Plant Developmental Genetics

Erwin HEBERLE-BORS
a.o.Univ.Prof., Dr. (University of Berlin, Germany)

Research

Emphasis is on the molecular mechanisms of plant growth and development with a major interest in pollen maturation and embryology.

H Hirt and coworkers
Cell cycle and signal transduction in plants

A number of plant genes encoding cyclins and cyclin-dependant protein kinases (CDKs) has been isolated for the first time by this group. A typical approach to isolate these plant genes involves yeast genetics, particularly complementation of yeast mutants by plant cDNAs. Once identified the genes are subjected to functional analyses in synchronized suspension culture cells and in various plant tissues.

Emphasis is given to the root-specific expression of genes , particularly after infection with bacteria of the genus *Rhizobium* which produce root nodules that fix atmospheric nitrogen. *Rhizobia* produce a signalling substance, the nod-factor, which initiates cell divisions in the root.

Signal transduction involves another set of evolutionary conserved genes in eukaryotic organisms. From yeast to man and plants a set of protein kinases, called mitogen-activated protein kinases or MAPKs, is used which transduce a variety of extra-cellular signals to the nucleus, the cytoskeleton and metabolic enzymes. A number of MAPK genes has been isolated from plants and work is now in progress to find out which signals activate the different MAPKs and which are the downstream targets of the MAPKs.

Pollen Development

Plants have a unique sex life. Sperms and eggs are not free cells as in most other organisms but are part of larger structures. Sperm cells are part of pollen grains which develop from microspores, the primary products of meiosis, by two further cell divisions. Microspores and immature pollen grains have a further developmental option: In the test tube and after a stress treatment, they divide continuously and form embryos which have the haploid number of chromosomes.

O Vicente, A Touraev, E Heberle-Bors
Pollen Biotechnology

With a system of in vitro maturation of pollen this group identified flavonols and steroids as new growth substances in plants, capable of promoting pollen tube growth.

In their pollen embryogenesis project Heberle-Bors and co-workes are isolating genes specific to the induced pathway. They are particularly interested in how stress signals are perceived by the

microspores and how cell cycle genes are involved in the switch from an orderly sequence of cell divisions giving rise to mature pollen grains to the stress-induced continuous cell division activity which eventually gives rise to embryos.

The two pathways of pollen development offer new opportunities in plant biotechnology. DNA is being transferred to microspores with a DNA-gun. After in vitro maturation pollen grains are used for in vivo pollination and the generation of transgenic plants. Alternatively, microspores are submitted to a treatment leading to embryogenesis, transgenic haploids are recovered and, after colchicine treatment, fertile, diploid and homozygous transgenics are obtained. This is a completely new method of plant transformation.

Finally, this group participates in an Austrian program aiming at mapping the wheat genome for resistance genes against *Fusarium* wilt. A mass production technique for doubled haploids from wheat microspores will speed up breeding programmes in wheat, particularly to select for *Fusarium* wilt resistant high quality wheat varieties.

Teaching

Members of this section teach developmental genetics and plant genetics in both basic and advanced lecture and laboratory courses.

International Cooperations

University of Amsterdam, CPRO-DLO and University Wageningen, University of Tübingen, CSIC Madrid, Czech Academy of Sciences, Prague.

Selected References

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