Intercropping Oil Palm:
A Tree-soil-crop Interactions Model

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Objective

To explore whether in less suitable climate mixed oil palm can be an agronomic option to increase growth and production of oil palm through the role of deeper root of intercropped trees as hydraulic lift redistribution using WaNuLCAS model.

Conclusions

- In conditions with long dry period and with hydraulic lift, bunch weight of oil palm in mixed system is predicted to be higher than in monoculture system. In other words, hydraulic lift stimulates production of female inflorescence; however, it only happened during the early production stages.
- The physiology of flowering in response to water availability and growth reserve, therefore, needs further fine-tuning; process-level understanding can be used to predict complex intercropping effects and options for agroforestry in sub optimal oil palm climates.

Modeling Steps and Study Sites

1. Model parameterization,
2. Model calibration and performance evaluation by comparing measured and simulated data,
3. Explore growth and production of monoculture oil palm, monoculture cacao, and mixed oil palm-cacao in factorial design of:
   - Water hydraulic redistribution by deeper root: without and with
   - Long dry period (3 months): without and with
   - Annual rainfall: 2200, 1100, 550 mm yr-1.

Existing experiment of oil palm-based agroforestry systems, Tome-Acu, Brazil

- Survey of 25 oil palm plantations, Indonesia
- Existing experiment of oil palm monoculture, Kalimantan, Indonesia

Planting distance:
- Oil palm monoculture: 8.5 m × 8.5 m (138 palm ha^{-1})
- Cacao monoculture: 4 m × 4 m (833 tree ha^{-1})
- Oil palm and cacao in mixed system: 8.5 m × 8.5 m (138 palm or tree ha^{-1}) for both cacao and oil palm

Results and Discussion

- Growth for the whole cycle have strong relationship between measurement and simulation. FFB production have good agreement between measurement and simulation at the early production stage (at year 3 – 9), but tend to over estimate at the late production stage (Fig. 1).
- With a long dry period and hydraulic lift effect, bunch weight of oil palm in mixed system was predicted to be higher than in monoculture, however, only at the early production stage (Fig. 2). The lower production in subsequent years is due to smaller bunch size.
- Hydraulic lift can reduce the effect of long dry periods on male flower induction (Fig. 3).

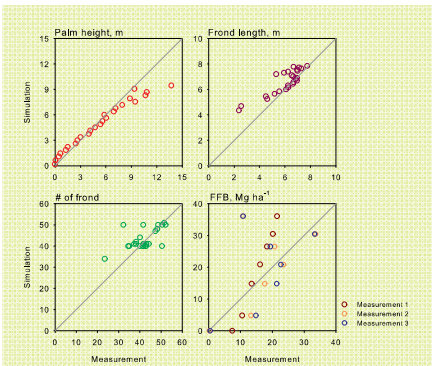

Fig. 1. Measurement vs simulation of oil palm growth and production

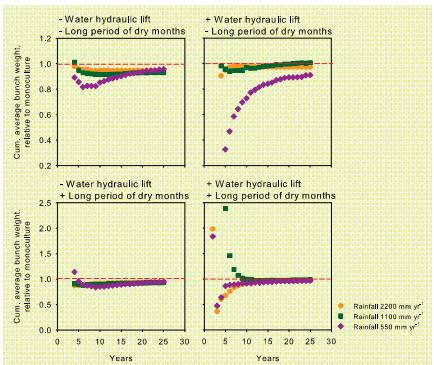

Fig. 2. Cumulative average bunch weight of oil palm in mixed system (relative to oil palm monoculture) at different conditions

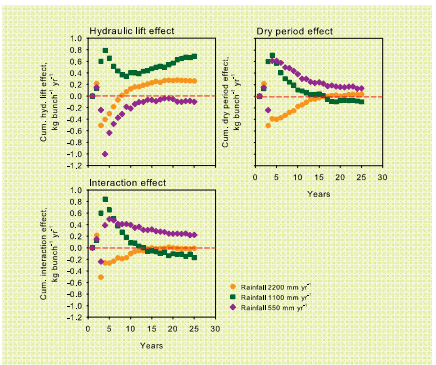

Fig. 3. Cumulative effect of each condition

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