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Effect of Elevation on Seasonal Gas Exchange of Mango (*Mangifera indica* L.).

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Abstract

Anticipating warming related to climate change, commercial mango plantations in China have been shifting from lower to higher elevations. Such practice may expose mangoes to suboptimal climatic conditions. Exploring the photosynthetic performances of cultivars at the younger sage can be a good tool to predict later crop success. Therefore, we established two main commercial mango cultivars, Tainong No.1 and Jinhuang at 450 m and 1,050 m, and examined their seasonal gas exchange. The result of the seasonal gas exchange of the two cultivars showed variations due to elevation particularly during the warmer seasons. Therefore, elevation modifies seasonal gas exchange of mangoes.

Introduction

Mango (*Mangifera Indica* L.) is the most economically important tropical fruit tree (FAO, 2020) and China is the second-largest mango producing country (Gao *et al.* 2019). In the past two decades commercial mango cultivation has been significantly expanded in the southern part of China (Gao *et al.* 2019). Yunnan is one of the provinces of China where expansion of mango production has been occurring (Gao *et al.* 2019) and cultivars Tainong No.1 and Jinhuang are among the main commercially cultivated mango cultivars in the region (Gao *et al*. 2019). Anticipating warming related to climate change mango plantations in the country have been consistently shifting from lower to higher elevation (Gao *et al.* 2019). However, establishing mango plantation at higher elevation may expose mangoes to unfavorable climatic conditions. This could affect gas exchange regardless of good management practices. Thus, exploring the effects of elevation on the gas exchange of commercial cultivars in the field is fundamental to ensure later crop successes. Field and greenhouse studies on mango have shown that temporary exposure to suboptimal temperatures caused inhibition of light-saturated photosynthetic assimilation (Allen 2000, Allen and Ort 2001). Moreover, depending on the cultivar used, the degree of chilling could negatively impact photosynthesis (Allen and Ort 2001, Elsheery *et al.* 2007, Elsheery *et al.* 2008). Therefore, investigating the gas exchange of young mangoes in response to elevation is one of the key steps for predicting the suitability of commercial mango cultivation at higher elevations.

Materials and Methods

The effect of elevation on seasonal light saturated gas exchange was assessed at PPFD of 1000 µmol m^{-2} s^{-1}, and reference CO_2 concentration at 360 µmol mol^{-1}. Measurements at the two elevations was carried out on four healthy, sun exposed, recently matured (RM) leaves on four replicate trees (n = 4x4) per cultivar per elevation, for a total of nine days to represent the hot-dry (HD) season, (April, 19 to 21, 2019), warm-wet (WW) season (July 17 to 19, 2019) and cold-dry (CD) season (December 15 to 17,2019). Gas exchange measurements were carried out using a portable photosynthesis system (Li-Cor 6400xt, USA) between 8:00 to 11:30 h local time. Means were compare using t-test and data was presented as mean (±SE).

