Photosynthesis of three dessert banana cultivars along an altitudinal gradient

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INTRODUCTION

Bananas are grown by small holder farmers planted in agro-forestry systems in a wide range of climatic conditions throughout mid and high altitude zones of Latin America and the Caribbean. However, few studies have analyzed the photosynthesis (An) of different banana cultivars at mid and high altitudes, and how it is affected by different temperatures. Gros Michel (AAA) is the preferred cultivar for national dessert bananas, but is susceptible to Fusarium wilt. The two FHIA hybrids FHIA 17 and FHIA 23 (AAAA) are dessert bananas reported to be resistant to Fusarium wilt and are potential substitutes for Fusarium infested fields.

OBJETIVES

The objective of this study was measured the photosynthetic performance of three desert banana along an altitudinal gradient and temperature, as well as to relate the photosynthetic capacity to leaf traits of the cultivar.

MATERIALS AND METHODS

In this study the photosynthetic performance at leaf level of banana of three cultivars (*Musa* AAA cv Gross Michel, *Musa* AAAA cv FHIA 17, *Musa* AAAA cv FHIA 23) at intermediate (1000 masl) and high altitude (1400 masl) were compared. Gas exchange measurements of light and CO_2 response curves on the third leaf of plants were conducted to estimate the parameters of a biochemical model of An (Farquhar et al., 1980); such as the maximum carboxylation rate (Vcmax), the potential light-saturated electron transport rate (Jmax) and day respiration (Rd).

RESULTS

The results showed higher rates of An at mid altitude (1000masl) compared to high altitude (1400 masl), and the estimated parameter Vcmax, Jmax and Rd were also higher a mid altitude for all the three banana cultivars (Table 1). The estimated parameters Vcmax, Jmax and Rd were dependent on leaf temperature. Scatter in the data suggest additional effects such as soil fertility and water availability which may vary site to site (Figure 1).

The cultivars FHIA 17 and FHIA 23 presented higher rates of An than Gros Michel, thus the parameters Vcmax and Jmax were higher compared to GM (Table 1). Vcmax and Jmax standardized at 25ºC were highly correlated with leaf specific area (Figure 2) suggesting that cultivars with a thicker leaf blade presented higher photosynthetic capacity.

