INTERNATIONAL BARLEY HUB

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Q&A >

Sonia, can you tell us where you are based and how your career has taken you there?

I'm based at University College Dublin at the School of Biology and Environmental Science, and I have been here since summer 2018. I'm Portuguese and studied agronomy initially.

When I finished my undergraduate degree, I decided I didn't want to work in a lab and an opportunity came along to undertake a PhD on breeding, which is my passion, so I followed that path. It was focused on the breeding of heritage Portuguese rice and was in collaboration with the International Research Rice Institute (IRRI) in the Philippines. I travelled a lot between Philippines and Portugal, and I lived in the Philippines for a few months. After my PhD completion, I started my postdoc, and at this point I started working on the area of abiotic stress in rice.

During this period, I was attending an international conference where I met Professor Mark Tester. After I finished my postdoc he got in touch and offered me a job working in Saudi Arabia. I moved there with my husband and worked at the King Abdullah University of Science and Technology for five years in Professor Tester's lab. I learned a great deal and decided I would like to start my own lab. I began to apply for positions and was very fortunate to find this role at UCD.

Sónia Negrão

What are your main areas of research expertise?

My main focus is on abiotic stress, basically the environmental stress plants feel and how they cope with it. There are different strategies and genetic mechanisms plants adopt to cope with environmental stress, which is fascinating from the genetics point of view. This is an area I work on a mainly and I am also very keen on plant physiology, and how plants respond to environmental changes. For example, the reduction of growth or maintenance of growth and yield. In my lab we use imaged based-technologies and drones in the field. This allows us to look at the plants non-destructively on a daily basis and see how they respond to the stress, which is very powerful.

As part of this I do also focus on genomics and genetics.

Sónia Negrão

You have talked about the ‘omics revolution’. Can you tell us more about why this is important and what the most exciting advances happening in this area are?

My view on ‘omics’ relates to breeding as that is my background. Traditionally, the breeding process takes many, many years, and more recently we have started to have marker-assisted selection so that we could extract DNA more easily and see which plants had the genes of interest. It allowed the whole process to be sped up. After that came the CRISPR-Cas 9 technology, which has had a massive impact on genome editing and huge potential.

And of course, we are increasing knowledge of genomes and their sequencing all the time. The cost of doing this is also becoming more achievable. We have much cheaper ways of having each individual genotype so that we have an idea of what is their DNA and that makes it much more accessible, which is hugely important.

We also have the imaging technologies, which have made a significant impact. Even a couple of years ago phenotyping would be the bottleneck for advancing breeding as you have to quantify more precisely and in a non-destructive way how plants respond. With high-throughput phenotyping or phenomics supported by remote sensing and imaging sensors we have a huge potential to enhance smart agriculture. That leads to much more precision farming.

However, the major challenge now is the management and analysis of Big Data. We have lots of data coming in and for that there must be a multidisciplinary view working together with statisticians, computer scientists to deal with this Big Data problem. We need to work out together what we can actually extract in terms of the features (or traits) that are more relevant to the research question we have.

However, it’s way more challenging than you might think in terms of data capacity, and huge terabytes of data that we are dealing with. And we need to ensure we are encouraging open science so that this data is accessible for research. But that is also a challenge.

Sónia Negrão

How does this work translate through to the farming and crop-reliant industries?

I have a project funded by the Science Foundation Ireland where we are working together with the James Hutton Institute and Professor Robbie Waugh. And we have assembled an heritage barley collection. That means that it is really old cultivars of barley, from landraces right through to beginning of the century.

About 80 per cent of our collection would have been assembled before the 1990s. So, these barley lines were those that would have been used by our grandparents' generation to actually malt Guinness, for example. These are two-row spring barley and we are studying waterlogging, which is when the plants have a rainfall and their root area is totally flooded for a few days. This means that there is limited oxygen in the root area, in the rhizosphere, so the oxygen is replaced by water. There is a slow gas diffusion. and this affects the whole plant because plants need oxygen. Due to the changes in our climate, there is more precipitation and more drought in a season. It is more unpredictable to see how the climate will be. One of the challenges remains waterlogging and while this has been very well studied at molecular level, there is complexity remaining in terms of logistics for studying in field trials.

We have been undertaking studies in the field, at our site on the Northwest side of Dublin, UCD Lyons Farm, and we have assembled this collection of 230 barleys from northern Europe. Some of them have very strong historical importance and we are just examining how they behave in regular and waterlogged field conditions. To do this has required lots of cubic metres of water all to be transported by lorry to allow the waterlogging trials to take place. So it is very challenging and very driven as this heritage barley is an untapped resource that can be used further by brewers, breeders or farmers.

There are some malting companies here in Ireland and it is important to have a premium product for them and to have it as Irish barley. Of course there are breeding companies too who want to understand that characterisation of this heritage barley and how this can also be used for pre-breeding. There is a lot going on, and technologies such as imaging and machine learning are giving us a range of further capabilities, which is very interesting and creates many new potential opportunities.

Sónia Negrão

You have studied and worked around the world – how collaborative has the wider crop and particularly barley community been in your work so far?

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The barley community is brilliant and really collaborative. We met very little because of COVID, but the Barley Genetics Symposium held in 2022 in Riga was wonderful to be back together.

Sónia Negrão

Did you always want to be a scientist?

Actually, no I didn't. I originally wanted to be a veterinarian, but I didn't get the points to get into university. I was left very frustrated by this and decided to apply to join the army as it was just at the stage that they were starting to admit women in Portugal. I sat all the tests but realised that it was not really what I wanted and that I should apply again for university. I was always very interested in genetics, and loved Mendel's Laws and Punnett Squares, and had also always been very interested in plant science and biology. So, I decided to apply to study agronomy. This was helped by a very fortunate encounter on a school trip at the end of my final year to a research institute where I discovered there was an opportunity for an internship, so I applied and was successful. Life is a series of events that happen with crossroads where we have to decide which path to take. I'm very happy with the events and crossroads I have experienced and cannot imagine life going any other way.

Sónia Negrão

How can we encourage greater numbers and more diverse groups to study plant science given the need to enhance the vitally important research that underpins the future of our planet?

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It's so challenging and we struggle here as well because often there is more pull to the human side of science. However, one of the things that I believe also causes an impact is a legitimate phenomenon called 'plant blindness'. It is when people can't see the plants in an image and focus on something else like a person, animal or structure. That is plant blindness students often don't realise the importance at all of plants and lots of people take for granted what we have in the supermarkets.

However, I think that has changed a lot and we have had maize and cereal crisis leading to food price surges in 2008 and now the war in Ukraine, which has seen huge shortages in crops like wheat. It's a huge country in terms of agricultural importance, so this has affected tremendously food at global scale. From the agricultural markets all around the world, not only in terms of grain, but also in terms of input fertilisers and seeds, but this has led to an increased awareness in plant importance.

You do also have changing dietary habits, especially with a lot of teenagers becoming vegetarian and vegan, and this increases awareness of plants and their importance in diet. I do believe that there will be more opportunity to engage a younger, diverse audience. I do often say that we eat three times a day, but only go to the doctor maybe once a year, so crops and crop science are hugely important for our daily lives.

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