Interview of

# Dr. Kutubuddin A. Molla

## Scientist (Biotechnology), ICAR-NRRI, Cuttack, India.

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More on Dr. Kutubuddin A. Molla

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https://scholar.google.com/citations?user=PlZs7N8AAAAJ&hl=en

ORCiD

https://orcid.org/0000-0002-9897-7906

## Could you in a few words describe your journey so far as a Plant Scientist and tell us how you got to where you are now?

Dr Molla:I would start from my childhood. I belong to a farming family. We had farming land and we used to cultivate rice mainly because, you know, our staple food is rice. I used to visit rice fields often in my childhood and had gained a little bit knowledge about how to plant rice from seed beds and how to irrigate them and all those kinds of things. From the beginning, I always had an interest in rice. In India, we have a very good free government education system. So, I started my early education in government free-primary school. In my village, there is a higher secondary school named Joygram Janaki Nath High School from where I have completed my schooling. Then, I went to Calcutta to do my ***Bachelor of Science in Botany*** as an honours subject and a combination of Chemistry and

Zoology as my compulsory subjects from City College under University of Calcutta. It is a 150-year-old University and very well-known University in India. Then, I did my ***Master of Science in Botany from Calcutta University***'s Ballygunge Science College campus, and that was the time when my attention was drawn to Molecular Biology and I got fascinated towards DNA and RNA stuff. I attended a workshop organized in our department, funded by the University Grant Commission. This workshop was co-ordinated by Dr. Moumita Bandyopadhyay. I was really lucky to be selected for that workshop. That was the first time I visualized DNA bands in a UV transilluminator. They did restriction digestion, and they added a solution to the DNA which divided it into two parts. I was amazed to see how a protein could cut DNA and the two separated parts ligated into a single fragment. That was really a breakthrough point in my life that drew my attention towards Molecular Biology. So, I decided to go for Biochemistry and Molecular Biology as special paper in my last semester of M.Sc. Then I did my ***PhD under the guidance of a famous scientist in rice biotechnology, Professor Swapan Kumar Datta***. He was with the team of Ingo Potrykus in the development of Golden Rice. He worked in Zurich, Switzerland and then he worked as a biotechnology team leader in IRRI (International Rice Research Institute), Philippines. Later he joined our University, we were very attracted to him. I applied for my PhD position and I got a chance to carry out my PhD in his lab. I got ample opportunities from that lab and I gained expertise on how to develop Transgenic Rice and what are the crucial points to do genome modification in rice. And then, while I was preparing to submit my thesis, I appeared for Agricultural Research Service (ARS). I know in USA, there is ARS, which is conducted by USDA, here also, we have a similar ARS system in India. So, through that system, I got my first job as a scientist at Delhi, in the National Bureau of Plant Genetic Resources (NBPGR). NBPGR is well known for having the National Gene Bank of India. So, I worked there for one year. Then, as I have a great interest to work on rice genetic improvement, I joined the ***National Rice Research Institute (NRRI)***, Cuttack in 2015. In NRRI, I spent two years and then I got the opportunity to go for a ***Fulbright Fellowship***. Obviously no other technology attracted me other than genome editing. I came to know about a Nature article published about the 'genome edited non-browning mushroom' by Prof. Yinong Young and I contacted him and yeah, I was

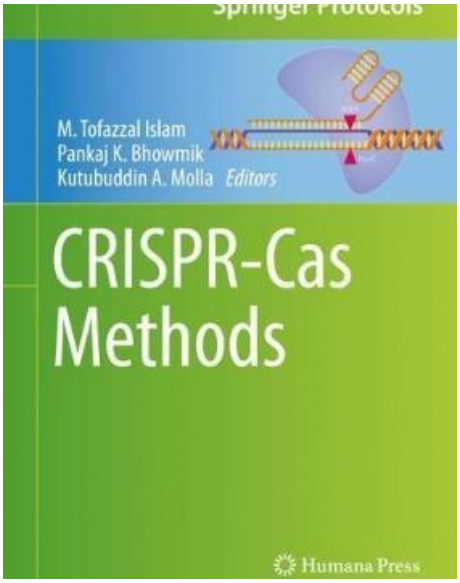
Prof. Swapan K. Datta

https://en.wikipedia.org/wiki/Swapan_Kumar_Datta

lucky that he accepted me in his lab. This was the story of my Postdoc and now I am back in NRRI, Cuttack and applying all those experience that I gained there, for rice crop improvement for my nation.

