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AND CELL RESEARCH**

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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 endocytotaxitism) 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)

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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  $6 \mu\text{mol} \cdot \text{g}^{-1}$  nodule dry weight (4). High phytoalexin levels were not found in nodules where the peribacteroid membrane remained intact, regardless of whether the symbiosis was  $\text{fix}^+$  or  $\text{fix}^-$  (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 hypersensitive 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<sub>1</sub>D<sub>2</sub>Y 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 genotypes 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 × Williams inoculated with *Bradyrhizobium japonicum* USDA 123. The genotype/strain specific occurrence of the hypersensitive response in root nodules resembles the race/cultivar specific incompatibility of several plantpathogen interactions (2).

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