Intrinsic determinants of mango tree growth and reproduction: Consequences on functional-structural modeling

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Mango trees are characterized by alternate-bearing, i.e. strong flowering and fruiting in on-years, and by phenological asynchronisms. This behavior results from a complex interplay between reproductive and vegetative development. This interplay influences the tree in a quantitative way (% branching, % flowering…) and in a temporal way (date of budburst…). To build a functional-structural model, these factors must be integrated. Our objective was thus to identify and organize the intrinsic factors, most of them being of an architectural nature, that influence the vegetative and reproductive functioning of mango trees.

Materials and Methods
The study was carried out in Reunion Island, in the southern hemisphere. The effects of intrinsic factors, in particular architectural ones, were investigated on a dataset resulting from an exhaustive description of growth units (GUs) of five trees of four cultivars (Cogshall, Irwin, José and Kensington Pride) during two phenological cycles, from June 2003 to February 2006. Branching patterns, flowering and fruiting were analyzed for each cycle using generalized linear models. Different types of variables (either as response or explanatory variables) were considered: qualitative (occurrence of budburst; GU type: vegetative, flowering, fruiting; GU position: apical or lateral; tree fruit load: with or without), quantitative (number of GUs) and temporal (date of budburst).

Results and discussion
The statistical models highlighted multiple interactions between vegetative growth and reproduction both between and within a phenological cycle. For instance, apical GUs were generally larger, branched more and had higher flowering and fruiting probabilities than lateral GUs. Vegetative GUs had a higher probability of budburst than flowering GUs. Thus, the intrinsic factors influenced the tree not only in a qualitative way. Indeed, the date of budburst depended on the production of an apical GU. So the GU architectural characteristics affected the tree development in a temporal way, i.e. tree phenology. The same pattern of factors effects was observed along consecutive phenological cycles. This statistical modeling approach enabled us to identify and characterize the intrinsic factors that must be integrated in a functional-structural model of the development of the branching system during a phenological cycle accounting for:

- branching and reproductive structure, taking into account dependencies between successive GUs;
- time ordering and duration of vegetative and reproductive events.

This model will be applied for predicting yields or sensitive periods of mango trees to pests.