Technologies for Managing Fall Armyworm: Lessons from Brazil

Speakers: Antônio Álvaro Corsetti Purcino, Embrapa Maize and Sorghum; Joseph Huesing, USAID Bureau for Food Security
Moderator: Julie MacCartee, USAID Bureau for Food Security
Date: August 22, 2018
Dr. Antônio Álvaro Corsetti Purcino is the General Director of Embrapa Maize and Sorghum, Brazil’s premiere research organization. He received his PhD from Oklahoma University, completed postdoctoral research in Japan and the US and has published more than 40 research papers in scientific journals.
Joseph Huesing, U.S. Agency for International Development

Dr. Joseph Huesing is Senior Biotechnology Advisor for the USAID Bureau for Food Security. He has spent much of his career in the biotechnology industry where he held positions in Gene Discovery, Intellectual Property and Regulatory Affairs. He was also Director of the Science Project Management and Leadership Masters Degree Program at Webster University where he educated scientists in the art of Project Management. A former Adjunct Associate Professor of Entomology at Purdue University he supported biotechnology efforts in the developing world. With a background in Integrated Pest Management, he won the prestigious Entomological Society of America Team IPM award in 2013.
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Fall Armyworm in Africa: A Guide for Integrated Pest Management

Follow The Guide!!
Integrated Pest Management (IPM)

The IPM TRIANGLE is Your Framework!

- Host Plant Resistance (HPR) (Conventional & Biotech)
- Cultural Controls
- Biocontrol (BioC)
- Pesticides (Conventional & Biopesticides)

Maize Grain Is Your Protection Goal
Integrated Pest Management (IPM)

Two concepts:

- **Economic Injury Level (EIL)**
  - The smallest number of insects (amount of injury) that will cause yield losses equal to the insect management costs.

- **Economic Threshold (ET)**
  - The pest density at which action should be taken to prevent an increasing pest population from reaching the EIL.

To Calculate the ET & EIL We Need to Know:
1) Value of the crop yield
2) Cost of the treatment: active ingredient, labor & risk

It’s All About Economics
Pre-Scouting (Prepare)
- Host Plant Resistance
- Agronomics
- Cultural Controls & Landscape Management
- Biocontrol

Post-Scouting (Respond)
- The goal is NOT to Spray!
- Pesticides
- Mechanical control
- Biocontrol

Damage Level = ET
Take Action
<table>
<thead>
<tr>
<th>Technology</th>
<th>Efficacy</th>
<th>Safety</th>
<th>Cost relative to current costs in Africa</th>
<th>Needs prior to implementation</th>
<th>Years to launch</th>
<th>Scalable in Africa?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host plant resistance (HPR)</td>
<td>++</td>
<td>✔</td>
<td>✔</td>
<td>None</td>
<td>Minimal</td>
<td>✔</td>
</tr>
<tr>
<td>GM maize</td>
<td>++++</td>
<td>✔</td>
<td>✔</td>
<td>None</td>
<td>Seed dealers in place</td>
<td>0-3</td>
</tr>
<tr>
<td>Chemistry</td>
<td>+++</td>
<td>PPE needed</td>
<td>Not always</td>
<td>Higher for newer/safer</td>
<td>Applicators</td>
<td>✔</td>
</tr>
<tr>
<td>Conventional chemistry seed treatments (early stage)</td>
<td>+++</td>
<td>Some PPE</td>
<td>✔</td>
<td>Higher for newer/safer</td>
<td>Applicators</td>
<td>✔</td>
</tr>
<tr>
<td>Biocides</td>
<td>++++ if timed correctly</td>
<td>Some PPE</td>
<td>✔</td>
<td>Higher – multiple sprays</td>
<td>Applicators</td>
<td>✔</td>
</tr>
<tr>
<td>Botanicals</td>
<td>?</td>
<td>Some PPE</td>
<td>Not always</td>
<td>Depends on source</td>
<td>Applicators</td>
<td>✔</td>
</tr>
<tr>
<td>Biocontrol</td>
<td>?</td>
<td>✔</td>
<td>✔</td>
<td>Higher</td>
<td>Applicators</td>
<td>✔</td>
</tr>
<tr>
<td>Trichogramma wasp inundative release</td>
<td>++</td>
<td>✔</td>
<td>✔</td>
<td>Higher – multiple applications</td>
<td>Biofactory Extension Service</td>
<td>✔</td>
</tr>
<tr>
<td>Biocontrol</td>
<td>++</td>
<td>✔</td>
<td>✔</td>
<td>NA</td>
<td>NA</td>
<td>✔</td>
</tr>
<tr>
<td>Self-limiting insects</td>
<td>?</td>
<td>✔</td>
<td>✔</td>
<td>Higher</td>
<td>High</td>
<td>✔</td>
</tr>
<tr>
<td>Landscape management</td>
<td>++</td>
<td>✔</td>
<td>✔</td>
<td>Depends on cropping system</td>
<td>Depends on cropping system</td>
<td>✔</td>
</tr>
</tbody>
</table>
The IPM Pillars
Host Plant Resistance
Conventional & Genetically Modified

