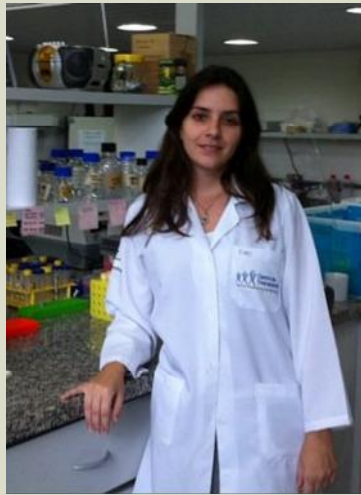




## Experiences of five young EU-SOL scientists

**While delivering a huge amount of scientific output EU-SOL offered a special occasion for young scientists to experience participation in an international research platform, operating in the frontline of scientific development in plant genomics and plant breeding. We asked five of those young scientists how they contributed to EU-SOL, what they liked about it and what it contributed to their scientific career: Sonia Osorio-Algar, a molecular biologist from Spain, Juliana Almeida and Fabiana de Godoy, both from Brasil, Saleh Alseekh from West Bank – Palestine, and Erwin Datema, a bioinformatician from the Netherlands.**

### Investigating the genetic basis of fruit quality traits



Juliana Almeida (left) and Fabiana de Godoy (right) have been working at the GaTE (Genomic and Transposable Elements) Lab of the University of São Paulo, Brazil. This EU-SOL partner has been investigating the genetic factors that control fruit quality traits. In particular, this group is focused on indentifying the genes that influence vitamin E, sugars and amino acid content in tomato fruits.

The group of Fabiana and Juliana was able to demonstrate that the identified candidate genes affect indeed vitamin E, sugars and amino acid content in tomato fruits. "Moreover, from the analyses of DNA sequence data produced by our group, we were able to address some interesting evolutionary questions like the

date between cultivated tomato and its wild relative *Solanum pennellii*<sup>1</sup>, and the presence of positive selection for diversification of some secondary metabolism pathways."

"By using functional genomic approaches we are working to address the role of specific genes in determining the nutraceutical content. We apply a vast spectrum of techniques including basic molecular biology methods, quantitative real time PCR, metabolite quantification by High-performance liquid chromatography (HPLC), DNA sequencing and transgenics."

### What did you like most about your work for EU-SOL?

The young scientists we asked to comment all consider the international scientific cooperation a major feature. Erwin: "I immensely enjoyed the strong interaction between the many international groups involved in the tomato genome sequencing and assembly, both within EU-SOL and within the larger international SOL community." "I have found really interesting how the different approaches have been integrated in the same framework from different research groups in different countries. I liked the very good relationship between groups with a very fruitfully collaborations, also I have to add to this nice atmosphere between groups, the really nice environment in my own labs.", Sonia says.

Saleh, Fabiana and Juliana emphasize the relevance of international scientific cooperation for the transfer of science and technology to their country. "In this work, I had the chance to learn from scientists from all over the world which enables me to transfer the technology and knowledge to develop my county", Saleh noted. "I live in a country that has a world- wide importance as food producer and growing consumer market, so it is very important to us the possibility to bring new advances and technology to increase food production and improve nutritional quality", Fabiana says. " EU-SOL enabled us to reinforce the regional knowlegde and establish professional colaborations, what is a big gain for the Brazilian Plant Science", Juliana adds.

<sup>1</sup> *Solanum pennellii* is an inedible wild tomato with sticky green fruit, very different to the commercial tomato.



### integration of genomic data with metabolomic studies



Sonia Osorio-Algar has been working in tomato genomics as a part of tomato genome sequencing in Dr. Antonio Granell's lab in Valencia, Spain, and also in tomato metabolomic studies in Dr. Alisdair Fernie's lab in Postdam-Golm, Germany.