## According to you which sectors of plant science and research and agriculture are likely to prosper in the near future do you think ?

Dr. Molla: A lot of cross industry applications are possible in agriculture. They may not be that popular yet in India and in many developing countries, but they are being highly used in developed countries. For example, the use of drones in agriculture. Then comes Precision Agriculture and Artificial Intelligence. They help to know what part of the crop field is affected by disease or nutrient deficiency through satellite imaging. Then comes Nanotechnology. Nano formulations of fertilizers and pesticides that are less harmful for the environment than the conventional chemical fertilizers. Another very interesting technology that I came across a few days ago, 3D printing. The 3D Printing is also impacting the Agri-prototypes productions field. It allows you to rapidly evaluate all different kinds of designs and what design would be suitable for your application. If I want to give you an example, Cassava (I told you about Cassava in my presentation). You must peel out the skin, before you eat cassava. Then you need to grate the Cassava, dry and soak it, and then drain the water. So, if you want to design a Cassava grater, you can go for 3D Printing. You can visualize a lot of models and then select the best one that will be most suitable to fulfil your purpose. Experts believe that hydrocolloids are also highly prospective in agriculture. Hydrocolloids means the substrate that forms gels with water. These hydrocolloids could be used to replace the base ingredients of our foods with renewable sources like Algae, Duckweed. I think the top-notch technology that I want to mention here, is genome editing with CRISPR-Cas9, that is revolutionizing crop improvement. Another is Vertical Farming. Urban people can do farming in a very limited space. If you see the example of Israel, they are doing it in a very huge



label. So, I think these are the areas that are likely to prosper in near future.

## Do you consider genome edited CRISPR crops as GM crops?

Dr. Molla: In the current scenario, regulatory bodies, they are dividing the gene edited crops based on how and why they have been produced. Genome editing procedures are divided into three categories- SDN 1, SDN 2, and SDN3. SDN 1 is the simplest one, so if you knock out a gene, most of the world regulatory bodies consider SDN 1 as a non-GMO. Suppose if you want to get rid of the toxin from Cassava and you knocked out 2 genes from Cassava and you developed a gene edited Cassava that does not have that toxin, that Cassava would not be regulated as GMOs as per the recent regulation of most of the countries if the end product does not contain any transgenes. I read the recent draft proposal by the Department of Biotechnology (DBT), India. There is a similar classification about SDN 1 and that it would not be regulated as GMOs. I was talking with Liberty about Pamela Ronalds from UC Davis. She is a famous scientist. I visited her lab also and met her postdoc fellow Oliver Dong, he is a very good friend of mine. They recently published a paper where they integrated the carotenoid biosynthetic pathway cassette into a safe harbor locus in rice. So, if you see the genome organization there are some portions of the genome, if they harbor a foreign gene, it would not likely to hamper the normal phenotype of plant or it would not have any bad effects. That is called safe harbor loci of a genome. So, this technology, CRISPR-Cas9 allows you to solve the issue with normal transgenic technology. When you insert a foreign gene through conventional transgenesis, you would not be able to control where it is going to integrate. Now, if you use CRISPR-Cas9 to integrate a foreign gene using Homology directed repair, then you could insert your gene of interest at the point where you want. So, what they have done (Pamela Ronald and team)? They inserted carotenoid biosynthetic pathway cassette into a safe harbour locus and then they developed a new variety which has golden colour grain. So that's Vitamin A rich Rice and that should be called golden rice. We know that where the cassette is integrated so it is easy to analyze. If this kind of development happens then it

Dr. Molla with Nobel Prize 2020 winner Dr. Jennifer A. Doudna (UC, Berkeley, USA)

would be regulated as GMOs. Most of the regulatory bodies agree because it contains the biosynthetic pathway gene inserted into the genome. In order to produce the trait (vitamin A), the plants must have that cassette integrated into a genome. This is called SDN 3 and this SDN 3 is considered as GMOs; but SDN 1 and SDN 2 are most likely not GMOs as per the current views of many countries like USA, Canada, Australia and some Latin American countries. SDN1 and SDN2 create few base pair change in the existing gene or other native genetic parts but do not lead to the permanent insertion of foreign DNA. So, SDN1 and SDN2 generated plants do not fall under current GMO legislation.

