Thesis Title: Studies on hormonal control of isoprene biosynthesis in tropical tree *Ficus septica*.

Abstract

Tropical trees emit a huge amount of isoprene into the atmosphere, exerting strong influences on tropospheric chemistry. Meanwhile, isoprene has been considered to protect leaves from many environmental stresses. In this thesis, I addressed the hormonal control of isoprene biosynthesis during short-term and long-term responses using tropical trees *F. septica*:

Plant hormone signaling and circadian clock gene have been implicated in the transcriptional control of isoprene biosynthesis. To get more insight into the hormonal control of isoprene biosynthesis, the first part of present study analyzed the plant hormone concentration of the leaves in our previous two model studies: JA treated leaves in which isoprene biosynthesis was mainly controlled by transcriptional modulation of isoprene synthase (*IspS*) gene; short-term drought stressed leaves in which control of isoprene biosynthesis was mainly by post-transcriptional regulation of *IspS* gene. To explore the hormonal control of isoprene biosynthesis, present study analyzed the correlations between hormone concentration and gene expression of 2-C-methyl-D-erythrytol 4-phosphate (MEP) pathway, hormone signaling and circadian rhythm processes, and metabolite pool sizes of MEP pathway. Results suggested that hormone balance between JA-Ile and IAA plays a central role in the transcriptional regulation of IspS gene through the transcription factor *MYC2* and *SAUR21*, the early auxin responsive gene. Putative cis-acting element for SAUR on *IspS* promoter (TGTCNN and CATATG) in addition to G-box for MYC2 supports above proposal. Whereas, no significant changes were noted in the plant hormone concentration and related signaling pathway gene expression under short-term drought stress suggesting a limited importance of hormone signaling in the post-transcriptional regulation of *IspS*.

To get insight into the role of plant hormone in the long-term control of isoprene emission, next study monitored isoprene emission from *F. septica* leaves, plant hormone concentration and signaling gene expression, MEP pathway metabolite concentration and related enzyme gene expression throughout a year in the field conditions. Isoprene emission largely paralleled with the air temperature and light intensity of the field showing higher emission in summer season (Jul. to Oct) and low or negligible emission rate in winter season (Dec. to Mar.). This seasonality of isoprene emission was mainly driven by temperature and light-dependent changes in substrate availability via the MEP pathway and transcriptional and post-transcriptional regulation of *IspS*. Seasonality of isoprene emission modulated plant hormone profiles due to trade-off between isoprene and hormone biosynthesis. This was most clearly manifested with the profile of cytokinins with decrease in summer and increase in winter season. Among the MEP metabolites, only HMBDP showed a positive correlation with the concentration of cytokinin suggesting that HMBDP and its biosynthesis enzyme *HDS* play a role in the channeling of MEP pathway metabolite to cytokinin biosynthesis. These observations on hormone profile, *IspS* gene expression, MEP pathway metabolite and related gene expression prompted the authors to postulate a putative feed-forward control of isoprene biosynthesis by cytokinins. The hormone balance of IAA/JA-Ile nor respective transcriptional factor *SAUR21/MYC2* suggested to be a factor for short-term transcriptional regulation of *IspS* gene showed no correlation with *IspS* transcript and isoprene emission under long-term natural conditions. This study thus extended our previous study and revealed the difference between short- and long-term hormonal regulation of isoprene biosynthesis and emission from the tropical tree *F. septica*.