Effectiveness:
- Can provide complete control of FAW
- No safety issues

Constraints:
- Hybrid maize
- Regulated at country level
- Policies & laws need to be in place
- Requires stewardship
Generalist predators of FAW in the Americas

Predators:
- *Olla v-nigrum* (Mulsant) (Col.: Coccinellidae)
- *Hippodamia convergens* (Guérin-Méneville) (Col.: Coccinellidae) etc.
- *Doru luteipes* Scudder (Derm.: Forficulidae)
- spp. (Hem.: Reduviidae)

Effectiveness:
- Generalists attacking members of several families of insects including FAW

Constraints
- Abundant when FAW are already high;
- Often weak host specificity
- Effect only measurable on high densities of FAW

Photos: Ivan Cruz
The IPM Pillars
Biological Control – Natural & Augmentative

Known effective egg parasitoids of FAW in the Americas

Parasitoid:
• *Trichogramma pretiosum, T. atopovirilia* (Egg parasitoids)
• Mass rearing and inundative field releases ca 100,000/ha

Effectiveness:
• Reported to be effective in Brazil where in use. Good results in conjunction with pheromone based thresholds

Constraints
• Rearing technique not widely established;
• Intervention thresholds need to be adjusted to local cropping conditions
• Need for alternative host to rear large populations
• Vicinity of rearing facility / transport to release site / repetitive releases
• if cost effective opportunity for local business
• Competition with other parasitoids / predators attacking FAW?

Photos: Heraldo Negri / Divisão & Ivan Cruz
PESTICIDES

Active Ingredient (a.i.) & Efficacy, Hazard & Exposure, Quality (Fraud), Cost

Synthetics

• FORTENZA™ Duo Seed Treatment
• Upold

Botanicals

• NEEM (Azadiratin)
• Tephrosia vogelii - fish-poison-bean

Biopesticides

• Bacillus thuringiensis (Bt)
• Spinosads – (Saccharopolyspora spinosa)
• Avermectins macrocyclic lactones (Streptomyces avermitilis)
• SfNPV

Note About Generics
Risk assessment and field data will isolate the pesticides that meet the needs of African farmers.

- 61 pesticides recommended against FAW in Africa
- 8 are Highly Hazardous
- 22 high risk to aquatic life
- 12 to wildlife
- 24 to pollinators
- 4 to bystanders
- 10-15 lower risk
- Lower risk
- 6-10 efficacious and low risk

Where we started vs. Where we are now:

Pesticide selection process
Summary

• Follow the FAW Pest Management Guide
• Use the IPM Triangle - It’s the key
• Scouting & Economics
• Technologies – Integration is key
Corn Crop in Brazil and Management Control Technologies for *Spodoptera Frugiperda*

Antonio Álvaro Corsetti Purcino, Ph.D
Director, Embrapa Maize and Sorghum
Sete Lagoas, Brazil
Embrapa Maize and Sorghum Research Center
A Small Family Farm in Brazil
Transformation of the Brazilian “cerrado” in 40 years

“...1972 ... most of the country was then regarded as unfit for agricultural production.”
“... In the four decades since, it has become the first tropical agricultural giant and the first to challenge the dominance of the “big five” food exporters (America, Canada, Australia, Argentina and the European Union).”

Source: The Economist, 08/26/2010
Social Impacts of Technology and Agriculture in Brazil

Main impact of production increase and diversity of Brazilian agriculture in the past four decades has been the assurance of a permanent supply of low-cost food for Brazilian society.

Food Basket Real Prices (Jan/1975 – Feb/2011)

Food Basket Real Price (Base 100 / Jan. 1975 – Feb. 2011)
World and Brazilian Corn Production

Brazil’s Production - 2017/18 Crop Year (MMT)

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Total</td>
<td>225.5</td>
</tr>
<tr>
<td>Soybean</td>
<td>116.6</td>
</tr>
<tr>
<td>Corn</td>
<td>88</td>
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</table>

± 91% of grain production

Corn World Production - 2017/18*
(MMT)

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<table>
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<tbody>
<tr>
<td>Total</td>
<td>1,044</td>
</tr>
<tr>
<td>USA</td>
<td>370.3</td>
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<tr>
<td>China</td>
<td>215</td>
</tr>
<tr>
<td>Brazil</td>
<td>88</td>
</tr>
<tr>
<td>Others</td>
<td>152.8</td>
</tr>
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3rd in production
2nd in export

*estimate
Unit: millions of tons
**Corn Supply and Demand in Brazil**

**Total Production:** 92.35

**Import:** 0.4

**Final Stocking:** 23.2

**Domestic consumption:** ...

- **Industry:** 8%
- **Ethanol (MT):** 2%
- **Human Consumption:** 3%
- **Other uses:** 5%
- **Losses:** 3%
- **Seeds:** 1%
- **Animal Nutrition:** 77%

**Export:** 30

**Stocking:** 18.9

**Other uses**

- **45%**
- **20%**
- **7%**
- **5%**

Sources: CONAB (2018), ABIMILHO (2017)
New intensive production systems in Brazil lead to an increase in land use efficiency: from one soybean or one maize crop a year to two crops + livestock.

