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IN BRIEF

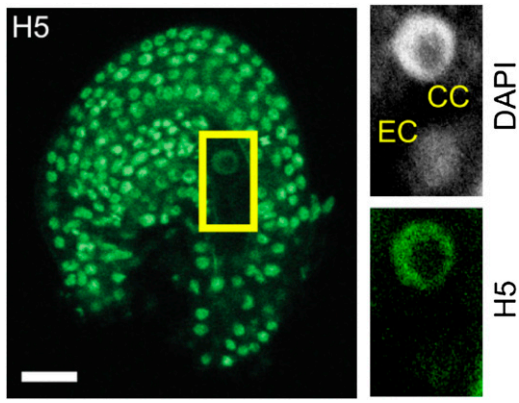
Mother Knows Best: Maternal Influence on Early Embryogenesis

During embryogenesis, there is a major switch from dependence upon products deposited by parental tissues, particularly those from maternal tissues, to reliance on products of the zygotic genome. In animals, this so-called maternal-to-zygotic transition often occurs after a period of transcriptional quiescence on the part of the embryo, but much less is known about the process in plants (reviewed in Baroux et al., 2008). New work from **Pillot et al. (pages 307–320)**, in a spectacular combination of molecular genetics and fluorescence microscopy, addresses the extent to which maternal products influence early embryonic development in *Arabidopsis thaliana*.

The maternal-to-zygotic transition has been studied in other systems by preventing de novo transcription after fertilization, usually with chemical treatments, and determining the point at which previously deposited mRNAs and proteins could no longer support development. This approach is technically difficult in angiosperms because the embryos are protected by seed coats, but Pillot et al. successfully used RNA interference to down-regulate RNA polymerase II in *Arabidopsis* endosperm and embryos simultaneously. They found that whereas endosperm development required de novo transcription, early embryo development could be supported by stored products until the preglobular stage (consisting of 16 to 32 cells). In agreement with this, an antibody able to recognize active RNA polymerase II gave an immunofluorescence signal in wild-type endosperm nuclei but not in zygote nuclei. Thus, there is transcriptional activity in the endosperm while the zygote is relatively quiescent.

The striking difference in transcriptional activity of these two tissues points to epigenetic regulation. The authors checked for differences in chromatin structure by determining the global patterns of dimethylation on lysine 9 of histone H3 (H3K9me2), which is generally repressive of transcription (reviewed in Berger, 2007). Their analysis showed that endosperm and embryo nuclei have different H3K9me2 patterns, with lower levels of H3K9me2 in the endosperm, a result that is consistent with the endosperm maintaining a relatively high level of transcription. This epigenetic dimorphism was found to include both euchromatic and heterochromatic repressive marks. Furthermore, the dimorphism was present in the mature female gametophyte, and there was no signal for active RNA polymerase II in the egg at the same time as there was strong signal in the central cell (see figure). Thus, it appears that the epigenetic and transcriptional patterns of the endosperm and the embryo are established in their progenitors (the central cell and egg, respectively) even before fertilization.

The authors identified mutants in which these patterns were disrupted in one cell type or the other and provide evidence suggesting that the quiescent period is needed for normal embryogenesis. In sum, this work confirms that in plants, as in animals, the embryo is quiescent early in development, a state that may be important for facilitating epigenetic reprogramming. The endosperm, on the other hand, remains active and, importantly, Pillot et al. reveal that the responsible epigenetic changes likely occur in the female gametophyte before fertilization.



Differential RNA polymerase II activity in the egg cell (EC) and central cell (CC) of a mature ovule (left panel). The right panels show enlarged views of the boxed region. Active RNA polymerase II, recognized by the H5 antibody (green), is mostly confined to the central cell, and 4',6-diamidino-2-phenylindole (DAPI) labels the DNA in chromatin of both cells. Bar = 10μm.

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