Photosynthetic Characterization of *Manglietia stella* and *Liriodendron chinense* x *tulipifera* of *Magnoliaceae*

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Summary

Manglietia stella G. L. Jiao is a newly discovered tree species of fast growth rate. In order to understand the underpinning mechanism, its photosynthesis was characterized using LI-COR LI-6400 photosynthetic system and compared with a better known species of *Liriodendron chinense* x *tulipifera* of the same family. *M. stella* had higher light saturated net photosynthesis rate (Pnl), dark respiration rate, apparent quantum yield, light compensation point than *L. chinense* x *tulipifera*. The response patterns of stomatal conductivity to light and CO_2 and the diurnal patterns of net photosynthesis rate were different between the two species. The photosynthesis of *M. stella* was not saturated under PAR 2000 μmol $m^{-1}s^{-1}$ but that of *L. chinense* x *tulipifera* was saturated at PAR 800 μmol $m^{-1}s^{-1}$. In a diurnal process photosynthetic capacity of *M. stella* was induced to higher level but that of *L. chinense* x *tulipifera* was depressed by both stomatal and non-stomatal factors. The peculiar photosynthetic mechanism of *M. stella* helps understanding of its fast growth rate and support its use in plantation for economical and environmental advantages.

Introduction

Trees are very important for the sake of timber production industry. Raising tree's productivity is the final target of many kind of researches, including breeding, pest and disease control, water and fertilizer management, etc. The authors of this study adopted a new approach of exploring plant diversity for high productive tree species. This approach had led the authors to find a new species, *Manglietia stella* G. L. Jiao. The selected individuals of this species is fast growing, a potential superior timber producer, and could be the fourth known fast growing tree after poplar, paulownia, and eucalypt. The use of eucalypt in afforestation in Southern China had evoked a hot debate upon its long term effect of reducing habitant productivity. Our new species could provide a choice to replace eucalypt in afforestation in Southern China. Researches necessary for its use in plantations had started. The present study aimed at characterizing its photosynthesis by comparing with a better known fast growing tree of the same family. The results shown that *Manglietia stella* photosynthesized fast because it can sustain photosynthesis under high light conditions which caused photoinhibition in *L. chinense* x *tulipifera*.

Materials and Methods

One selected tree of *M. stella* and *L. chinense x tulipifera* grown in Shenzhen Fairy Lake Botanical Garden were used as materials. The photosynthetic system of LI-6400 from LiCor was used in all the measurements. Three leaves in the lower part of the crown were measured and the averages were presented.

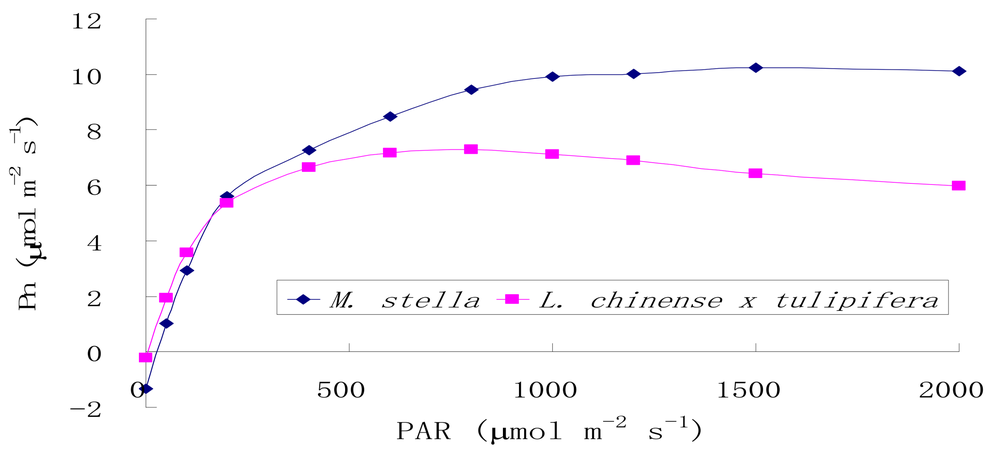

Figure 1. Net photosynthesis rate response of *M. stella* and *L. chinense x tulipifera* to photosynthetic active radiation density.

