Microspore embryogenesis

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Brassica napus microspore embryogenesis as model to study the initiation of plant embryogenesis

Genetic studies to screen for embryo mutants in higher plants have led to the identification of genes involved in basic developmental processes such as axis establishment, pattern formation and organogenesis. Molecular and biochemical analyses of late seed-specific processes such as storage product accumulation and seed dormancy have also been carried out. However, due to the inaccessibility of the egg cell and zygote in angiosperm seeds, progress has been far more limited in our understanding of the developmental events that take place during fertilization and early embryo induction. We use embryogenesis from Brassica napus microspores in culture as an efficient system to provide us with large amounts of experimental material for molecular and biochemical analysis of both induction and early development of embryos. By incubating microspore cultures at 18℃ and 32℃, we can compare essentially non-embryog enic cultures with highly embryogenic ones (see Figure 1).

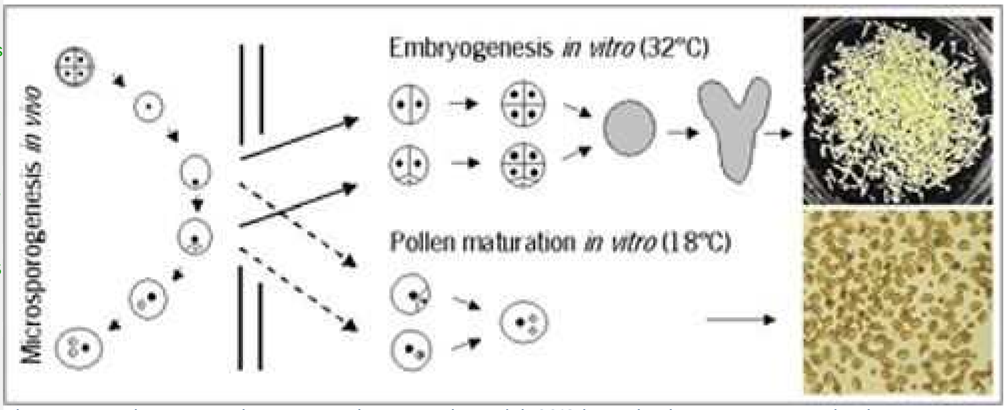

Figure 1:Brassica napus microspore embryogenesis model: 32℃ heat shock stress treatment leads to embryogenesis, whereas no stress results into pollen maturation

In the past we have used differential molecular screens, to identify genes that are differentially expressed during early embryo development in microspore embryo cultures. Some of these genes include BABY BOOM, (encodes an AP2 transcription factor that triggers embryogenesis) and LIGAND LIKE PROTEIN (encodes a CLV3 related ligand that is required for proper embryo pattern formation). Now we are focussing on 'omics'-based analyses of Brassica napus microspore embryo cultures.

Microspore-derived embryos with functional suspensors

For many years, microspore embryogenesis has been known to result from the switch of the developmental program of gametophytic development into sporophytic development leading to formation of multicellular microspores that differentiate into embryos later on. Morphologically, however, this growth behavior is very unlike the process of zygotic embryogenesis, where the suspensor plays an important role in early embryogenesis. Recently, we developed a Brassica napus microspore embryogenesis protocol where suspensor-like filamentous structures are produced, whose distal tip cells proceed to form the embryos (see Figure 2). Here, it is for the first time that microspore embryogenesis is exhibiting the highly ordered cell division pattern observed in zygotic embryogenesis, which makes microspore embryogenesis a more attractive model system for studying embryogenesis of plants.

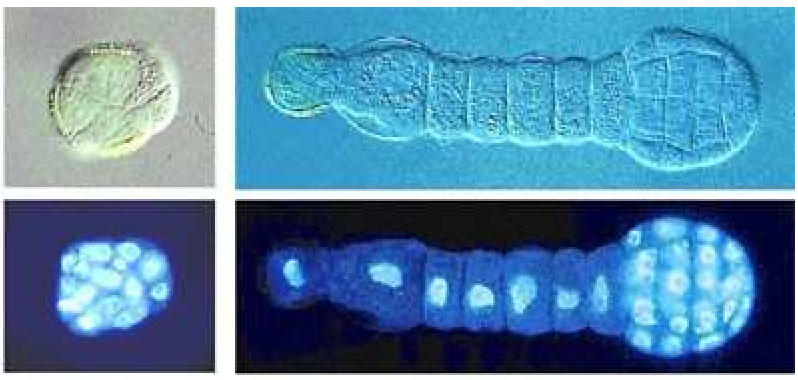

Figure 2: Classical system of microspore embryogenesis starting from a multicellular microspore (left panel) and the new system with a suspensor formed mimicking zygotic embryogenesis (right panel)

Microspore culture protocol development

Haploid and doubled haploid plants regenerated from microspore embryos are invaluable breeding tools, as complete homozygosity is obtained in a single generation. Such homozygous plants can be used directly as parents in F1-hybrid breeding, and they can facilitate analysis of multiple (recessive) traits and development of molecular maps. Based on our expertise in microspore culture systems in a number of model species, we developed microspore culture protocols for commercial crops. Such crops include among others hot pepper, Anemone, Delphinium, Zantedeschia, and tulip (see Fig. 3). In this area of research, our main emphasis is on ornamentals, where the use of doubled haploids may result in replacement of expensive tissue culture vegetative propagation by multiplication through seeds , as hybrid varieties can be easily introduced to obtain high quality uniform starting material.

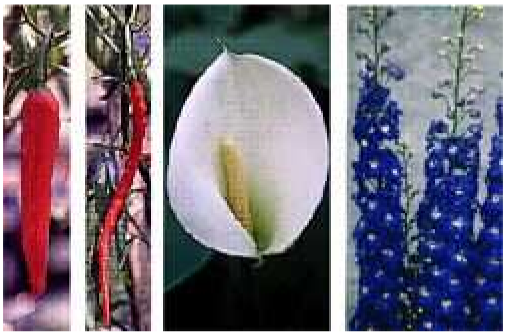

Figure 3: Species for which we successfully developed microspore culture protocols: Hot pepper, Zantedeschia and Delphinium

Recent Posters:

- Microspore embryogenesis in ornamentals; promising results with standard protocols
- Brassica microspore embryogenesis as a model system to isolate embryo-specifiec genes: The identification of LLP1

References:

Custers, J.B.M., J.H.G. Cordewener, M.A. Fiers, B.T.H. Maassen, M.M. van Lookeren Campagne and C.M. Liu (2001) Androgenesis in Brassica: A model system to study the initiation of plant embryogenesis. In "Current Trends in the Embryology of Angiosperm", S.S. Bhojwani and W.Y. Soh (Eds), pp451-470.

Cordewener, J.H.G., J.H.W. Bergervoet & C.M. Liu, 2000. Changes in protein synthesis and phosphorylation during microspore embryogenesis in Brassica napus. J. Plant Physiol. 156: 156-163.

Cordewener, J.H.G., Custers, J.B.M. and Van Lookeren Campagne, M.M. (1998) Microspore culture: A model for investigating the role of stress in the induction of embryogenesis, in Y. Chupeau, M. Caboche and Y. Henry (eds), Androgenesis and Haploid Plants, Springer, Heidelberg, pp. 54-68.

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