Long term Research and Technology Transfer to Increase Cacao Productivity at Mars, Incorporated

Genomics based breeding, and enhanced productivity

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The Problem:

Low productivity continues to be an issue due to:

- Ageing trees, pest and disease vulnerability, farmers’ lack of access to inputs
- Declining soil fertility and lack of access to and knowledge about appropriate fertilizers practices
- Lack of knowledge and training access on good agricultural practices (GAP)

Lack of support for **long term research and technology transfer**
MARS Response to these difficulties have been:

- Long term research
- Technology transfer
- Enhancing impact assessment
- Enhancing the productivity aspects of certification
- Public-private partnerships such as CocoaAction
Breeding has the potential to provide a step change on productivity:

**Cotton**

\[ Y = 443.9 + 9.46X \]

**Corn and Cocoa Yields Over Time**

Source: USDA, ICCO
Genes determine traits combination
• Thousands of genotypes under evaluation

• Dozens of clones selected for various combinations of high yield, disease resistance and quality traits
Long Term Cacao Research is Needed:

**Pruning parameters in grape (Jackson 2008)**

<table>
<thead>
<tr>
<th>Character assessed</th>
<th>Optimal Value</th>
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<tbody>
<tr>
<td>Canopy width</td>
<td>300-400mm</td>
</tr>
<tr>
<td>Shoot characters</td>
<td>10-15 nodes</td>
</tr>
<tr>
<td>Lateral development</td>
<td>Less than 5-10 lateral nodes total per shoot</td>
</tr>
<tr>
<td>Ratio of leaf area to fruit mass</td>
<td>~10cm²/g (range 6-15 cm²/g)</td>
</tr>
<tr>
<td>Ratio of yield to canopy surface area</td>
<td>1-1.5 kg fruit/m² canopy surface</td>
</tr>
<tr>
<td>Ratio of yield to total cane mass</td>
<td>6-10</td>
</tr>
<tr>
<td>Internode length</td>
<td>60-80 mm</td>
</tr>
<tr>
<td>Ratio of total cane mass to canopy length</td>
<td>0.3-0.6 kg/m</td>
</tr>
</tbody>
</table>

**Pruning in Cacao**
### Why Long Term Research Support is Needed:

- Cacao has a long biological cycle; projects with funding under five years generally have no time to achieve their goals.

- The original genetic diversity in the center of origin of the species is disappearing due to deforestation and the international germplasm collections lack of funding as a consequence, trees representing unrecoverable genetic diversity are dying.

- Research funding in cacao producing countries is very limited.

- Research institutes outside cacao producing countries (i.e., CIRAD, CABI, USDA, etc.) have no longer or have decreased cacao research programs.

- Research is implemented on small plots and results get rarely scaled out.
The CDC/CVC Concept:

**Research**
- Development / Identification of High Yielding Clones
- Planting Material Propagation
  - Development of a critical mass of budwood for its distribution to farmers
- Centralized budwood gardens,
  Somatic Embryogenesis

**Transfer**
- Cocoa Development Centers (CDCs):
  - Demonstration of farm rehabilitation and Good Agricultural Practices and coaching
- Cocoa Village Center (CVCs):
  - Sell inputs and services (includes decentralized clonal gardens/nurseries), run by a trained individual from the cocoa community:
  - The Cocoa Doctor
CDC/CVC in Indonesia

Cocoa Doctor at its own CVC

Farmer after rehabilitating through side grafting using improved planting material (yields tripled 3 years from grafting)
CocoaAction

The challenges resulting in low productivity (including the needs for long term research) are too big and complex for one actor alone to tackle. A collaborative effort among all the actors of the cocoa sector is needed.

CocoaAction, a strategy with high ambition, to bring the industry sustainability efforts to the next level.
Thank You!