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About

Noni Franklin-Tong's research focuses on the cellular mechanisms involved in the model cell-cell recognition system of self-incompatibility (SI) in *Papaver rhoeas* (the Field Poppy). She is recognized at an international level for her work in the field of plant cell biology. Specifically she has made major contributions to the field of self-incompatibility, a field that has high importance in relation to the future focus on food security. Her research has had a world-wide impact in the broader fields of plant cell signalling, the plant cytoskeleton and programmed cell death in plants.

Her work includes several publications in *Nature*, has been highlighted in *News & Views* and *"Editor's Choice" in Nature and in "Leading Edge" in Cell*. Noni is currently Secretary General for the International Association of Sexual Plant Reproduction Research (IASPRR) and has served on the Society for Experimental Biology (SEB) Plant Biology Committee for more than 10 years and has also served on Council. She is currently on the Editorial Board of *Journal of Experimental Botany*, and *Sexual Plant Reproduction*, and is a Review Editor for *Frontiers in Plant Physiology*.

Noni has a long-term commitment to enthusing children about science education and has been involved in providing the general public with a broader understanding of science through a number of activities. She was one of the original BBSRC Regional Coordinators of the Schools Liaison Scheme.

Qualifications

BSc (Hons) Biological Sciences (University of Birmingham) 1982

PhD Department of Genetics (University of Birmingham) 1986

Biography

Noni Franklin-Tong was born in London, U.K. She received her BSc in Biological Sciences and PhD in Genetics from the University of Birmingham. Most of her career has been based at Birmingham, though she has worked for brief periods of time in Umeå, Sweden, ICMB, University of Edinburgh and UMass, Amherst, USA. She obtained a BBSRC Advanced Research Fellowship in 1992, was appointed to a lectureship in 1997, and a Chair in Plant Cell Biology (2004-2014). Following breast cancer she is partially retired, working part-time research-only (2014-).

Research

Research Theme within School of Biosciences: **Plant Genetics and Cell Biology (/research/activity/plant-genetics-cell-biology/index.aspx)**

Targets and mechanisms involved in the self-incompatibility response in *Papaver rhoeas* pollen

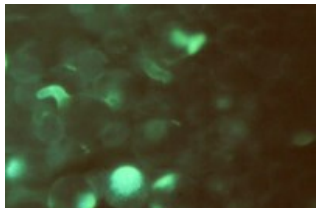
Sexual reproduction in higher plants involves pollination, involving specific interactions between pollen and pistil. A key mechanism to prevent inbreeding is self-incompatibility (SI), which is a controlled by a single, multi-allelic S-locus. Incompatible ("self") pollen is rejected and compatible ("non-self") pollen is allowed to fertilize the plant.

My lab is investigating the signalling cascades, targets and mechanisms regulating pollen tube tip growth inhibition induced by SI in *Papaver*. The "self" interaction triggers a Ca^{2+}-dependent signalling network, resulting in incompatible pollen tube tip growth being inhibited and programmed cell death being induced. Our long-term goal is to establish how the different components integrate and interact in what has turned out to be a complex signalling network. Currently research falls into several areas:

1. Investigations into programmed cell death in the SI response.

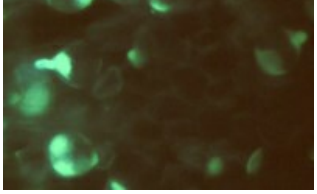
Programmed cell death (PCD) is an important mechanism responsible for the controlled death of targeted cells in animal and plant cells. We recently demonstrated that PCD is triggered in incompatible pollen. We have identified several caspase-like activities (a VEIDase and a LEVDase) that are activated by an incompatible SI response. We are currently investigating the early events involved in PCD in pollen further, and are investigating if reactive oxygen species (ROS) and nitric oxide (NO) are involved in the SI response in incompatible pollen.

2. Alterations in the actin cytoskeleton



In many cells alterations to the cytoskeleton are the first visible response to extracellular stimuli. We have shown that both the actin and microtubule cytoskeleton are important target for SI signals, and recently obtained evidence for crosstalk between actin and microtubules. In animal cells sustained actin depolymerization can stimulate apoptosis via caspases. We recently showed that actin depolymerization can trigger PCD in pollen. We are currently investigating signalling to the actin cytoskeleton further.

3. Cytosolic soluble inorganic pyrophosphatases are targets for SI signals



Soluble inorganic pyrophosphatases (sPPases) are enzymes that catalyse hydrolysis of inorganic pyrophosphate (PPi), to two inorganic phosphates (2Pi). Their activity is essential for making a wide variety of biosynthetic processes thermodynamically favourable. We established that a pollen sPPase is phosphorylated during the SI response. This represents the first report of a eukaryotic sPPase being phosphorylated and of regulation of its activity by phosphorylation. Our identification of sPPases as a target for the SI response implicates an additional mechanism utilized for SI-mediated inhibition of pollen tube growth. We are currently investigating the significance of the phosphorylation in a joint project with **Dr Scott White (/staff/profiles/biosciences/white-scott.aspx)**

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4. Investigating a possible functional role for the pollen gene, PrpS, as the pollen of S-receptor.

This project is a collaborative project with **Professor Chris Franklin (/staff/profiles/biosciences/franklin-chris.aspx)** . We recently identified the pollen S-locus determinant, named PrpS. We are currently investigating binding of the proposed pollen S-receptor with the pistil component, which will test our longstanding hypothesis that the pistil S protein interacts with the pollen S-locus determinant through a receptor-ligand interaction.

