ABS - Water use by rubber and oil palm plantations: sap flux responses to different site conditions

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Introduction

In Asia, oil palm and rubber plantations cover large areas and are rapidly expanding. In both plantation types, there is concern about the integrity of the hydrological cycle. Our study aimed at a comparison of the water use rates of the two plantation types with respect to site conditions.

Materials and Methods

- 8 rubber and 8 oil palm plantations, 7-17 years old
- Pair-wise measurements: on a ridge and a valley bottom site; some valley bottom sites were periodically flooded
- Sap flux measurements with Granier-type thermal dissipation probes
- On oil palm, sensors were installed in the leaf petioles; 4 leaves per palm; 4 to 10 palms per plot; a species-specific calibration was applied
- For rubber, 2 sensors per tree were installed, 6 to 10 trees per plot; original calibration equation used

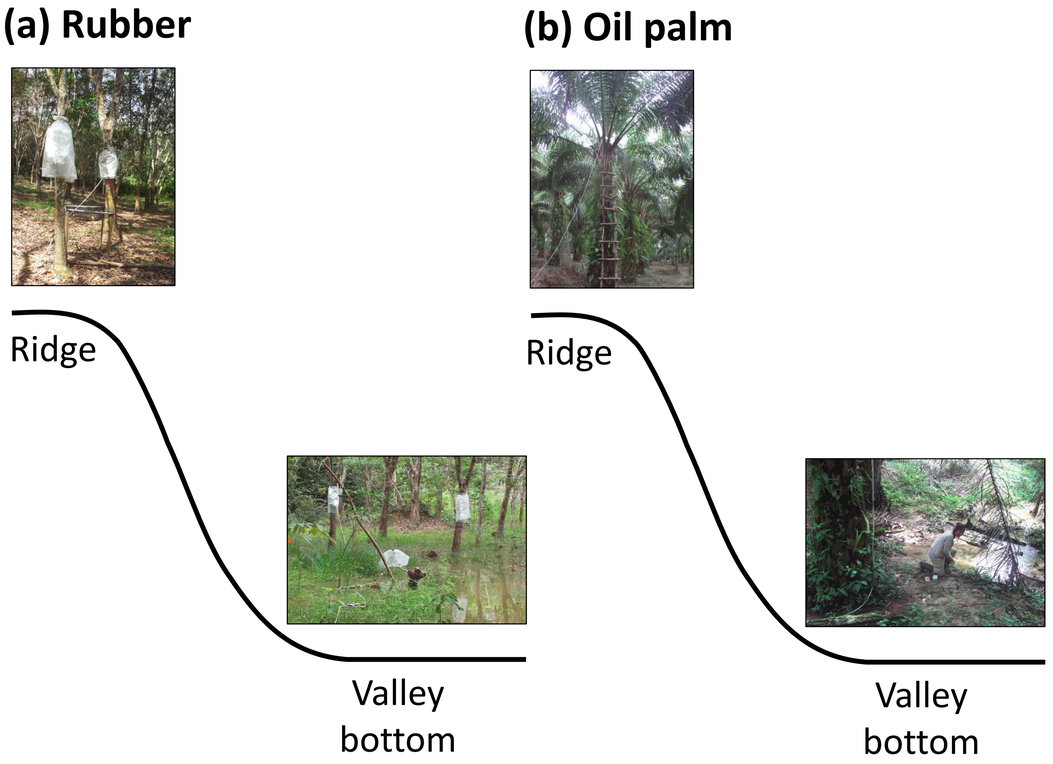

Fig. 1. Research sites on ridges and in valley bottoms for rubber (a) and oil palm (b) plantations.

