Representation and functions of shoot apical meristems in FSPMs

KEYNOTE

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Functional Structural Plant Models (FSPM) are individual-based models that explicitly account for the interactions between plant architecture and its abiotic and biotic environment. Plant morphogenesis, growth and grain or fruit production are among the most represented processes in FSPMs. These biological processes are largely determined at the Shoot Apical Meristem (SAM) level as it drives the rate of leaf initiation, phyllotaxy, leaf geometry, floral induction and the production of reproductive organs. Nevertheless, not all FSPMs are based on an explicit representation of SAMs, their functioning is then ignored in the case of non-dynamic models or embedded in parametric or statistical functions of plant morphogenesis in dynamic models. For FSPMs that include an explicit representation of SAMs, they are mainly constructed on the L-systems formalism which is well suited to describe plant development (Boudon *et al.*, 2012). First, one of the main functions of SAMs in these FSPMs is the production of new leaves or growth units, usually at a constant rate expressed in thermal unit. In some cases, the rate of leaf production by SAMs is coordinated with the rate of leaf emergence, leading to the concept of self-regulated architecture. However, the effect of substrate or water availability on the functioning of the SAM in terms of the size or properties of the emitted primordia is not accounting for. Secondly, the representation of apices in models is also used to simulate axillary bud break and the production of tillers, branches or new growth units. In these cases, the transition from a latent to an active SAM is controlled by light intensity and its spectrum (Verdenal *et al.*, 2008; Faverjon *et al.*, 2019), or temperature or hormones (Prusinkiewicz *et al.*, 2009) or is based on stochastic approaches. Finally, some FSPMs also account for the production of reproductive organs like grains and fruits by SAMs (Boudon *et al.*, 2020; Rouet *et al.*, 2022). Nevertheless, this aspect of SAM functioning remains poorly described in FSPMs despite its importance in plant production, yield and ecology. We believe that a better integration of SAMs functioning and control in FSPMs is a promising way to assess functional hypotheses and predict plant plasticity to the environment.

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