Plant biologists discover gene that switches on 'essence of male'

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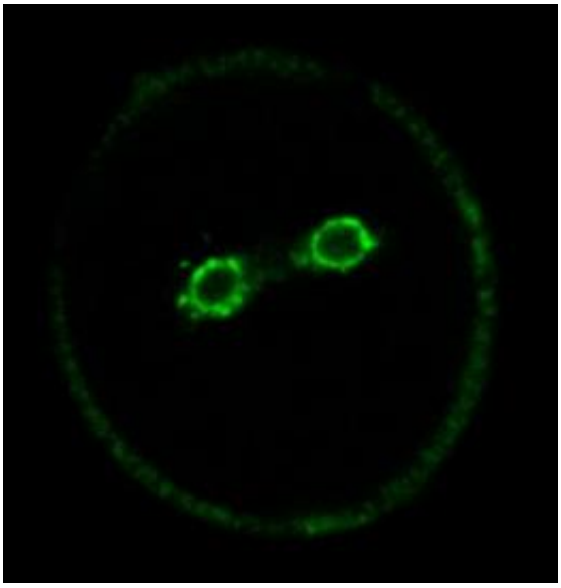


Pictured is a confocal image of an Arabidopsis pollen grain showing sperm cell-specific expression of the GFP-tagged plasma membrane protein Generative Cell Specific1 that is required for double fertilisation in flowering plants. The GCS1-GFP fusion protein appears in the periphery of the sperm cell pair (spectacles) present in each pollen grain. The authors show that germ cell division and specification, including the expression of GCS1 are regulated by the germline-specific transcription factor DUO POLLEN 1. Thus DUO1 has an integrative role linking germ cell division and sperm cell differentiation in flowering plants. Credit: Image generated by Lynette Brownfield (University of Leicester)

Biologists at the University of Leicester have published results of a new

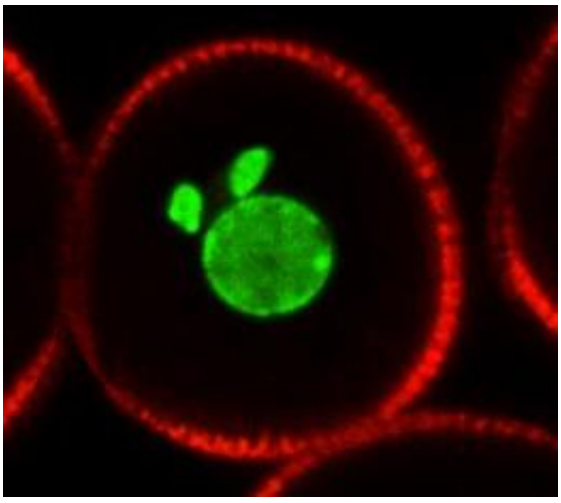
study into plant sex - and discovered that a particular gene switches on 'the essence of male'.

The study takes to a new level understanding of the genes needed for successful plant reproduction and seed production.

Professor David Twell and colleagues in the Department of Biology at the University of Leicester reported the discovery of a gene that has a critical role in allowing precursor reproductive cells to divide to form twin sperm cells.

Their study is reported in the journal *Public Library of Science Genetics* (*PLoS Genetics*) and was funded by the Biotechnology and Biological Sciences Research Council (BBSRC).

Professor Twell said: "Flowering plants, unlike animals require not one, but two sperm cells for successful fertilisation. One sperm cell to join with the egg cell to produce the embryo and the other to join with the central cell to produce the nutrient-rich endosperm tissue inside the seed. A mystery in this 'double fertilisation' process was how each single pollen grain could produce the pair of sperm cells needed for fertility and seed production.



Pictured is a confocal image of an Arabidopsis pollen grain showing ectopic GFP expression in the pollen vegetative cell (outlined in red with large single green nucleus) under control of the normally male germ cell-specific histone H3 (MGH3) promoter (pair of green sperm cell nuclei). The MGH3 promoter is induced by the ectopic expression of the germline-specific transcription factor DUO1 in the pollen vegetative cell. The authors show that germ cell mitosis and specification are regulated by DUO1, including the expression of cell cycle and gamete fusion proteins. Thus DUO1 has a key integrative role linking germ cell division and sperm cell differentiation in flowering plants. Credit: Image generated by Lynette Brownfield (University of Leicester)

"We now report the discovery of a dual role for DUO1, a regulatory gene required for plant sperm cell production. We show that the DUO1 gene is required to promote the division of sperm precursor cells, while at the same time promoting their specialised function as sperm cells. It effectively switches on the essence of male.

"We show that DUO1 is required for the expression of a key protein that controls cell division and for the expression of genes that are critical for gamete differentiation and fertilisation.

"This work provides the first molecular insight into the mechanisms through which cell cycle progression and gamete differentiation are coordinated in flowering plants.

"This knowledge will be helpful in understanding the mechanisms and evolution of gamete development in flowering plants and may be useful in the control of gene flow and crossing behaviour in crop plants."

The researchers also report on the presence of genes closely related to

DUO1 in a wide variety of flowering plants and even in lowly land plants such as moss, which suggests that DUO1 may be part of an ancient sperm cell regulatory network that evolved even before pollen and flowers appeared on the scene.

Interestingly, DUO1 is also related to a super class of Myb regulator proteins also present in animals that have an important role in controlling cell proliferation and that are implicated in certain human cancers such as leukemias. So like animal cell Myb proteins, DUO1 is needed for control of cell proliferation, but DUO1 is distinguished by its specific role in plant reproduction, namely its dual role in sperm cell production and switching on their ability to fertilize.

Professor Twell added that the study could help to unravel the evolutionary origins of plant sperm cells and provide new molecular tools for the manipulation of plant fertility and hybrid seed production - as well as to control gene flow in transgenic crops where the male contribution may need to be eliminated.

Source: University of Leicester