Results

Sap flux density under non-flooded and flooded conditions

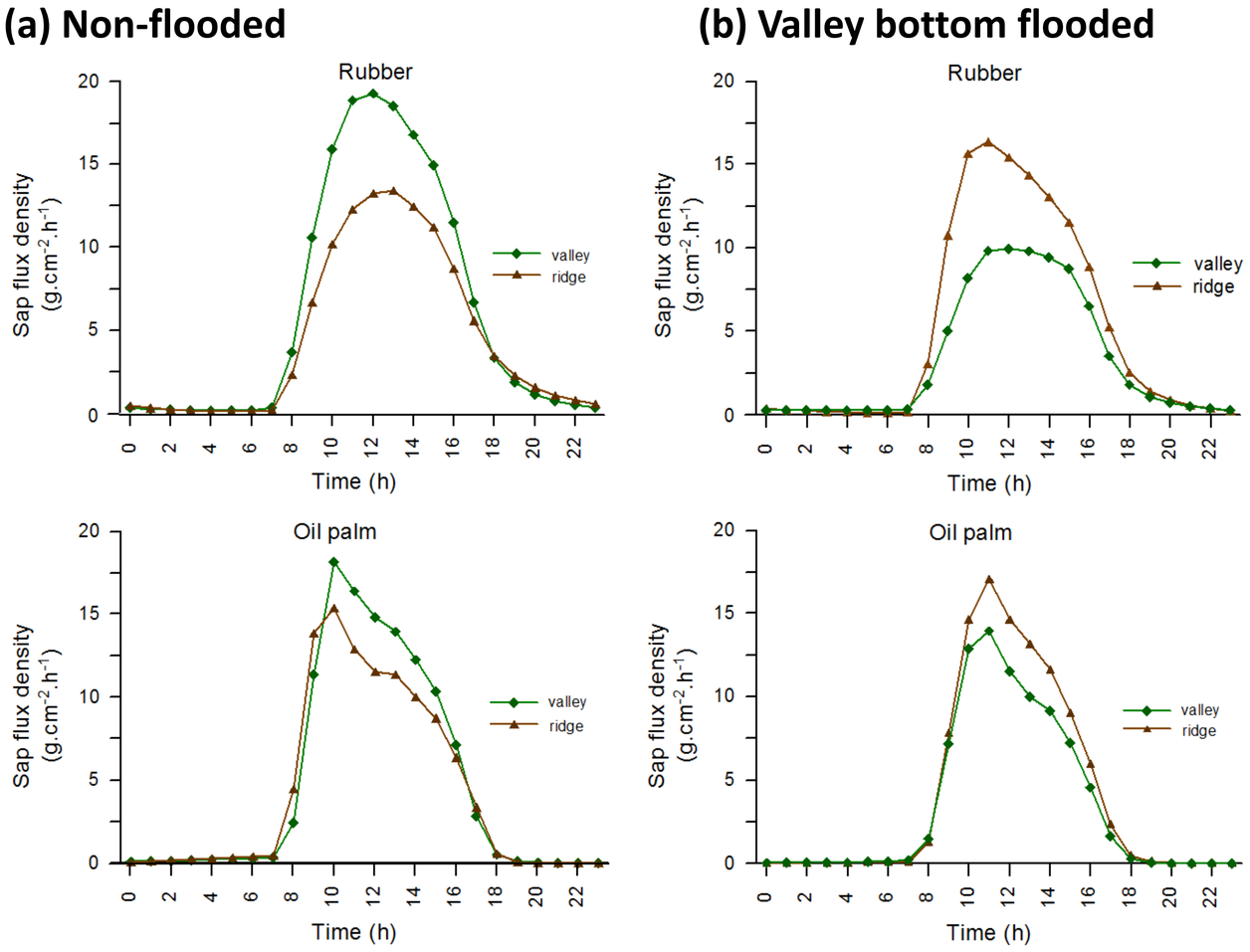

Fig. 2. Sap flux density (averages) of rubber and oil palm trees on neighboring plots, on the ridge and at the valley bottom, respectively; under non-flooded (a) and valley bottom flooded (b) conditions.

Under non-flooded conditions, sap flux densities at the valley bottoms were higher than on ridges. We assume, that this is due to a higher soil moisture availability at the valley bottoms. Under flooded conditions, sap flux densities at valley bottoms are lower than on the ridges. The differences among sites were more pronounced in rubber than in oil palm.

Water use response under wet conditions

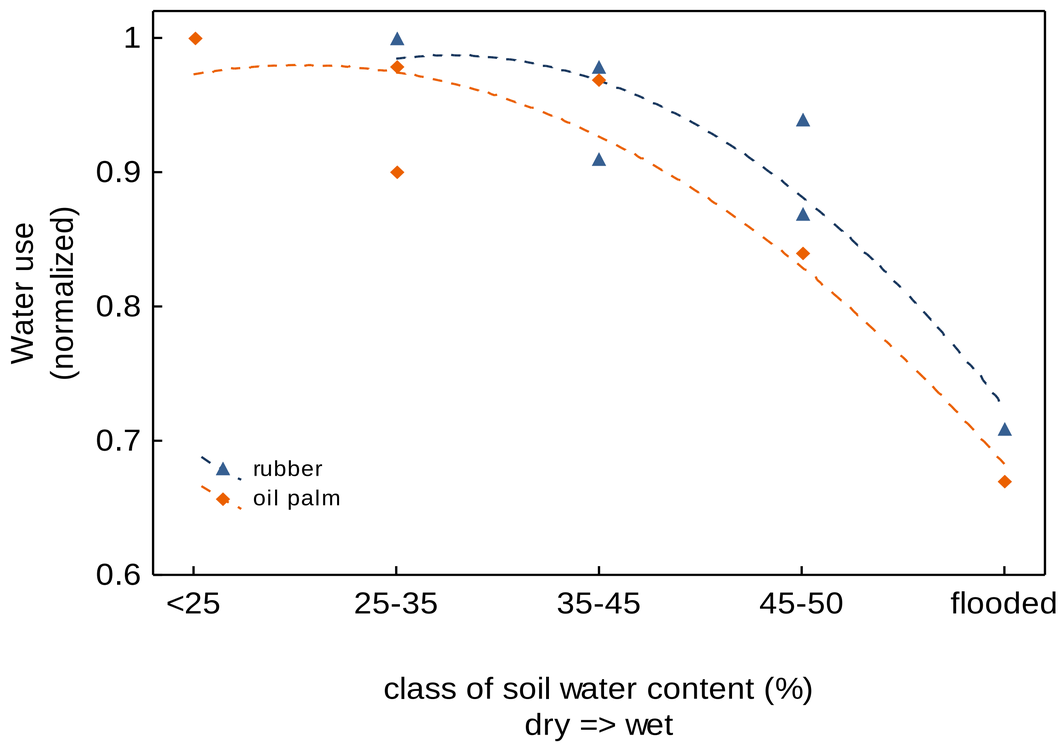

Fig.3. Water use response (normalized) of rubber and oil palm trees to changes in soil moisture content; constructed from 6 sites per plantation type.

At high soil moisture contents (>35%), plant water use decreased gradually with increasing soil water content. Under flooded conditions, water use was significantly reduced.

Conclusions

Landscape position and soil water content clearly influenced water use of oil palm and rubber plantations. When rubber trees were fully leaved, transpiration responded more sensitively to changes in soil moisture than in oil palm. Additionally, rubber transpiration showed a strong seasonality due to leaf shedding during pronounced dry periods. In consequence, oil palm transpiration seems to be more conservative towards environmental drivers than rubber transpiration.

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