ISE Letters

International Journal on

ENDOCYTOBIOSIS AND CELL RESEARCH

Organ of the International Society of Endocytobiology (ISE)

continued on page V (inside back cover)

Contents - continued

TITLE FIGURE: Computer-assisted 3-D reconstruction of the basal bodies (central brown cylinders) - microtubular roots (X-shaped rows of green, red, yellow, violet diamonds) - eyespot (red-yellow ellipsoid) - mating structure (light-violet disc) - nucleus (blue network) - association in gametes and zygotes of Chlamydomonas reinhardtii, pellicula not shown (further details see Gaffal, el-Gammal and Arnold, pp. 151-176).

Aims and Scope

ENDOCYTOBIOSIS AND CELL RESEARCH, an international journal and organ of the International Society of Endocytobiology, aims to promote the flow of information and to stimulate the cooperation between SYMBIOSIS researchers and CELL biologists.

ENDOCYTOBIOSIS AND CELL RESEARCH will be (along with the ISE News Letters) a communication forum between all the scientists ((micro) biologists, biophysicists, biochemists, genetical, medical and veterinary researchers) who are concerned with the origin, development, differentiation, evolution and phylogeny of endosymbioses (including endocytoparasitism) and of the eukaryotic cell.

ENDOCYTOBIOSIS AND CELL RESEARCH is covered in Current Contents (CC/AB&ES) and the Science Citation Index (SCI).

SYMBIOSIS AS EVOLUTION FROM CHEMICAL DEFENCE TO STRUCTURAL DEFENCE (COMPARTMENTATION)

D. WERNER, E. MÖRSCHEL, P. MÜLLER, M. PARNISKE and A. WOLFF
Fachbereich Biologie - Lahnberge, Philipps-Universität Marburg, D-3550 Marburg

The symbiosome (peribacteroid) membrane is the decisive physiological barrier between microsymbiont and host cytoplasm (1). Using *Bradyrhizobium japonicum* strains and mutants which give rise to various peribacteroid membrane phenotypes (5), a strong correlation has been found between symbiosome membrane disintegration and the onset of plant defence responses. In soybean, this recognition is apparent as the production of the phytoalexins, glyceollin I-III. Isomer I is quantitatively the most important of the 3 glyceollin isomers. Twenty days after infection with *Bradyrhizobium japonicum* 61-A-24 glyceollin I levels had reached 6 $\mu mol \cdot g^{-1}$ nodule dry weight (4). High phytoalexin levels were not found in nodules where the peribacteroid membrane remained intact, regardless of whether the symbiosis was fix^+ or fix^- (6,7). Thus in wild type nodules, the host plant does not recognise the 10,000 endocytobionts per cell as nonself. This is apparently due to the presence of an intact peribacteroid membrane.

The mutation of the *nifA* gene of *Bradyrhizobium japonicum* leads also to a pathogenic-like response of the host plant. Soybean nodules induced by the *nifA* mutant A9 exhibited symptoms of a hypersensitve reaction (HR) normally observed in plant pathogen interactions as localized death of infected cells and the accumulation of the phytoalexin glyceollin I. Little or no glyceollin I was present in nodules elicited by wild type *Bradyrhizobium japonicum* 110 spc4 (3).

Bradyrhizobium reacts to the production of glyceollin with an induced resistance, which is also induced by the flavonoids daidzein and genistein, strong inducers of nod genes in cooperation with the nod D gene products. Resistance against this phytoalexin was also induced in a nod D_1D_2Y ABC deletion mutant of *Bradyrhizobium japonicum*, indicating another recognition site for flavonoids besides the nod D genes (8).

Varying the host plant genotype three *Glycine* genotypes, *G. max* cv. Williams, *G. soja* PI 468397, and *G. soja* PI 342434 in combination with the two rhizobial strains *Bradyrhizobium japonicum* USDA 123 and *Rhizobium fredii* USDA 193 were analysed for phytoalexin concentration in the nodules. In the nodules of PI 468397/*Brady-*

rhizobium japonicum uSDA 123 a very strong glyceollin I accumulation occurred around 30 d.p.i. Ultrastructural analysis of these nodules revealed several symptoms of a severe plant defence response associated with plant cell death (Hypersensitive reaction): The cytoplasm of the infected cells was degraded and organelles had vanished. The cell walls of the infected cells showed remarkable thickening. This plant defence response could only be observed in this strain/genotype interaction. The same strain did not elicit a phytoalexin accumulation in the other plant genotyes tested, indicating that this response occurs at the genotype-specific level. This special character of *G. soja* PI 468397 is heritable as indicated by glyceollin I analysis of the nodules formed by F1 hybrids of PI 468397 x Williams inoculated with *Bradyrhizobium japonicum* USDA 123. The genotye/strain specific occurrence of the hypersensitive response in root nodules resembles the race/cultivar specific incompatibility of several plantpathogen interactions (2).

References

1. Mellor, R.B., C. Garbers and D. Werner: Peribacteroid membrane nodulin gene induction by *Bradyrhizobium japonicum* mutants. Plant Mol. Biol. 12, 307-315 (1989)
2. Parniske, M., C. Zimmermann, P.B. Cregan and D. Werner: Hypersensitive reaction of nodule cells in the *Glycine max* sp./*Bradyrhizobium japonicum* symbiosis occurs at the genotype-specific level. Botanica Acta 103, 143-148 (1990)
3. Parniske, M., H.-M. Fischer, H. Hennecke, D. Werner: Accumulation of the Phytoalexin Glyceollin I in Soybean Nodules Infected by a *Bradyrhizobium japonicum nifA* Mutant. Z. Naturforsch. 46c, 318-320 (1991)
4. Werner, D., R.B. Mellor, M.G. Hahn and H. Grisebach: Soybean root response to symbiotic infection. Glyceollin I accumulation in an ineffective type of soybean nodules with an early loss of the peribacteroid membrane. Z. Naturforsch. 40c, 179-181 (1985)
5. Werner, D., E. Mörschel, C. Garbers, and R.B. Mellor: Particle density and protein composition of the peribacteroid membrane from soybean root nodules is affected by mutation in the microsymbiont *Bradyrhizobium japonicum*. Planta 174, 263-279 (1988)
6. Wolff, A., R. Mörschel, C. Zimmermann, M. Parniske, S. Bassarab, R.B. Mellor and D. Werner: Peribacteroid membrane stability and phytoalexin production in legume nodules. In: Physiological Limitations and the Genetic Improvement of Symbiotic Nitrogen Fixation (eds. F. O'Gara et al.), pp. 65-74, Kluwer Academic Publishers, Dordrecht 1988
7. Wolff, A.B. and D. Werner: Defence reactions in *Rhizobium*-legume symbiosis: Phytoalexin concentration in *Vicia faba* nodules is affected by the host plant genotype. Z. Naturforsch. 45c, 958-962 (1990)
8. Parniske, M., B. Ahlborn and D. Werner: Isoflavonoid-inducible resistance to the phytoalexin glyceollin in soybean rhizobia. J. Bacteriol. 173, No 11 (1991)