

Early stages of development of terrestrial orchids: the effect of saccharides and phytohormones

Rané fáze vývoje semenáčků terestrických orchidejí: vliv sacharidů a fytohormonů

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Abstract

Orchids have very small seeds with only limited contents of reserves. Therefore, in early stages of their development most of them fully depend on nutrition provided by mycorrhizal fungi. Nearly all orchids remain partial mycotrophs during whole life, even after a start of their own photosynthesis. These characteristics make orchids an ideal model for studies of mycorrhizal associations and bring us good opportunity to study different feeding strategies in the single species. This work targets on early developmental stages of orchids and by studying carbohydrate status of both plant and fungus and their sensitivity to different types of phytohormones estimates potential of these signalling compounds to control plant-fungus coordination. Firstly, the capability of selected orchids to utilize different carbohydrates have been tested. Results confirmed their ability to metabolize sucrose, fructose, maltose, raffinose and trehalose. Only low level of utilization have been shown for lactose and mannitol. For the first time it has been shown, that some orchids are able to utilize sorbitol. In contrast, fructose has clear inhibition effect on germination or early developmental stages of *Ophrys* protocorms, while not fructose but glucose inhibits germination and subsequent development of *Dactylorhiza*. The effect of phytohormones on orchid mycorrhizal fungi is also presented. It is shown, that auxins stimulate branching of selected mycorrhizal fungi hyphae. Auxins as a possible means of mutual communication between fungi and orchids in mycorrhizal associations is discussed. Further, developmental effects of selected phytohormones on early developmental stages of orchid protocorms differentiation were studied. Based on the achieved results an attempt have been made to propose a model of auxin-cytokinin directed developmental regulation of early development in orchids. Auxins stimulate growing of basal parts of protocorms, while cytokinins stimulate growing of apical parts and differentiation of shoot meristem. It is proposed, that auxins are in early protocorm transported to basal parts, where they stimulate development of mycotrophic tissue. As a result of this auxin distribution polarization cytokinin effect can overbalance in apical part, where lead to meristem differentiation. To support the conclusion a transgene plants carrying GFP under control of

auxin inducible promoter DR5 have been prepared to visualise endogenous auxin levels in orchids.