One of the major results of Sonia Osorio's teamwork was the identification of malate as a potentially important regulatory metabolite on tomato ripening: "We demonstrated that alterations in the level of malate resulted in dramatic effects on transitory starch metabolism. The results confirmed that altering mitochondrial malate metabolism would have far-reaching metabolic and developmental consequences on tomato fruit ripening. This work has been published in *Plant Cell* this year (Centeno, 2011). Additionally, we are preparing a manuscript in which we identify high number of quantitative fruit metabolic loci that modify yield-associated traits. "

"I have been working in the identification and validation of seed and extension Bacterial Artificial Chromosomes (BACs)<sup>2</sup> as part of the tomato sequencing project. Regarding metabolomic studies I have been working in the analysis of primary metabolites in different tomato populations. This contributed to the integration of genomic data with metabolomic studies. "

Saleh thinks he has been very lucky to contribute to this large project that brings together expertise scientist from all over the world: "In addition, I got financing twice to travel to Italy and Germany for training, also I attended three EU-SOL meetings, which was great! Thanks EU-SOL!"

### Linking the tomato and potato genome maps and traits



Saleh Alseekh is working in the Biotechnology Lab of the Hebron University, West Bank – Palestine. His lab was involved in development of mapped genetic resources. It has the basic equipment used for plant genotyping.

Saleh was involved in developing a common, PCR-based marker frame-work, which links the tomato and potato maps and the numerous qualitative and quantitative traits mapped in both species: "In our work we use PCR based markers to map 76 *Solanum pennellii*<sup>1</sup> introgression lines ensuring whole genome coverage. In addition, to help in producing sub-lines by verifying the breakpoints of new sub-lines, in a manner such that the mapping resolution of target traits be markedly improved. This facilitates quantitative trait locus (QTL) identification, additional mapping, cloning of the underlying genes and the use of the novel variation in marker-assisted breeding."

"My work starts with DNA extraction from tomato tissue. Then I use the polymerase chain reaction (PCR) technique to amplify a target region (genes) using different molecular markers as well as the cutter enzymes in order to detect the polymorphisms between the genotypes (integration lines). Moreover, I have been doing quite a lot of breeding in addition to plant phenotyping in the greenhouse and field."

### What is your opinion about the EU-SOL programme as a whole?

The five young scientists agree that EU-SOL has yielded a huge amount of useful knowledge and tools.

Erwin: "In my opinion, EU-SOL has succeeded very well in bringing together the experts from various disciplines in biological and biochemical research, which has resulted in novel knowledge, expertise and tools that can be exploited by both tomato/potato researchers and breeders in the coming years."

<sup>2</sup> A Bacterial Artificial Chromosome (BAC) is a DNA construct used for transforming and cloning in bacteria, usually *E. coli*. BACs are often used to sequence the genetic code of organisms in genome projects. A short piece of the organism's DNA is amplified as an insert in BACs, and then sequenced. Finally, the sequenced parts are rearranged in silico (via computer simulation), resulting in the genomic sequence of the organism.



Saleh: "It's a great idea; bringing together expertise from different disciplines to focus on tomato and potato qualities and production, and I think the EU-SOL succeeded in this."

Fabiana and Juliana: "This project is a big initiative to increase our understanding of the genetic basis of variation in important agronomic traits. Beyond Solanaceous crop species, which are models for plant biology, the knowledge achieved will serve as a reference for other study systems and, possibly, transferred to other crops with the aim of satisfy the food demand and the competitive market."

The Brazilian PhDs add to this the element of outreach and awareness that was included in the program: "EU-SOL has overcome the scientific aspect and dedicated a entire Module to awareness about tomato and potato quality to consumers, industrial or professional users. An excellent example of this information transfer has been the development of the "educational package for secondary schools" to introduce the principles of Mendelian genetics to secondary schools through hands-on practical experience using tomato populations breed by the project.

Sonia also is very positive about how the EU-SOL programme has promoted the young scientists research: "In general, the EU-SOL programme can be used as model for future similar programmes.", she adds.

