

# VINCENZO DE LUCA

NSERC DISCOVERY GRANT RECIPIENT - 2017 COMPETITION

## “Monoterpenoid Indole Alkaloid Biosynthesis”

### What is the aim of your research?

The aim of our research is to study interesting biochemical pathways in plants by using and developing technologies that facilitate the discovery process. The complexity of the studies require creative use of emerging technologies together with their systematic and logical application that will foster the next generation of plant scientists who will continue the progress that we have achieved over the past 30 years.

### What is the overall importance of this project?

This project is extremely important for completion of our understanding of how the medicinal plant *Catharanthus roseus* (Madagascar periwinkle) makes powerful anticancer drugs currently being used in modern chemotherapy. We and others have now characterized 26 of the 28 genes required for the assembly of these MIA anticancer drugs.

This project will complete the characterization of the remaining steps and will produce prototype microorganism strains that express this pathway. Ultimately, the technology developed from this basic research will be transferred to the chemical engineering industry where these prototype strains will be improved for eco-friendly commercial production.

### How would you describe the creativity and/or innovation in the heart of your research?

The NSERC Discovery Grant program has funded my core research over the past 27 years since I became a university professor at the University of Montreal and at Brock University (since 2001). The program funds curiosity-based fundamental research that could not be funded by any other program available in Ontario and in most of Canada.

The fundamental studies that have been carried out in my Discovery based program have led to the detailed understanding of how plants assemble a class of molecules termed monoterpenoid indole alkaloids (MIAs) that serve in the treatment of various human conditions including cancer, hypertension, pain, cognitive decline and epilepsy. The freedom to do such studies has led to many discoveries of biosynthetic pathways whose backbones are the sources of thousands of biologically active MIAs and to a fundamental understanding of the biological mechanisms that have evolved in plants for accommodating this biological activity.

### How do you envision your research benefitting the general public?

The implications of this research for humans and their society is evident since the tools will permit the production of many diverse MIAs that may be used as drugs for human or veterinary use, as pesticides, fungicides and any number of other yet to be imagined possibilities.

### What does receiving this grant mean to you?

I am extremely grateful for receiving this 7th consecutive NSERC Discovery Grant that has now funded my core basic research since 1989. The substantial increase in funding that I was awarded confirmed our productivity and innovation by our scientific peers and will certainly be helpful in continuing basic studies on MIA assembly in plants and towards the transfer of the pathways to microorganisms where many different biologically active and commercially useful molecules can be engineered.

### What aspect of your work/research are you most passionate about?

The thought processes and discussions that lead to the development of a hypothesis are very rewarding. The experimental verification/modification of the hypothesis that takes place when an experiment is performed triggers creativity in interpretation of the results. The discovery process, while it is exciting, is short-lived since it inevitably raises new questions about how biology works. Each of these components involve extensive discussion with lab members in order to make decisions on the next steps in the process.

### What do you think are your most significant research accomplishments?

The most significant research accomplishments for my lab is the discovery of how plants make a key class of biologically active molecules. During the course of these studies, many students have received training at the undergraduate, graduate and postgraduate levels. Many of these students have continued on to have productive research careers in academia, education, government and industry.

professor  
BIOLOGICAL SCIENCES

Tier 1  
CANADA RESEARCH CHAIR  
plant biotechnology



### What made you decide to enter this field of research?

I grew up in Montreal in areas of the city that were still wild and within a short distance of the Montreal Botanical Gardens. This is where I became interested in plants. I had excellent mentors who introduced me to the merits of reductionist approaches to studying plant biology during my undergraduate, graduate and postgraduate career.

### Who has influenced you most in your career and/or research?

During my MSc, I heard symposium presentations by Professors Albert Lehninger (author of *Principles of Biochemistry*) and Frederik Sanger (2 Nobel Prizes in Chemistry) when I attended the first scientific conference of my life. During their presentations, I was struck by the humility and great curiosity of these famous scientists. This certainly stimulated me to emulate them and to pursue my scientific career. My MSc and PhD supervisors also had a great impact on my continued interest in a scientific career.

### What do you enjoy most about your career?

I enjoy most the freedom that I have, being employed as a University professor and as a researcher. I do not know of any other activity that would better reflect my personality and my creative interests. The position is incredibly stimulating from an intellectual point of view and allows me to study Nature at the molecular and biochemical level. The human interactions have been, and continue to be, wonderful with each crop of students, postdoctoral fellows and collaborators that I have trained and interacted with over my career. My research has permitted me to develop contacts and collaborations with colleagues around the world and be involved in stimulating conversations, research and advisory capacities.

### What are your most important publications?

My most important papers are those which contributed new insights about how biology functions to do complex chemistry. For example, we documented that not all cells perform the MIA chemistry involved. As certain cells become specialized within the organism for performing photosynthesis, some cells become specialized for making MIAs!

### What courses do you teach at Brock University?

BIOL 2P94: Plant biology: growth and development  
BIOL / BCHEM / BTEC 4P08: Topics in plant and microbial biotechnology  
BIOL 5P86: Current topics in basic and applied plant biology

### What is your teaching philosophy?

Studies in plant biology require a combined appreciation of plant anatomy, cell biology and the biochemical mechanisms that are responsible for the functioning plant. The importance of plants as a key component in the development and evolution of complex life forms on our planet is an essential component of what I wish to teach students in my classes.

While my classes are structured for learning fundamentals, I do expect students to obtain insights about the importance of plant biology in their lives and to the well-being of our planet. This is accomplished by providing students with real life examples for the importance of plants in human existence (food, fuel, medicine, clothes, housing etc). Courses are also designed to teach students to be critical and to make informed decisions based on understanding the problems to be solved, their interconnection with the Humanities and the issues that need to be addressed to obtain a solution.

### Words of advice for students interested in a career in your field and/or subject area?

The sciences teach us about ourselves and the world we live in. Plant biology is the engine responsible for life as we know it. Solutions to climate change and ecological problems are found by learning how plants participate in, and control, these processes. While this is a serious and challenging business, a career in plant biology offers unlimited opportunities for creative people.

### What research opportunities are available for students through your department?

Virtually all members of the Department of Biological Sciences are funded by NSERC Discovery and other grants. There are many opportunities for doing basic (ecology, neuro- and plant biology) and more applied (Oenology and Viticulture) studies for undergraduate (honors research thesis), graduate (MSc and PhD) and post-graduate (postdoctoral studies) research.