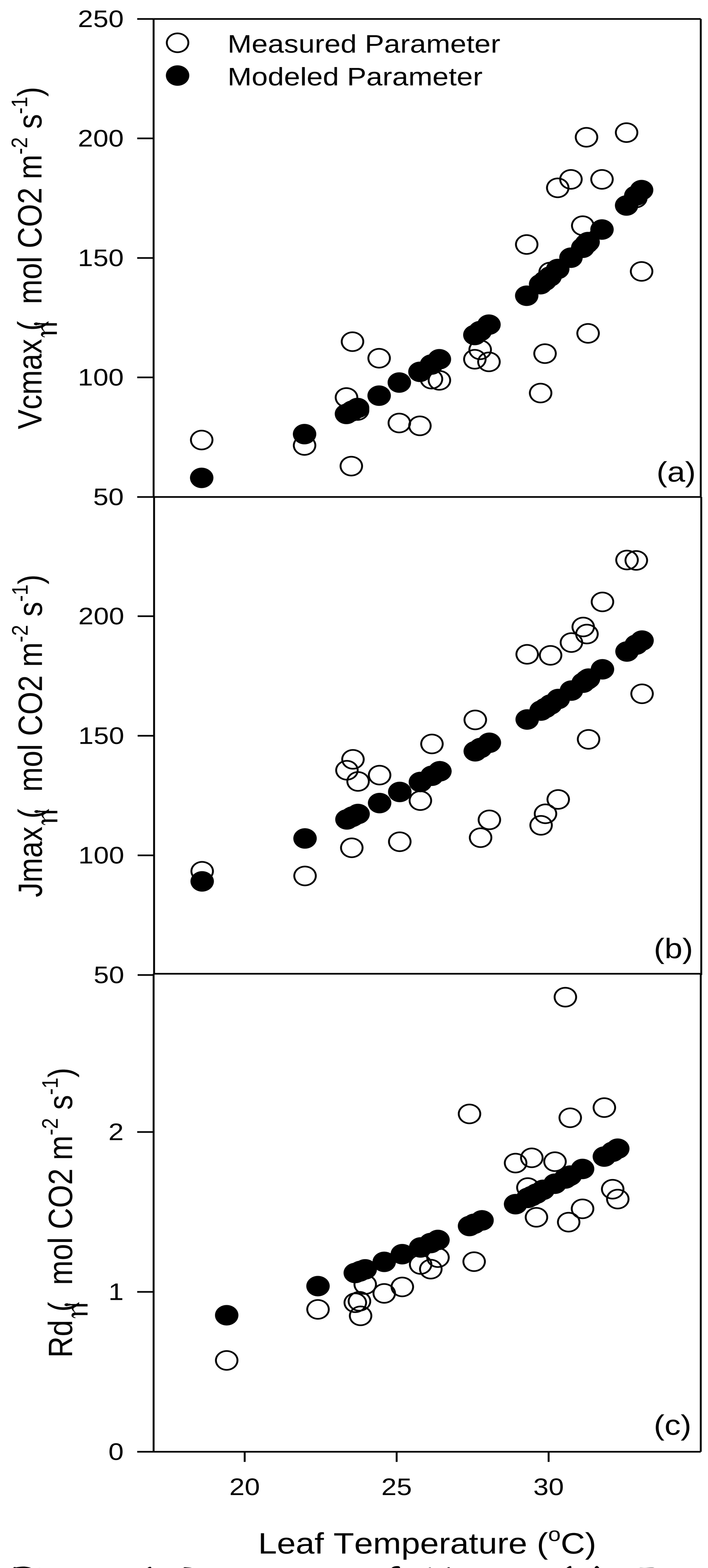

Figure 1. Response of *Vcmax (a), Jmax (b) and Rd (c) to leaf temperature.*

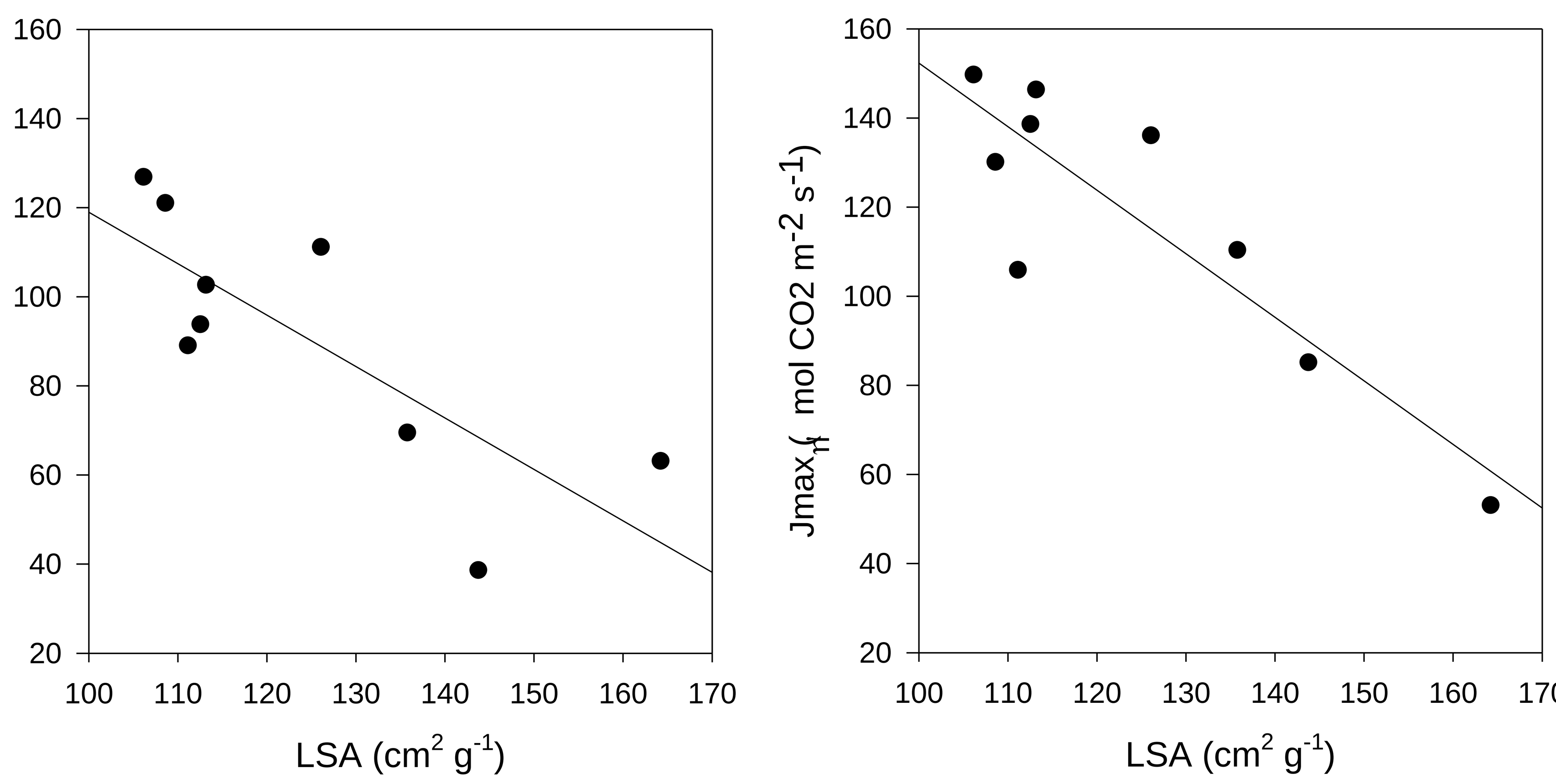

Figure 2. Relationships between the two key parameters of the photosynthesis model (*Vcmax, Jmax)* and the leaf specific area (LSA).

Table 1. Comparison of the photosynthetic parameters Vcmax, Jmax and Rd derived from CO_2 response curves from different locations (1000, 1400 masl) and cultivars (Gros Michel, FHIA 17, FHIA 23).

	High altitude (1400 masl)			Mid altitude (1000 masl)		
	FHIA17	FHIA23	GM	FHIA17	FHIA23	GM
Vcmax (μmol m^{-2} s^{-1})	98.4	82.6	52	168.1	154.1	145.9
Jmax (μmol m^{-2} s^{-1})	121.9	118.8	78.5	191.1	185.7	153.1
Rd (μmol m^{-2} s^{-1})	0.9	0.9	1.9	1.9	1.6	1.8

CONCLUSIONS

In general, it was found that the photosynthetic parameters were lower a high altitude explained by lower leaf temperatures in all the cultivars. Also, the cultivars FHIA17 and FHIA 23 presented higher photosynthetic capacity compared to Gros Michel, which is related to simple leaf trait as LSA. Understanding changes in photosynthetic parameters for banana are crucial for modeling long-term photosynthesis and productivity in coffee agroforestry systems with banana.

REFERENCES

Farquhar, G.D., S. von Caemmerer and J. Berry 1980. A biochemical model of photosynthetic CO_2 assimilation in leaves of C3 species. Planta. 149:78-90.

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