

**EFFECTS OF NANOSECOND PULSED ELECTRIC  
FIELDS (nsPEF) ON THE CYTOSKELETON OF  
PLANT CELLS**

Thomas Berghöfer, Christian Eing, Bianca Flickinger and  
Wolfgang Frey  
*Institute for Pulsed Power and Microwave Technology,  
Karlsruhe Institute of Technology,  
76344 Eggenstein-Leopoldshafen, Germany*

Petra Hohenberger, Lars Wegner and Peter Nick  
*Botanical Institute I, Karlsruhe Institute of Technology,  
76128 Karlsruhe, Germany*

To examine the influence of nsPEF on intracellular constituents, transgenic derivatives of the tobacco cell line *Nicotiana tabacum* L. cv BY-2 expressing fusions of the green fluorescent protein (GFP) with various organelle markers were treated with electric field pulses with a duration of 10 ns and a field-strength of 33 kV/cm. These marker lines allowed to study effects of nsPEF on actin filaments, microtubules and the endoplasmic reticulum. Using confocal laser scanning microscopy upon nsPEF treatment, a disintegration of the cytoskeleton in the cell cortex, followed by contraction of actin filaments towards the nucleus and a disintegration of the nuclear envelope have been observed. These responses are accompanied by irreversible permeabilization of the plasma membrane manifest as uptake of Trypan Blue. By pretreatment with the actin-stabilizing drug phalloidin, the detachment of transvacuolar actin from the cell periphery can be suppressed, and this treatment can also suppress the irreversible perforation of the plasma membrane. The results are discussed in terms of a model, where nanosecond pulsed electric fields trigger actinresponses that are key events in the plant-specific form of programmed cell death.

1. Th. Berghöfer et al., "Nanosecond electric pulses trigger actin responses in plant cells", *Biochemical and Biophysical Research Communications* 387 (2009) pp. 590-595.