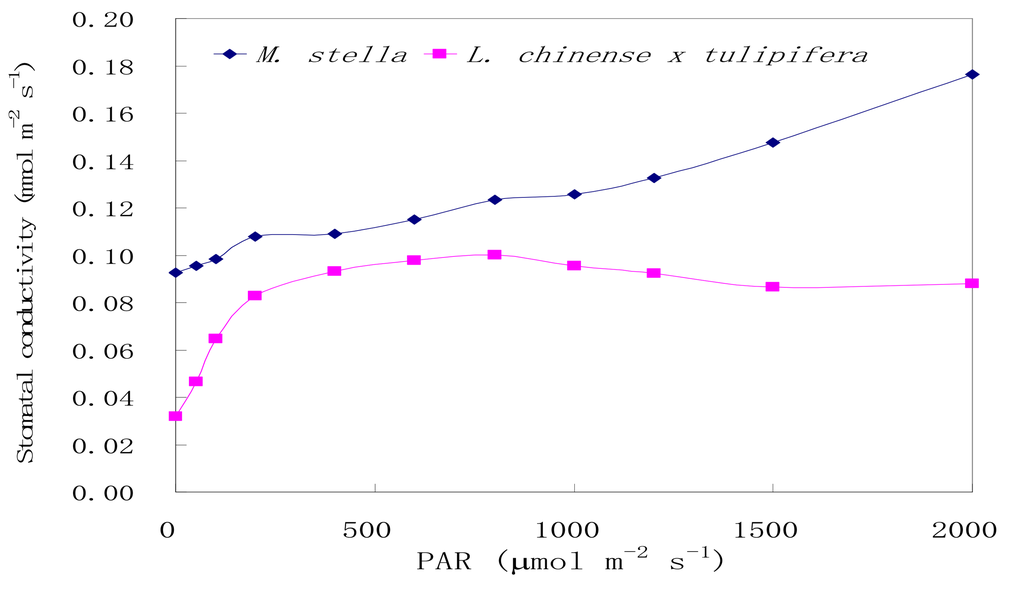

Figure 2. The response of stomatal conductivity of *M. stella* and *L. chinense x tulipifera* to density of photosynthetic active radiation.

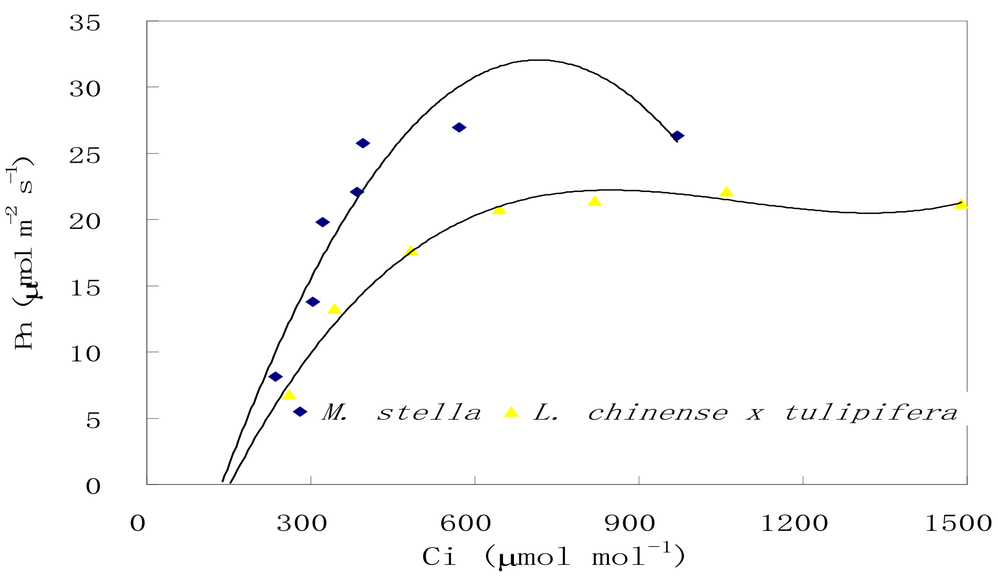

Figure 3. The response of net photosynthesis rate of *M. stella* and *L. chinense x tulipifera* to leaf intercellular CO_2 concentration.

