A02 – Tree and palm water use characteristics in rainforest transformation systems

Alexander Röll[1], Furong Niu[1], Afik Hardanto[1,2], Andrea Hanf[1], Heri Junedi[3], Herdhata Agusta[4], Hendrayanto[4], Dirk Hölscher[1]

[1]Georg-August-Universität Göttingen, [2] Universitas Jenderal Soedirman, Purwokerto, [3]Universitas Jambi, [4]Institut Pertanian Bogor

Contact: aroell@gwdg.de

DFG Deutsche Forschungsgemeinschaft

Introduction

Rainforest transformation most likely alters ecosystem water cycles with respect to

- the magnitude of fluxes,
- the spatial heterogeneity and
- the temporal variability.

We studied patterns and differences in tree and palm transpiration in oil palm plantations and on forest reference sites.

Picture 1: Sap flux installation at forest reference site.

Picture 2: Sap flux installation on oil palm, at least four leaves measured per palm.

Methods

- CRC forest and oil palm (9-17 years old) core plots, additionally three young (<6 yrs) and three old (>18 yrs) oil palm plots in the study region to examine effects of plantation age.
- Sap flux measurements with thermal dissipation probes (TDP) on 16 leaves (oil palm) and in the trunks of 8 trees (forest) per plot; species-specific calibration and sampling scheme for the TDP method for oil palm.

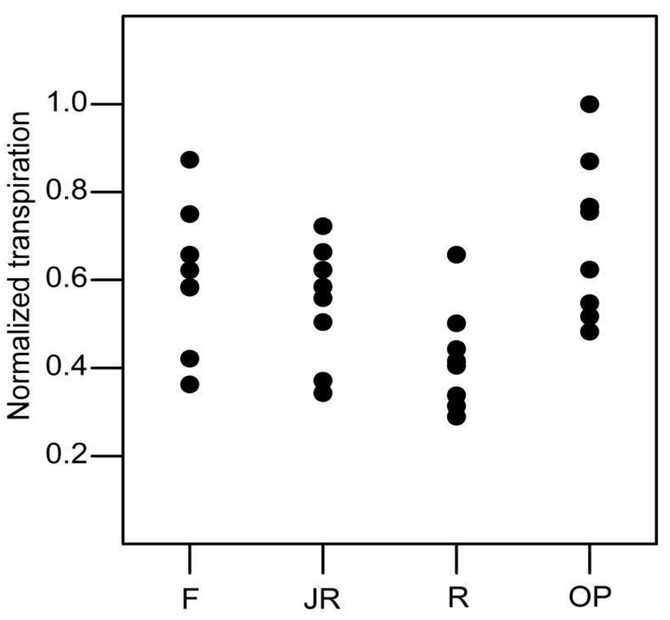

Fig 1: Between-plot variability of transpiration (mm day^{-1}) under sunny conditions; data from eight forest (F), jungle rubber (JR), rubber (R) and oil palm (OP) plots.

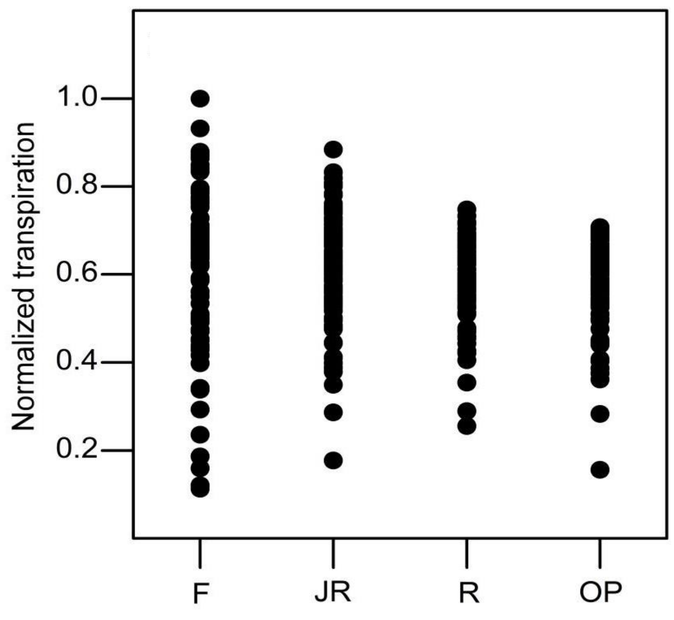

Fig 2: Day-to-day variability of transpiration (mm day^{-1}); one plot per category; 90 days, simultaneous measurements.

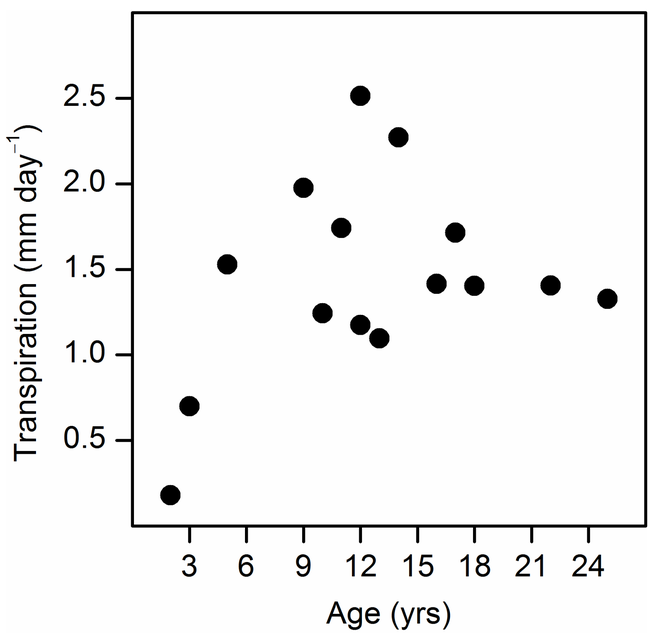

Fig 3: Oil palm transpiration (mm day^{-1}) vs. plantation age (yrs) under sunny conditions. Data of 15 oil palm plots between 2-25 yrs old.

Picture 3: Oil palm landscape in Jambi.

Results

Average stand transpiration rates and variability among plots (mean, coefficient of variation) on sunny days were similar for oil palm and forest (1.6 and 1.5 mm day^{-1}, CV 24% and 27%, respectively); transpiration was much lower for rubber (Fig.1).

The day-to-day variability of transpiration was almost two-fold higher in the forest (CV 30%) than in rubber (16%) and oil palm (CV 17%) (Fig.2).

In oil palm, transpiration rates also depended on plantation age (2-25 yrs): they increased almost 8-fold from a plantation age of two years (0.2 mm day^{-1}) to five years and then remained relatively constant. Stand transpiration among the examined stands varied 12-fold, showing particularly high variability among medium-aged stands. An intensively managed 12-year old commercial plantation had the highest transpiration rate (2.5 mm day^{-1}) (Fig.3).

Discussion

Average transpiration rates of trees and palms on oil palm and forest plots were quite similar; also, the spatial heterogeneity among the plots was similar. The temporal, day-to-day variability of transpiration was, however, two-fold higher in the forest than in oil palm, which points to a buffered response of oil palm transpiration to environmental drivers.

Acknowledgements

Supported by a grant from the German Research Foundation (DFG, CRC 990, A02). Afik Hardanto received a scholarship from the Indonesian-German Scholarship Programme (IGSP) and Furong Niu received a scholarship from the China Scholarship Council (CSC).