UK, Canada, Germany, Russia, Switzerland, France and Portugal. Continuous discussions with collaborators and developing new collaborative ventures are further driving forces that motivate me.

Is there anyone that you consider to be a role model?

I have worked with amazing people, who are great and well respected in their fields. My PhD supervisor Werner Kaiser, who taught me how to formulate hypotheses and conduct experiments to test them, had a great impact on my career. I learned how to prepare great papers with careful organization and attention to detail from my postdoctoral supervisor Professor George Ratcliffe at the Department of Plant Sciences, University of Oxford, UK. Dr Alisdair Fernie from the Max Planck Institute of Molecular Plant Physiology, Potsdam, Germany, is another amazing scientist from whom I learned about the flexibility of plant metabolism. Professor Christine Foyer is another inspiration to me with her ability to think and make novel findings. Professor Abir Igamberdiev's studies on mitochondrial energy metabolism have inspired me, and he has become a very good collaborator. We have jointly investigated the phytoglobin–NO cycle and we continue to publish very good work together. In India, Professor Sudhir K. Sopory's work is very inspiring and his suggestions are always insightful, thoughtful and provide excellent directions. Further, Dr Ramesh Sonti's findings in basic and applied research have motivated me to apply my basic research to practical applications. Dr Subhra Chakraborty has been an inspiring pioneer in nutritional genomics and plant immunity research, and I learned these great qualities while collaborating with her on NO-related plant–pathogen interactions over the last few years, and continue to do so. Professor

Fig. 1 Pomegranate (*Punica granatum*). Photo credit: G. Manjunatha.

Satyajit Mayor from the National Centre for Biological Science, Bengaluru, India, is another inspiration from whom I see collaborations worldwide, as he always says that science is global. Dr Rajesh Ghokale from the National Institute of Immunology, New Delhi, India, is my great inspiration in bringing laboratory ideas to the market place to benefit human welfare.

What are your favourite *New Phytologist* papers of recent years, and why?

There are amazing papers in *New Phytologist* and many of them are my favourites. A recent paper by Martínez-Medina *et al.* (2019) where the authors demonstrated that the phytoglobin–NO cycle helps in the generation of NO signatures during the establishment of the *Solanum lycopersicum–Rhizophagus irregularis* mycorrhizal symbiosis is an example. This study was very exciting for me because the paper explains the importance of the NO signatures and cognate patterns of phytoglobin expression in determining symbiosis or pathogenicity. Hence I highlighted it in a *Trends in Plant Science* spotlight article (Kumari *et al.*, 2019). Another example is the paper by Berger *et al.* (2020) where they demonstrated the power of the phytoglobin–NO cycle at every stage of the *Medicago–Sinorhizobium meliloti* symbiosis using *Phytoglobin1.1* transgenic lines. An earlier paper by Cvetkovska & Vanlerberghe (2012) in which the authors demonstrated that mitochondrial alternative oxidase-driven respiration acts to minimize the generation of reactive oxygen and nitrogen species in

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plant mitochondria, remains one of my favourite research articles in *New Phytologist* because the paper described a very important of role of alternative oxidase (AOX) in NO homeostasis. Another excellent *Tansley insight* by Lee & Bailey-Serres (2021) describes mechanistic insights into evolutionary variation in the integration of nuclear and cytoplasmic processes that contribute to variations in flooding resilience in plants. Interestingly, in that article the authors emphasized the use of single cell RNA sequence analysis for identification of cell specific responses to a decrease in oxygen during flooding and development. This is important to investigate because different tissues and cells experience different degrees of hypoxia during flooding.

What is your favourite plant, and why?

Pomegranate (*Punica granatum*) is my favourite plant. It is a small shrub or tree with very attractive flowers and fruits (Fig. 1). The National Institute of Plant Genome Research (NIPGR) campus has these plants. It is very pleasing to watch the bright red flowers throughout the year and to see how these hermaphrodite flowers gradually develop into very attractive fruits over a period of six to seven months. This plant is very popular in India and it is grown in kitchen gardens as a good nutritional source. The fruits are very attractive and their interior has a ruby-coloured glistening appearance of very tasty and nutritious antioxidant-rich seeds, with the compartments separated by a membranous wall. I became more interested in this plant when I started collaborating with Dr G. Manjunatha from the College of Horticulture, Bagalkot in the southern part of India. I visited his field sites and I can say it was the most wonderful experience I ever had at any farm. We are currently collaborating on the role of nitrogen nutrition in increasing resistance of pomegranate to bacterial blight caused by *Xanthomonas axonopodis* pv *punicae* (Xap). We are following an innovative approach to tackle the disease by using nanotechnology. I started growing these plants in the field at NIPGR and they are very adaptable to diverse climates and varied soil types. Interestingly, every part of the fruit, including peel, seeds and aerils, has commercial value. The peels and flowers can be used for preparation of dye due to the presence of granatonine and this has a huge commercial value in the textile industry.

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