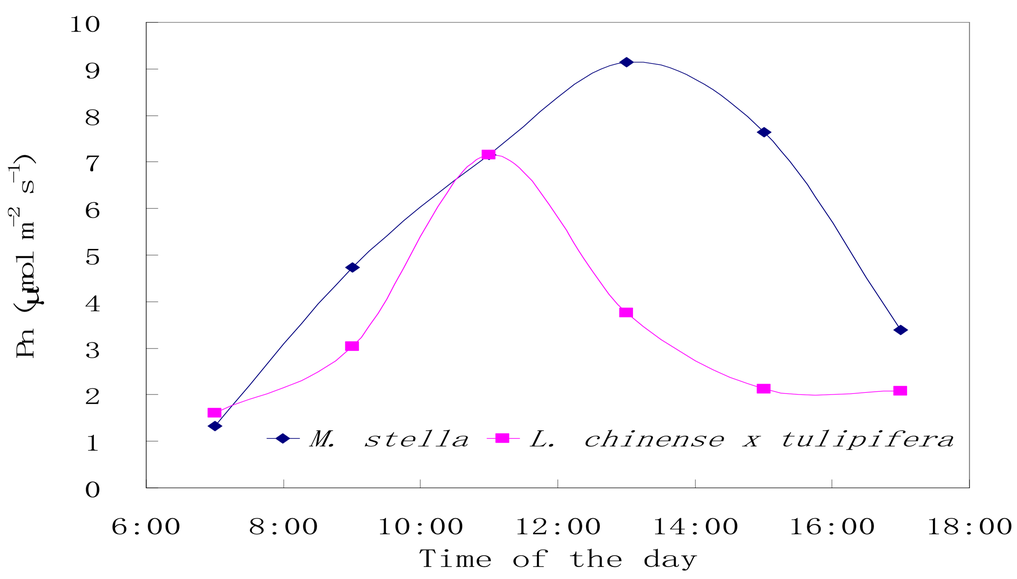

Figure 4. The diurnal patterns of net photosynthesis rate of *M. stella* and *L. chinense x tulipifera*.

Discussion

The positive correlation between plant productivity and net photosynthesis rate had been demonstrated in many cases. The present study showed this kind of correlation in the comparison of *M. stella* and *L. chinense x tulipifera*, i. e., fast grower had higher net photosynthesis rate. The response of Pn to PAR showed that *M. stella* had higher dark respiration rate, apparent quantum yield, light saturation net photosynthesis rate than *L. chinense* x *tulipifera* (Figure 1). The response of stomatal conductivity to PAR showed that *M. stella* had higher stomatal conductivity than *L. chinense x tulipifera*, especially in high and low PAR ranges (Figure 2). The higher stomatal conductivity in high and low PAR ranges accounted for higher apparent quantum yield and light saturation Pn of *M. stella* in some extent. The response of Pn to Ci showed that Pn of *M. stella* increased faster with rising Ci and leveled off at lower Ci than that of *L. chinense x tulipifera*, indicating *M. stella* had higher maximum electron flow rate and, probably, higher Robisco CO_2 affinity than *L. chinense x tulipifera* (Figure 3). The diurnal pattern of Pn showed that *M. stella* maintained a higher Pn over the day than *L. chinense x tulipifera*, the Pn of which decreased to a very low lever after mid day probably due to photoinhibition (Figure 4). To summarize, *M. stella* had higher capacity to maintain higher Pn at low and high light density and at conditions inhibitory to Pn of *L. chinense x tulipifera.*

Conclusion

1. *M. stella* had higher dark respiration rate, apparent quantum yield, light saturation Pn, maximum electron flow rate than *L. chinense x tulipifera*.
2. *M. stella* had higher CO_2 use efficiency, probably due to higher Robisco CO_2 affinity, than *L. chinense x tulipifera*.
3. *M. stella* maintained photosynthetic activity under conditions inhibitory to photosynthesis of *L. chinense x tulipifera*.