Bern University of Applied Sciences
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HAFL Master's Thesis Abstract

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English Title: **Organic or conventional robusta coffee, grown with or without shade trees? A view from Amazonia**

English Summary:

Coffee production is currently threatened by both climate change and decreasing revenues for producers, accounting for more than 100 million people. Using shade trees might protect against temperature variability, soil erosion and excessive radiation but there may be trade-offs in productivity and quality. While impacts of shade trees on arabica (*Coffea arabica*) have been reviewed, a global synthesis on robusta (*Coffea canephora*) coffee is lacking. We conducted a meta-analysis based on literature search in Web of Science and CAB Abstracts on 16 December 2019. Thirty papers fulfilled our inclusion criteria. Shade improved robusta shrub growth and yield with some contrasting effects on physicochemical and biochemical properties. Shade (>30%) was associated with reduced beverage quality. Significant interactions between shade and location, rainfall level and robusta clone were found. Among the clones tested, 06V, C153, LB1, GG229 and JM2 showed a higher productivity and growth (from +17% to +280%) under moderate shade (41%-65%). By synthesizing data from different studies, we highlight for the first time that the effect of shade on robusta coffee depends on tree age. Shade had positive impacts on older robusta shrubs (mean of 16 years), while the impact of shade on younger shrubs was either insignificant or negative. We highlight the importance of both clone type and tree ages. Research gaps included a lack of knowledge on the effects of shade with respect to coffee and shade tree age as well as interactive effects. More in-depth studies are needed to understand the mechanisms of how shade trees affect robusta coffee.

To fill this gap, a field experiment was conducted in the Ecuadorian Amazon to investigate how growth, nutrition (leaf N), phenological state (BBCH-scale) and yield of 5-year-old robusta coffee shrubs are affected by the presence or absence of leguminous trees, the type (organic v conventional) and intensity of management. The experiment was a factorial 5 x 4 design with four cropping systems: intensive conventional (IC), moderate conventional (MC), intensive organic (IO) and low organic (LO), and with five shading systems in a split-plot arrangement: full sun (SUN), both *Erythrina* spp. and *Myroxylon balsamum* (TaE), *M. balsamum* (TIM), *E.* spp. (ERY) and *Inga edulis* (GUA). Three monthly assessments were made. Cherry yields of coffee shrubs under moderate shade (c. 25%) were similar to those under high light exposure. Coffee shrubs grown with either *E.* spp. or *I. edulis* were taller (+10%) and had higher leaf N concentrations (22%) than those grown without consistent shade. Unless receiving c. 25% of shade, coffee shrubs grown under organic cropping systems showed reduced growth (25%). No correlation was found between height, cherry yield and leaf N. Both shading and cropping systems affected leaf N concentration, also depending on phenological state and yield. Further research is needed to confirm our findings in the long-term as well as to elucidate how leguminous trees may induce physiological responses in robusta coffee under humid tropical conditions.

Keywords: *Coffea canephora*, yield, meta-analysis, growth, leaf N, shade, agroforestry

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