### Drafting a high-quality draft genome sequence for tomato



In collaboration with several other bioinformaticians within EU-SOL, Erwin Datema from Plant Research International Bioscience, Wageningen has been working on the assembly of the high-quality draft tomato genome sequence for the last two years.

Erwin Datema's work contributed to the assembly of the high-quality draft genome sequence for tomato: "The tomato genome sequence is a powerful tool for breeders to improve their tomato varieties. It will allow them to identify genes for traits of their interest and develop novel markers to screen populations for these genes. Bioinformatics is an essential tool in assembling the large amount of genome research data into something useful to plant breeders."

"My work is completely computational. We started with the raw sequence data that was produced various sequencing technologies (Sanger, 454, Illumina, SOLiD), for which I developed some tools to clean them up by removing bad quality and duplicate sequences. This resulted in short read sequences which were then assembled on our computer cluster into long scaffold sequences. Those scaffold sequences were rigorously checked for consistency and quality. I then wrote some more tools to integrate these scaffold sequences with the genetic and physical maps into the tomato chromosome sequences that are available today."

### What will you do after the EU-SOL program has expired?

Fabiana and Juliana will first of all finish their PhD. Fabiana wants to do a post-doc and keep working on crop biotechnology, probably studying genes involved in cell wall structure and sugar content in tomato. Juliana intends to conduct post-doctoral research probably focusing on nutritional quality of crops. Sonia will continue her postdoc in Dr. Alisdair Fernie's Lab at the Max Planck Institute in Golm, and will be working in projects which involve genomics and metabolomics studies in fruits: "I will continue having collaborations with some of the research groups from EU-SOL community." Erwin will continue exploiting the genomic resources that have been generated in EU-SOL. He will apply his knowledge to other crop plant genomes. Saleh is looking for a position to continue with this work in a PhD program and applying this knowledge to achieve something significant. "Being involved in the EU-SOL programme has equipped me with expertise in various aspects of plant technology and motivated me to learn more and strengthen my knowledge."



### What should students do if they aspire a similar career?

What can students learn from the experience of these five EU-SOL scientists? What do you need to succeed in this type of science? Saleh: “I would say, be patient, confident, responsible, and learn a lot. You should be prepared to work very hard and for a long period of time, because the data and the results are very rewarding. If you failed in achieving something or you don’t have good results don’t give up and keep trying.” Juliana mentions similar qualities: “To do a good job in science you have to be curious, dedicated, persistent, and patient. Unlike the stereotype image, being a scientist is hard work.” Sonia also thinks that curiosity is a major quality “I always encourage students to continue in science if they really enjoy what they are doing. Scientific research gives us the opportunity to be curious for knowing more about the nature and the properties of the life around us. Research keeps an opened mind to discovering why and how the nature is working.”

Apart from the skills mentioned above, a scientist needs to develop communication skills. Juliana: “Beyond a solid scientific base, good social and communication skills are essential for collaboration with other scientists.” Erwin stresses the importance of such qualities too: “To become successful in bioinformatics research, it is important to have a good understanding of (molecular) biology as well as computer programming. Being able to clearly communicate with the biologists that produce the data, and formulating the questions that arise from these often noisy data in a manner that a computer can answer them, is essential.”

Fabiana argues that communication skills also apply to the world beyond the walls of the lab: “It is important to assume our social role and really believe that science is one of the main vehicles for the technological development and the base of education, elements that will impact directly the society life quality.”

### References

Centeno, Danilo C. *et.al.* (2011). Malate Plays a Crucial Role in Starch Metabolism, Ripening, and Soluble Solid Content of Tomato Fruit and Affects Postharvest Softening. *The Plant Cell*, Vol. 23: 162–184, January 2011.  
<http://www.plantcell.org/content/23/1/162.full.pdf+html>

*The EU-SOL project is supported by the European Commission through the 6th framework programme. Contract nr: FOOD-CT-2006-016214.*