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The unique characteristics of the angiosperm plant life cycle and their potential consequences on the developmental plasticity of nucellar cells using wheat as a model system

Angiosperm seed development is a crucial factor of agricultural production. Thus, a comprehensive understanding of the mechanisms governing it in cultivated plants is pivotal for crop productivity. The unique features of angiosperm life cycle such as continuous development, avoidance of a germline, flexible and reversible cellular differentiation, and the alteration of haploid and diploid generations are characteristics that confer a high level of plasticity upon flowering plants.

Intriguingly, angiosperm nucellar cells can either engage in or forgo meiosis, a cell fate "decision" depending on the developmental context. Consequently, in angiosperms, two developmental pathways of reproduction can be followed: sexual or amphimictic, and asexual (apomictic); the latter remaining the holy grail of basic research initiatives due to its elusive nature. When paralleled, the cell fate decision of the initiatory cell being the depository of the information triggering incipient mechanisms eventually leading to embryo formation of a particular nucellar/sexual cell in the angiosperm ovule is in contrast with the conditions required in vitro either for a reconstituted oocyte exploited to produce clones by somatic cell nuclear transfer (SCNT), or for mammalian stem cells induced to undergo meiosis and produce synthetic gametes. Viewed from an evolutionary perspective, the genomes of angiosperm species are more dynamic and labile at both the sequence and chromosome level, whereas mammalian genomes are more stable mainly due to setting the germ line cells apart during an early stage of development.

It appears that in attempts to unravel the molecular and cellular events leading to the "derailment" of the normal sexual pathway in the female gametophyte as it unfolds during the alternative developmental pathway during asexual seed formation, considering only gene-regulation networks in terms of the transcriptome may not supply us with a comprehensive picture pertaining to addressing the developmental flexibility of the nucellar tissues since an even greater complexity is conferred upon the angiosperm nucellus by the proteome. Furthermore, the wide range of plant transcription factors could be expounded by a unique feature of plants: their complex secondary metabolism providing a plethora of secondary metabolites; up to 25% of all plant genes are associated with a unique set of secondary metabolites not found in animals (the total number of plant secondary metabolites is close to 50,000, albeit it is estimated to be several hundred thousands)

Essentially, transcriptomics studies launched in wheat, being one of the most staple food crops in the world, promise to be of use in disentangling the expression profile of genes that control many agriculturally important traits. However, the use of wheat microarrays for gene expression measurements in hexaploid wheat having an enormous genome may be deemed to be limited, and even when coupled with approaches based on powerful tools such as sequencing-based transcriptomics techniques may not be deemed to enable us to fully decipher the complexity of mechanisms involved in embryonic development ensuing either upon or without fertilisation in female gametes/nuclear cells.

Elements of a complex system involving auxin gradient, positional information, maternal control end epigenetic factors will be touched upon in summarising the state of the art of endeavours addressing these issues of utmost importance in developmental biology.

Biography

Zsolt Ponya has completed his PhD at the age of 32 years from the Eotvos Lorand University of Arts and Sciences, Budapest, Hungary, and following obtaining his degree, he has launched his postdoctoral studies at the University of Siena, Italy, followed by a postdoc research fellowship at the Ben-Gurion University of the Negev, Israel. He is currently a senior scientist at the University of Kaposvar, Hungary. He has published a number of papers in reputed international journals and is a member of the editorial board of several prestigious scientific journals.

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