Dynamic cytoskeleton rearrangements in root-knot nematode feeding cells and future perspectives

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Abstract

Among plant pathogens, sedentary endoparasitic root-knot nematodes (Meloidogyne spp.) are one of the most harmful pests in global agriculture. The use of nematicides is highly pollutant to the environment and consequently new strategies must be envisaged. Root-knot nematodes are competent to transform plant root cells into feeding sites that supply nutrients for the nematodes. Nematode feeding cells, also called giant cells, harbor a dense cytoplasm and show a rearranged actin and microtubular cytoskeleton. As nematodes induce fragmentation and long-term rearrangements of the plant cytoskeleton during infection, manipulation of cytoskeleton components necessary for parasitism could be used as targets to obtain resistant plants. Recently, we have shown that new microtubules in plants are nucleated by cytoplasmic or microtubule-bound γ-tubulin ring complexes. Stable γ-tubulin-GFP expressing Arabidopsis lines provide compelling evidence for the physical interaction between components of the γTuRC, γ-tubulin and γ-tubulin-complex protein 3 (GCP3) as part of free cytoplasmic and microtubules associated complexes. Our results confirmed that γTuRC is an essential element of the microtubule nucleation apparatus throughout giant cell development. The reduction of γ-tubulin and GCP4 levels compromises γTuRC functioning and affects microtubule nucleation in giant-feeding cells, delaying their development and affecting nematode reproduction. Upregulation of microtubule nucleation induced by γTuRC is essential for the nematode parasitism and this process can be targeted in order to protect plants against nematode infection. The knowledge on the cytoskeleton reshuffling in feeding sites may well trigger the awareness of biotechnology companies and crop breeders in developing new strategies for the control of pathogen infection.