Virtual rose: a new tool to optimize plant architecture in glasshouse rose production systems

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Cut roses (*Rosa hybrida*) represent a high input and high-value ornamental glasshouse crop. Many factors affect number and quality of flowers, among them most prominently the manipulation strategy exercised by the grower, which aims at (i) maintaining a sufficient number of leaves exposed to light in order to sustain growth and (ii) to stimulate 'bud break', i.e. the emergence of new shoots from bud positions that yield high quality flowers. Basically, current plant manipulation strategies were developed empirically in practice. A more objective tool to guide growers in their decisions on plant manipulation is required. The objectives of the project include (i) to study bud break in relation to plant architecture and environment, and (ii) to use that knowledge to create a model that calculates flower production over time in relation to plant architecture, plant manipulation and glasshouse environment and that thus goes beyond existing process-based rose models (e.g. Lieth & Pasian, 1991), which fail to predict this spatial crop dynamics.

A preliminary version of a cut rose model written in XL using the modeling environment GroIMP (Kniemeyer 2004) will be shown. In a next step, this essentially morphological model will be turned into a functional-structural plant model by linking it with various submodels simulating external environmental (light, temperature) and internal processes (transport of nutrients, signal transduction). GroIMP's potential for user interaction and global context sensitivity will be explored in the context of management practices and their effects on crop physiology at different scales: shoot bending to increase source strength, pruning, and rose cutting for harvest.

So far, a conceptual model for the rose FSPM as well as two morphological models have been devised (see figure above). The model concept is based on knowledge about the topology of rose organs, whereas the morphological models are the first results of detailed morphometric and developmental studies of the primary shoot and the flower, respectively. Further modeling tasks include: development and growth over time (kinetics); assimilation and carbon partitioning; experiments to quantify the behaviour of axillary buds, as a function of interference with plant architecture: (pruning, harvesting, flower bud removal), light microclimate, source-sink balance.

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References

Kniemeyer, O. (2004). Rule-based modelling with the XL/GroIMP software. In: Harald Schaub, Frank Detje, Ulrike Brüggemann (eds.), The Logic of Artificial Life. Proceedings of 6th GWAL, Bamberg April 14-16, 2004, AKA Akademische Verlagsgesellschaft Berlin, pp. 56-65.

Lieth J.H., Pasian C.C. (1991): A simulation model for the growth and development of flowering rose shoots. *Scientia Horticulturae* 46, 109-128.