Nicholas J Talbot - Speech

First of all, I would like to thank the University of Alicante for this extraordinary honour that is has bestowed upon my today. I am extremely grateful and humbled by this award of an Honorary Degree. You do me a very great honour. It is a particular honour for me to receive this degree because, as you have heard, my mother was born in Spain in Valencia and I still have strong family connections there. I am very proud of my family history and connection to this great country. I feel very much a European and that we all in Europe share a common destiny, built upon friendship, cooperation, and free exchange of ideas.

I would also like to thank Dr Luis Vicente López Llorca for his very kind words. We are collaborators and friends in science and I have the greatest respect for his scientific contributions to our understanding of fungal biology and fungal interactions with a range of organisms, including plants.

I would like to tell you now about my research interests, which are concerned with the most devastating disease of rice world-wide. This disease is called rice blast and is caused by a fungus called *Magnaporthe oryzae.* Each year, this fungus claims up to 30% of the global rice harvest enough rice to feed 60 million people. These losses occur everywhere rice is grown, including Spain (particularly in the Ebro valley), across Southern Europe, South America and the southern United States, and across sub-Saharan Africa. However, it is in Asia that the disease still has the greatest impact, because this is the region of the world where 80% of the world's rice is grown and consumed. It is also the part of the world with the greatest population density and therefore rice blast disease is a significant threat to global food security.

My work on rice blast is divided into three main parts. First of all, I am interested in understanding how the fungus gains entry to rice plants, then how it can suppress plant immunity and cause disease, and finally how we can use this fundamental knowledge of the biology of rice blast disease to make a practical difference in controlling the disease in the developing world.

First of all, I will tell you about the biology of the early stage of infection. The rice blast fungus elaborates a special cell to infect plant called an appressorium. Three-celled spores land on the leaf surface, carried by dew drops, and rapidly germinate. They quickly for a special, pressurized cell, the appressorium, that is used to physically break the rice cuticle. This process uses physical force and *M. oryzae* is able to break thin plastic membranes in the laboratory. The process of appressorium formation is linked to the control of nuclear division and we have identified some of the regulatory circuits that control this process. The fungus then develops enormous pressure in the appressorium, which is lined with a thick layer of melanin. The cell generates up to 8.0 MPa of pressure – more than 40 times the pressure of a car tyre! This pressure is applied at a narrow point at the base of the cell, generating physical force to rupture the rice leaf cuticle. The pressure is generated by accumulation of glycerol to very high concentrations, which causes the osmotic pressure to rise. We have recently studied how the penetration hypha at the base of the appressorium forms and this requires a change in the axis of cell polarity and reorganisation of the cytoskeleton of the cell.

Once the fungus enters rice cells, it grows in a very different way, forming bulbous, branched hyphae that fill epidermal rice cells. The fungus is wrapped in the plasma membrane of the rice cells it colonizes, so the rice cells are invaded but are alive and not damaged initially. The fungus then rapidly spreads from cell-to-cell, using inter-cell connections in plants called plasmodesmata. As the fungus spreads between cells, it deliver a battery of more than 100 different proteins into rice cells to suppress immunity and enable it to grow rapidly within the plant. After about 5 days, the first disease symptoms develop and rice blast disease lesions are seen on leaves.

We have recently been trying to apply our fundamental knowledge of the biology of *M. oryzae* to help control the disease. I will tell you about some of our recent work that has set out to help control rice blast in Africa. Rice is a key food security crop throughout sub-Saharan Africa and is grown predominantly by smallholder farmers. There has been a huge rise in rice production across East Africa in recent years. In Kenya, for example, rice consumption is growing at 12% per annum compared to the main staple crops of maize at 1% pa and wheat at 4% pa. This trend is expected to continue, due to consumer preference and rapid urbanization, and there is now a constant gap between rice production and consumption. New, locally adapted rice cultivars have been developed in a project called the "New Rice for Africa (NERICA)" project and these new varieties of NERICA rice are now widely grown. However, they are very susceptible to rice blast disease which is now the biggest constraint to production. In the last four years, funded by the Bill and Melinda Gates Foundation, we have now collected over 1000 *M. oryzae* isolates from 9 countries; Kenya, Burkina Faso, Ghana, Tanzania, Mali, Nigeria, Benin, Togo, and Uganda. We have used these to do population genetic studies and disease-typing analysis that can reveal the structure of the rice blast population in Africa. We have used this information with plant breeders in Kenya, Burkina Faso, The Cote D'Ivoire, and at the International Rice Research Institute in The Philippines, to guide development of new rice varieties in which we have pyramided several types of rice blast resistance genes. We are currently testing these new varieties in 19 sites across 7 African countries. Once we establish which varieties perform best, we aim to release these to farmers via local government agencies across the continent.

In summary, my motivation for studying rice blast disease is to understand how diseases of plants operate at the molecular level, so we can devise completely new strategies to control the most devastating diseases that affect world agriculture. However, these problems are acute and urgent, so we also need to work, where possible, on immediate control strategies such as our work in Africa. My future career, in which I will shortly move to The Sainsbury Laboratory, will be focused on these aims, and trying to make a difference in the world.

Thank you again for this great honour and I would also like to thank my family for the unwavering support. My wife Catherine is here, along with my youngest son Euan. My wide and my three children, Sam, Caitlin and Euan are great sources of support and encouragement, as is my mother Rosita and my wider family. I take this opportunity to thank them for everything they have done for me.