The young scientist was felicitated on February 7, 2014 at Jammu University by Vice President of India Hamid Ansari with a cheque and an Award Certificate in the field of Agriculture and Forestry Sciences.

## Do you think that integration being classified as genetically modified would also include if you inserted extra copies from the same genome? Take for example, Golden Rice, if you inserted those carotenoid genes which already exist in rice in those safe harbor genes would it be considered as GM?

Dr. Molla: If you ask my opinion, it should not be, but I am not the controlling authority of all regulatory bodies. In my introductory slides, I gave an example of genome shuffling by normal crop breeding; huge genome shuffling occurs during conventional cross-breeding, huge number of unnecessary mutations occur during mutation breeding, a lot of different things are happening, but they are not being regulated. When you know that this gene is very much safe, the product of this gene is also safe, and has a long history of safe use, then scientist use that gene to develop a transgenic variety. That variety is regarded as genetically modified. The irony is that a small modification with a single or couple of gene is regarded as genetic modification, whereas larger modifications happening during cross-breeding and mutation breeding are not regarded

as a genetic modification. I do not know why. This is my scientific view.

## Do you have any advice for today's youth who are considering a career in Plant Sciences?

Dr. Molla: In Plant Science? Oh my god, I am not that big to advise people. But I have some points to mention as I guide few students. The things that I advise them, I could share with the audience present over here. So, if I go selectively for PhD students, as they need support and suggestions the most; because, to many, the PhD tenure seems the most frustrating and struggling part of life for many reasons. So, the first point is to keep in mind- whenever you enter your PhD program, you ***have to be very organized in the lab***, even if you keep a messy apartment or are not so organized in your personal life. You need to organize your thoughts and tasks- how to do, when to do and what to do. You must write everything in your daily note, what you are going to do today. I still do that now. I write in my notebook each morning- these are the tasks that I am going to complete today, and I take it one by one. So, this is one way of organizing yourself and you know, what you have to do and how far you achieved. When you complete the first and second task in your list, you feel confident, you feel energized, as you have accomplished something. But if you have all five works in your mind and you start doing them all simultaneously then it becomes easy to be distracted. So, you are going to be preoccupied with your thoughts about your pending tasks and get very little sense of accomplishment. That will make you stressful. Hence, it is good to make a list of what you are going to do.

Working on transgenic rice development for Sheath Blight resistance at University of Calcutta for PhD Thesis

The next important thing is- ***Time Management***. So, in Ph.D, although it varies from lab to lab, in an ideal condition a PhD student is his/her own boss. They must manage on their own. That is why, they have to prioritize how they will spend their time, when to have fun, when to go for chatting with friends, when to go for coffee and when to work. PhD is a continuous process, for which you have to continuously develop your academic skills by reading more and more. So, it is not that you

are going to get great ideas without reading even if you are a great thinker. It is difficult to think about a good idea without reading and without knowing what is going on in the present scenario. So, you must have to cope up with the present scenario by which you can overcome the problems. The third point, which is quite important is- ***self-motivation***. When you fail, it is the self-motivation that drives you forward. Nobody is there to motivate you. Your guide also would not know what is going on in your mind. If two consecutive experiments fail and you start thinking that my PhD is not going to be completed and I am not going to get the degree. Then, you need to motivate yourself. This is the common scenario with everyone, which happened with me and my friends. When you go to bed, you think in the direction that okay these two experiments have failed, maybe the third time I would be successful, maybe something good is waiting for me. Also, you can read some stories of great scientists, how they have failed and how they have succeeded in their consecutive attempts. So, these are the things, I think Ph.D. scholars should always keep in mind.