Impacts of climate change on coffee pests and diseases in the Jimma Highlands and Mount Kilimanjaro, Tanzania.

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Moshi,
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Climat Change

Climat

Environment
(variability from transect or laboratory source)

Microclimat

Plant Physiology
(fruit load; fruit drop)

Diseases

Pests

CHIESA WP5:
2100 m

1500 m

30 coffee plots

Micro climate

μ-Temperature
μ- Relative Humidity

AFType-1
AFType-2
AFType-3
AFType-4
AFType-5
Temperature gradient from Control Weather Stations; 2012-2014 data

Temperature gradient from farm data; 2012-2014 data.

Difference Climate – Microclimate Temperature
Canopy Cover assessment

The graph below shows the Canopy Cover (%) over different plots for two different months: October and May. The x-axis represents the plot number, ranging from 0 to 30, while the y-axis represents the Canopy Cover percentage, ranging from 0 to 90.
<table>
<thead>
<tr>
<th>Plot</th>
<th>Microclimate</th>
<th>Loggers data</th>
</tr>
</thead>
<tbody>
<tr>
<td>20m x 20m</td>
<td>250m x 250m</td>
<td>1km x 1km</td>
</tr>
<tr>
<td>LAI measurements</td>
<td>Veg. Index</td>
<td>LST</td>
</tr>
<tr>
<td>Plot shade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LULC</td>
<td>Edge Index</td>
<td></td>
</tr>
<tr>
<td>2m x 2m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Time series: 3 years*
CBD and berry drop
Coffee Leaf Rust

Coffee Leaf Rust Incidence; March 2013 (~ 2 months)
CBD; berry drop

CLR; spot per leave
Climate projection; Jimma transect.

Eight driving GCMs and two IPCC-AR5 representative concentration pathways (RCP4.5 and RCP8.5) 30 arc-seconds resolution (928 m).

Average Annual Temperature **1950-2000** (WorldClim v1.4)

Average Annual Temperature projected **2055** (RCP 4.5)

Average Annual Temperature projected **2085** (RCP 4.5)

Main pests of coffee in East Africa

Coffee berry borer
*Hypothenemus hampei*
- World production losses
  500 millions USD/year

Coffee stem borer
*Monochamus leuconotus*
- Major pest of coffee in East Africa

Antestia bugs
*Antestiopsis* spp.
- Major pests for Arabica coffee in African highlands
Contrasted relationships with elevation (field)

**Berry infestation rate (%)**
- Elevation (m asl): 1100, 1200, 1300, 1400, 1500, 1600
- Berry infestation rate (%): 0, 0.2, 0.4, 0.6, 0.8, 1

**Stem infestation rate (%)**
- Elevation (m asl): 1100, 1200, 1300, 1400, 1500, 1600
- Stem infestation rate (%): 0, 1, 1.5, 2

**Antestia/tree**
- Elevation (m asl): 1100, 1200, 1300, 1400, 1500, 1600
- Antestia/tree: 0.5, 1, 1.5, 2, 2.5
Contrasted impact of agroecological factors (field)

Contrasted impact of shade on infestation

Impact of shade depends also on elevation

CSB
++

Antestia bugs
+

CBB
−
Impact of temperature on pest populations (Lab)

Growth rate per generation for a reared population of Antestia bugs
Modelling the impact of temperature to predict distribution

**Temperature °C**

**Development time (Days)**

**Cumulative mortality rate (%)**
Research is still ongoing:

- Development of global phenological models for coffee pests based on temperature and life table parameters (including development, mortality, fecundity)

- Distribution maps based on the phenological models for the pest in East Africa, for current temperature maps and under the different climate change scenarios

- From field work, include other agroecological factors in the distribution models (shade, coffee fruiting cycle)

- Definition of shade management recommendations for the mitigation of climatic warming
Thank you very much!