SHEDDING LIGHT ON THE MAIZE AUXIN ROADS: ZmPIN1 PROTEIN LOCALIZATION STUDIES

FORESTAN C., VAROTTO S.

Department of Environmental Agronomy and Crop Science, University of Padova, Viale dell’Università 16, 35020 Legnaro (PD), Italy

auxin, PIN1, Polar Auxin Transport, GFP, Zea mays

The flow of a signalling molecule across tissues, or even few cells, that is then traduced into differential growth responses in those cells, is a fundamental concept during the development of multicellular organisms. In maize, such as in Arabidopsis, we frequently observed asymmetrical auxin distribution across adjacent cells during crucial stages of growth and development suggesting that the mechanism of auxin mediated morphogenesis is conserved among mono_ and dicotyledonous species.

Polar intercellular auxin flow, thus, provide vectorial information to plant tissues, making it a unique mechanism for transmitting spatial and temporal signals in plant development. Given that the polarity of auxin flow is modulated by changes in the subcellular localization of PIN efflux carriers within each auxin transporting cell, the regulation of PIN protein polarity should be highly controlled, very dynamic and extremely flexible, with the possibility of PIN protein re_localization within a single cell. This plasticity is fundamental to quickly respond to internal and external stimuli and then adapt plant development. In the last years several efforts have been made in Arabidopsis thaliana to identify genes regulating the polar targeting of PIN proteins, highlighting a very complex and interconnected regulative network. AtPIN1 basal localization is mediated by the GNOM ADP ribosylation factor/guanine nucleotide exchange factor (ARF/GEF) that functions in endosomal vesicle formation, controlling also AtPIN3 trafficking, while AtPIN2 exocytosis is mediated by SORTING NEXIN1 (AtSNX1) endosomes. The polarity of PIN localization is controlled also by direct phosphorylation of specific PIN residues: the serine/threonine protein kinase PINOID (PID) directly phosphorylates PIN proteins, marking them as apical cargo, while PIN basal localization is regulated by the dephosphorylation catalysed by the trimeric serine_threonine protein phosphatase 2A (PP2A). As a consequence, PIN protein sequence itself contribute to the control of polar PIN polarization thank to the presence of sequence-specific signals.

During our studies on the role of maize PIN1 orthologous genes throughout embryonic, vegetative and reproductive development, we observed different ZmPIN1 protein localization patterns in different cells or tissues, resulting in differential auxin accumulation patterns. Understand how ZmPIN1 proteins are directed to the plasma-membrane instead to be retained in cytoplasmic vesicles or are directed to distinct sides of the same cells is of outstanding importance to completely understand the role of auxin in controlling cell and tissues polarity in Zea mays. Preliminary tobacco protoplasts transformation experiments using ZmPIN1::GFP fusion constructs revealed that the three ZmPIN1 proteins may have different plasma-membrane insertion abilities or, more likely, may be subjected to different regulation pathways. To confirm these results, now we
are analyzing the cell membrane targeting of ZmPIN1::GFP fusion constructs in the homologous system by maize protoplast transient transformation.