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L-Pea: an architectural model of pea (*Pisum sativum*) development

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Highlights: an architectural model of pea, called L-Pea, was developed based on the L-System formalism. The input data account for the development of branches and phytomers as well as the kinetics of the vegetative organs growth.

Keywords: architectural model, morphogenesis, *Pisum sativum*, plant architecture.

Currently, pea (*Pisum sativum*) is the principle source of vegetable proteins. However, the productivity of pea crop is still under its potential. Studying pea architecture (e.g. Leaf Area Index (LAI), plant height, foliar inclination) enables to analyze its interactions with abiotic (light, nitrogen, water) and biotic factors (foliar diseases). Architectural models therefore appear as suitable tools for studying the functioning of pea (Barillot *et al.*, 2012). The aim of the present work was therefore to develop an architectural model of pea growth, hereafter called L-Pea (Fig. 1).

The model is based on the L-system formalism and implemented on the L-Py platform (Boudon *et al.*, 2012). Pea morphogenesis was modelled as being driven by thermal time which can be incremented from meteorological data at each time step. The above ground architecture is represented as a succession of phytomers that compose main stems and branches. Kinetics of phytomer and branch production are described in a *vegetative module*. Phytomers are considered as a collection of organs encoded as modules that support their state *i.e.* age, length, topology and geometry. The elongation and coordination of the organs generated in the *vegetative module* are then handled by a *growth module*. The initial parameters of phytomer production and organ growth were mainly based on measurements performed on a field-grown crop of winter pea, cv. Lucy.

In a companion study, the L-Pea model was interfaced with a dynamic model of wheat development (Fournier *et al.*, 2003) in order to generate virtual wheat-pea mixtures. This allowed us to study the relations between the architecture of the component species and the level of light partitioning. Detailed methods and results are given in Barillot *et al.* (2013). To our knowledge L-Pea is the first architectural model of pea available in the literature. This model can therefore provide a suitable framework for studying the behaviour of contrasted pea architecture towards light interception or foliar disease dispersion.

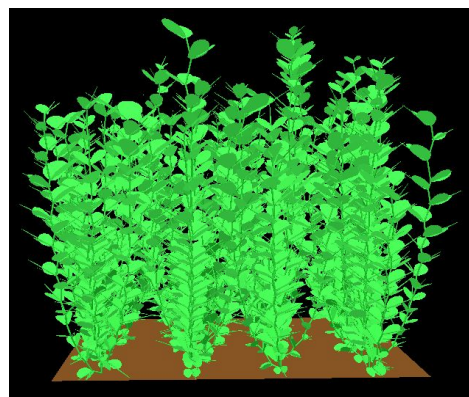


Fig.1: side view of a canopy of 3D pea plants generated from L-Pea model

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