Growth units dimorphism in mango. Consequences for structure-function modelling

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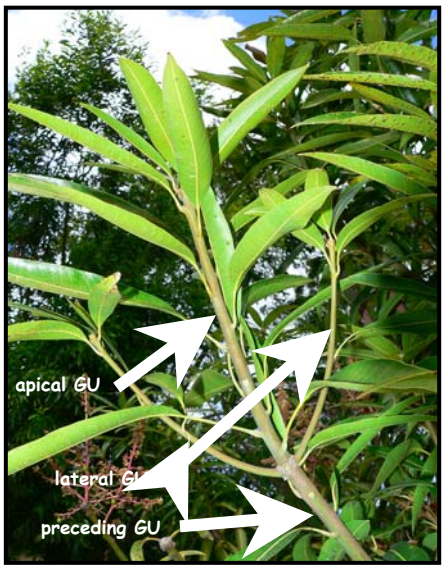

Fig 1 : Apical and lateral growth units on mango cv. José.

apical GU : GU stemmed from the apical bud of the preceding GU.

lateral GU(s) : GU(s) stemmed from the lateral sub-terminal bud(s) of the preceding GU.

Mango tree is characterised by rhythmic growth and terminal flowering. Therefore, flowering depends on, and in turn influences, vegetative growth. Close relationships between reproductive and vegetative developments are then suspected and should be integrated in a structural-functional model of mango tree.

In relation with this objective, we investigated on four mango cultivars the effect of growth unit (GU) position (apical vs. lateral; Fig. 1) on some morphological characteristics and functioning traits (branching pattern, flowering and fruiting probabilities).

Materials and Methods

The four mango cultivars, namely 'Cogshall', 'Irwin', 'José' and 'Kensington Pride', grafted onto the same rootstock, were planted in May 2001 on the CIRAD research station at Saint Pierre, Réunion Island (21°06'S, 55°32'E, 285 m a.s.l.).

The effect of GU position on its morphology was investigated on 10 to 15 current-year shoots sampled randomly on each cultivar, in June 2004. Several variables were recorded at the GU level: stem length and dry mass, stem dry matter content, number of leaves, total leaf area and dry mass, individual leaf area and dry mass, leaf dry matter content and leaf mass per area. The data were analysed for each year and cultivar with analysis of variance.

The effect of GU position on branching pattern, flowering and fruiting was investigated with a dataset resulting from an exhaustive description of GUs, flowering and fruiting of 5 trees per cultivar during one phenological cycle, from Sept 2003 to Feb 2005. These data were analysed with generalised linear models.

Results and discussion

The main and original result of this study was that the position of the GU had a conspicuous influence on its morphology and functioning in mango. Apical GUs were generally longer (Fig. 2A), heavier (Fig. 2B), and had a 2 to 3 times greater leaf area (Fig. 2C) than latera l GUs. They branched more (data not shown) and had higher flowering and fruiting probabilities (Table 1). These results were shared by the four cultivars, with however cultivar-specific effect.

These results are being integrated in a structure-function model which considers mango tree as a meta-population of apical and lateral GUs with their own morphological and functional attributes. Their relative proportion determines leaf area at the canopy periphery, and the branching, flowering and fruiting potential of the tree. The relative proportion of apical and lateral GUs varies at each growth or flowering event as a result of their specific branching or flowering behaviour. This modelling approach therefore accounts for the reciprocal relationships between vegetative and reproductive stages, at both spatial and temporal levels, on a mango tree. Further investigations are nevertheless necessary to identify other relevant factors affecting shoot morphology and/or functioning (e.g. presumably the vegetative or reproductive nature of the preceding GU) and to integrate their effects in the model.

Process	GU position	'Cogshall'	'Irwin'	'José'	'Kensington Pride'
Flowering	apical	0.78 a	0.87 a	0.58 a	0.93 a
	lateral	0.59 b	0.63 b	0.45 b	0.74 b
Fruiting	apical	0.52 a	0.45 a	0.69 a	0.71 a
	lateral	0.24 b	0.27 b	0.39 b	0.44 b

Table 1: Effect of the growth unit position on the flowering and fruiting probabilities of four mango cultivars. For each cultivar and process, different letters indicate significant differences (P < 0.05).

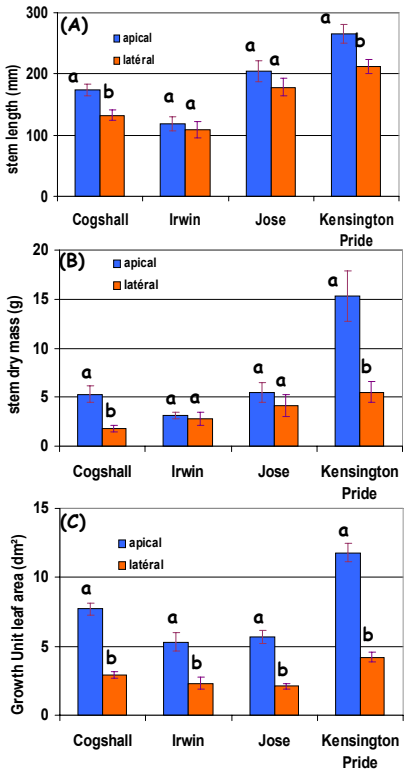

Fig 2: Effect of the growth unit position on the growth unit stem length (A), stem dry mass (B), and leaf area (C) in four mango cultivars (mean ± se). For each cultivar, different letters indicate significant differences (P < 0.05).

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Introduction

Mango tree is characterised by rhythmic growth and terminal flowering. Thus, flowering depends on, and in turn influences, vegetative growth. Close relationships between reproductive and vegetative developments are consequently suspected and should be integrated in a structural-functional model of mango tree. Our objective was then to identify and organize into a hierarchy some key parameters related to tree and shoot architecture. In relation with this objective, we investigated on four mango cultivars (namely Cogshall, Irwin, José and Kensington Pride) the effect of growth unit architectural position on its morphological characteristics and its functioning (branching pattern, flowering and fruiting probabilities).

Materials and Methods

The effect of growth unit position on its morphology was investigated on 10 to 15 current-year shoots sampled randomly on each cultivar in 2004 and in 2006. Several variables were recorded at the growth unit level: stem length and dry mass, stem dry matter content, number of leaves, total leaf area and dry mass, individual leaf area and dry mass, leaf dry matter content and leaf mass per area. The effect of growth unit position on branching pattern, flowering and fruiting was investigated with a dataset resulting from an exhaustive description of growth units, flowering and fruiting of 5 trees per cultivar during two phenological cycles from June 2003 to February 2006. Morphological data were analysed with analysis of variance. Branching pattern, flowering and fruiting were analysed for each year with generalised linear models.

Results and discussion

The main and original result of this study was that growth unit position had a conspicuous influence on its morphology and functioning in mango. Apical growth units were generally larger and had a 2 to 3 times greater leaf area than lateral growth units. They branched more and had higher flowering and fruiting probabilities. These results were common to the four cultivars, with however cultivar-specific effect. These results are being integrated in a structure-function model which considers mango tree as a meta-population of apical and lateral growth units with their own morphological and functional attributes. Their relative proportion determines the leaf area at the periphery of the tree, and the branching, flowering and fruiting potential of the tree. The relative proportions of apical and lateral growth units vary at each growth or flowering event as a result of their specific branching and flowering behaviour. This modelling approach therefore accounts for the reciprocal relationships between vegetative and reproductive development on a mango tree. Further investigations are nevertheless necessary to identify other relevant factors (e.g., fruit load) affecting shoot morphology and/or functioning and to integrate their effects in the model.