Results

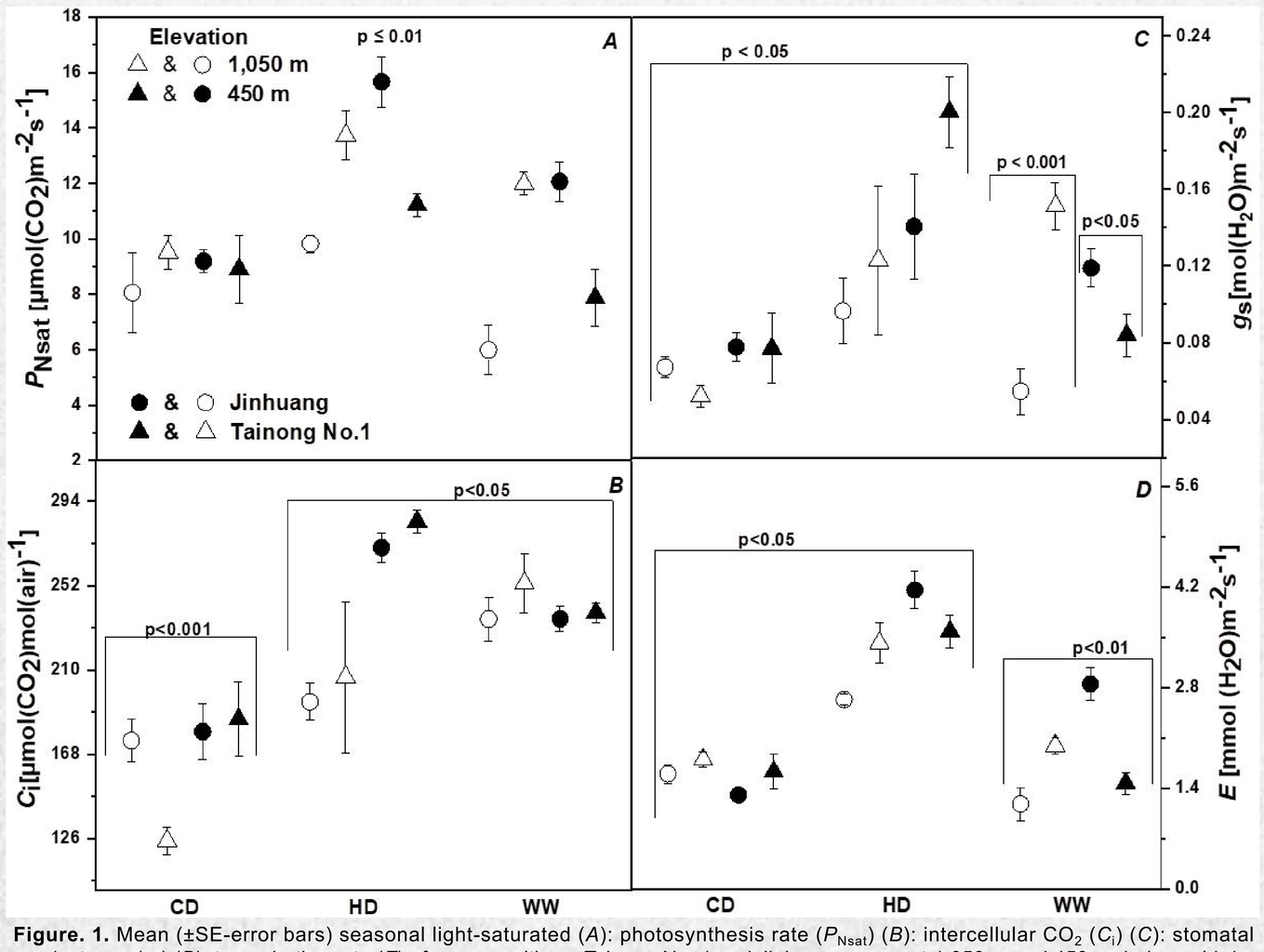

Figure. 1. Mean (±SE-error bars) seasonal light-saturated (*A*): photosynthesis rate (P_{Nsat}) (*B*): intercellular CO_2 (C_i) (*C*): stomatal conductance (g_s) (*D*): transpiration rate (*E*) of mango cultivars Tainong No. 1 and Jinhuang grown at 1,050 m and 450 m during cold-dry (*CD*), hot-dry (*HD*) and warm-wet (*WW*) seasons.

Discussion

Cultivar Tainong No.1 showed significantly higher light-saturated photosynthesis (P_{Nsat}) at 1,050 m compared to cultivar Jinhuang during hot-dry (*HD*) and warm-wet (WW) seasons. Conversely, Jinhuang showed significantly higher P_{Nsat} at 450 m during hot-dry (*HD*) and warm-wet (*WW*) seasons. However, both cultivars showed no statistically significant difference in P_{Nsat} due to elevation during the cold-dry season, and P_{Nsat} was generally low (Fig.1*A*) as also observed (Elsheery et al., 2007, Elsheery et al., 2008). Compared to cultivar Jinhuang, cultivar Tainong No.1 showed significantly low intercellular CO_2 (C_i) during cold-dry season at 1,050 m. Moreover, both mango cultivars showed higher C_i during hot-dry season at 450 m and wet warm season at both of the elevations (Fig.1*B*) this was also reported by (Elsheery et al., 2007). Moreover, seasonal stomatal conductance (g_s) of Jinhuang and Tainong No. 1 showed significant difference due to altitude during warm-wet season where Jinhuang showed higher g_s at 450 m while Tainong showed higher g_s at 1,050 m. In addition Tainong No.1 showed significantly higher g_s compared to Jinhuang was at 450 m during the hot-dry season. Generally, g_s was low during cold-dry while it was high hot-dry seasons at 450 m yet showed no significant difference between cultivars due to elevation (Fig. 1*C*). Findings were has also been reported in comparative studies by (Elsheery et al., 2007, Elsheery et al., 2008). Furthermore, cultivar Tainong No.1 showed significantly higher transpiration rate (*E*) compared to cultivar Jinhuang at 1,050 m, whereas cultivar Jinhuang showed significantly higher *E* compared to at *450 m* cultivar Tainong No.1. Transpiration rate (*E*) was higher during hot-dry season at both elevations in both of the cultivars. However, E was lower during cold-dry season (Fig.1D) which was in agrement with previous studies (Elsheery et al., 2007, Elsheery et al., 2008).

Conclusion

- Elevation modifies seasonal gas exchange of a given mango cultivar.

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