Initiating investigations into the nature of the pollen S determinant, PrpS as a receptor/ion channel, and its interaction with the PrsS ligand. This BBSRC-funded project is focusing on aspects of the receptor-ligand interaction and very early signaling events upstream of all the events so far characterised. (in collaboration with **Christoph Baumann (York), (http://bioltfws1.york.ac.uk/biostaff/staffdetail.php?id=cgb)** Dale Sanders (JIC), **Josh Rappoport (/staff/profiles/biosciences/rappoport-joshua.aspx)** and **Steve Publicover (/staff/profiles/biosciences/publicover-steve.aspx)** (University of Birmimgham) (York), Dale Sanders (JIC), and (University of Birmimgham)

Pursuing possible commercial aspects of using SI, by investigating whether poppy SI can be transferred to other species. This follows on from filing a patent in November 2008, based on preliminary data that suggested that transferring the pollen S-determinant, PrpS1, to Arabidopsis allowed it to recognise poppy recombinant PrsS proteins resulting in the inhibition of PrpS1-GFP pollen germination. This is a very exciting opportunity, and LES College **KT Development funding (£20,000)** allowed us to pursue obtaining further data to consolidate the patent. Links have been made with **PBL (http://www.pbltechnology.com/cms.php?pageid=1)** , who are currently marketing this application, which could be of immense value to plant breeders in the production of F1 hybrids.

Publications

Barend H. J. de Graaf, Sabina Vatovec, Javier Andrés Juárez-Díaz, Lijun Chai, Kreepa Kooblall, Katie A. Wilkins, Huawen Zou, F. Christopher H. Franklin and Vernonica E. Franklin-Tong. The *Papaver* self-incompatibility pollen *S*-determinant, *PrpS*, functions in *Arabidopsis thaliana*. **Current Biology** 22 (2), 154-159. doi:10.1016/j.cub.2011.12.006

Katie A. Wilkins, James Bancroft, Maurice Bosch, Jennifer Ings, Nicholas Smirnoff and **Vernonica E. Franklin-Tong** (2011). ROS and NO mediate actin reorganization and programmed cell death in the Self-Incompatibility response of *Papaver*. **Plant Physiology** 156, 404-416. DOI: 10.1104/pp.110.167510.

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Wouter G. van Doorn, Eric P. Beers, Jeffery L. Dangl, **Vernonica E. Franklin-Tong**, Hiroo Fukuda, Patrick Gallois, Jean Greenberg, Ikuko Hara-Nishimura, Alan M. Jones, Maki Kawai-Yamada, Eric Lam[11], John Mundy[12], Luis Mur, Morten Petersen, Andrei Smertenko, Michael Taliansky, Frank van Breusegem[16], Thomas Wolpert, Ernst Woltering, Boris Zhivotovsky, Peter V. Bozhkov(2011). Morphological classification of plant cell deaths. **Cell Death & Differentiation** 18, 8, 1241-1246.doi:10.1038/cdd.2011.36

Noni Franklin-Tong (2011). Self-fertilization: article in: Brenner's Encyclopedia of Genetics.

V.E. Franklin-Tong (ed.) ***Self-Incompatibility in Flowering Plants – Evolution, Diversity, and Mechanisms*****.** Publ. Springer-Verlag Berlin Heidelberg 2008. This is the first monograph on this topic for 30 years.

Natalie S. Poulter, Maurice Bosch, &**Vernonica E. Franklin-Tong** (2011) Proteins implicated in mediating Self-Incompatibility-induced alterations to the actin cytoskeleton of *Papaver* pollen. Annals of Botany: doi:10.1093/aob/mcr022.

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Maurice Bosch, Natalie S. Poulter, Ruth M. Perry, Katie Wilkins and **V. E. Franklin-Tong** (2010). Characterization of a legumain/vacuolar processing enzyme and YVADase activity in *Papaver* pollen. Plant Molecular Biology 74 (4), 381-393. DOI: 10.1007/s11103-010-9681-9.

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Wheeler, M.J., de Graaf, B.H.J., Hadjiosif, N.E., Perry, R.M., Poulter, N.S., Osman, K., Vatovec, S., Harper, A., Franklin, F.C.H & **Franklin-Tong, V.E.** (2009). Identification of the pollen self-incompatibility determinant in *Papaver rhoeas*. Nature 459, 992-995.

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Bosch M. & **Franklin-Tong VE.** (2007). Temporal and spatial activation of caspase-like enzymes induced by self-incompatibility in *Papaver* pollen. Proc. Natl. Acad. Sci. USA. 104 (46) 18327-18332.

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B.H.J. de Graaf, J.J. Rudd, M. J. Wheeler, R.M. Perry, E. M. Bell, K. Osman, F. C.H. Franklin & **V. E. Franklin-Tong** (2006). Self-incompatibility in *Papaver* targets soluble inorganic pyrophosphatases in pollen. Nature 444, 490-493. *Selected for "Editor's Choice" in Nature.*

Thomas, S. Huang , S. Li, C.J. Staiger and **V.E. Franklin-Tong.** (2006). Actin depolymerization is sufficient to induce programmed cell death in self-incompatible pollen. S.G. Journal of Cell Biology 174, 221-229. *This article was selected for a highlight JCB "In This Issue" section and by Cell in a "Leading Edge"; Aug 11th 2006 issue of Cell).*

Huang, S., Blanchoin, L., Chaudhry, F., **Franklin-Tong, V.E.** and Staiger, C.J. (2004) A gelsolin-like protein from *Papaver rhoeas* pollen (PrABP80) stimulates calcium-regulated severing and depolymerization of actin filaments. Journal of Biological Chemistry 279, 23364-23375.

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Expertise

Sexual reproduction in higher plants; preventing inbreeding through self-incompatibility; the mechanisms, including programmed cell death that tells incompatible pollen to commit suicide

Alternative contact number available for this expert: **contact the press office (http://www.birmingham.ac.uk/news/contacts/index.aspx)**