<table>
<thead>
<tr>
<th>Soybean ± 42% of the time</th>
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<tbody>
<tr>
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<tr>
<td>Corn ± 50% of the time</td>
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<tr>
<td>Soybean + 2nd corn crop ± 80% of the time</td>
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<tr>
<td>Soybean + 2nd corn crop + livestock ± 92% of the time</td>
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</table>
The Increased Importance of a Second Corn Crop

- 2 planting seasons – summer (first crop) and winter (second crop – “safrinha”)

Corn Production

Second crop – 70% of Brazil’s total corn production in 2017/18 (CONAB, 2018)

Sources: CONAB (2018), USDA (2018)
“Safrinha” – How Does it Work?

Soybean and corn breeding for short cycles

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<td></td>
<td>Soja (130 a 150 dias)</td>
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<td>Soja (120 a 135 dias)</td>
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<tr>
<td></td>
<td>Milho safrinha (140 a 160 dias)</td>
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<td></td>
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<td>Soja (110 a 125 dias)</td>
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<tr>
<td></td>
<td>Soja (90 a 105 dias)</td>
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<td></td>
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Kappes (2013)

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<tr>
<th></th>
<th>Brazil</th>
<th>Mato Grosso</th>
<th>Paraná</th>
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<tr>
<td>Soybean (a)</td>
<td>35</td>
<td>9,52</td>
<td>5,5</td>
</tr>
<tr>
<td>Corn Second Crop (b)</td>
<td>11,4</td>
<td>4,33</td>
<td>2,1</td>
</tr>
<tr>
<td>b/a</td>
<td>33%</td>
<td>45%</td>
<td>38%</td>
</tr>
</tbody>
</table>

CONAB (2018)
Major Technologies for Improved Crop Yields

- Crop genetics and Improvement
- Soil Microbiology
- Plant Nutrition
- Entomology and Phytopathology
- Mechanization
- Climatology
- Cropping Systems
- Pedology, Soil Physics and Chemistry
- Soil and Water Conservation
- Agronomy
- Integrated insect-pest and disease management
- Economics
- etc, etc, etc...
Access to Several Genetic Technologies

Total number of corn cultivars available in Brazil

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
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<tr>
<td>2000/01</td>
<td>206</td>
</tr>
<tr>
<td>2001/02</td>
<td>176</td>
</tr>
<tr>
<td>2002/03</td>
<td>207</td>
</tr>
<tr>
<td>2003/04</td>
<td>233</td>
</tr>
<tr>
<td>2004/05</td>
<td>230</td>
</tr>
<tr>
<td>2005/06</td>
<td>237</td>
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<tr>
<td>2006/07</td>
<td>279</td>
</tr>
<tr>
<td>2007/08</td>
<td>278</td>
</tr>
<tr>
<td>2008/09</td>
<td>321</td>
</tr>
<tr>
<td>2009/10</td>
<td>429</td>
</tr>
<tr>
<td>2010/11</td>
<td>498</td>
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<td>2011/12</td>
<td>489</td>
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<td>2012/13</td>
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<td>467</td>
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<tr>
<td>2014/15</td>
<td>478</td>
</tr>
<tr>
<td>2015/16</td>
<td>477</td>
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<tr>
<td>2016/17</td>
<td>315</td>
</tr>
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</table>

Total number of corn transgenic cultivars available in Brazil

<table>
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<th>Total</th>
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<tbody>
<tr>
<td>2008/09</td>
<td>19</td>
</tr>
<tr>
<td>2009/10</td>
<td>104</td>
</tr>
<tr>
<td>2010/11</td>
<td>136</td>
</tr>
<tr>
<td>2011/12</td>
<td>173</td>
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<tr>
<td>2012/13</td>
<td>216</td>
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<tr>
<td>2013/14</td>
<td>253</td>
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<tr>
<td>2014/15</td>
<td>291</td>
</tr>
<tr>
<td>2015/16</td>
<td>283</td>
</tr>
<tr>
<td>2016/17</td>
<td>214</td>
</tr>
</tbody>
</table>

2016/17 crop year 68% of cultivars with transgenic technology

Elaboration by Embrapa
Corn – Strategic for No-Tillage System in Rotation with Soybean

Soybean after corn “safrinha” in Goiás

No-tillage system – about 32 millions hectares in Brazil

FEBRAPP and Embrapa
Integrated Crop-Livestock-Forestry Systems: 39 Million Hectares
The Future is Integrated Systems

- Brazil - the only country in the world with 3 harvests during the same year without irrigation
  - September/January – Soybean
  - January/May – Crop intercropped with tropical forage
  - June/September – Livestock

Up to 90% of grain crops and meat produced in the same area using no-tillage system

Corn Intercropped with tropical forages simultaneously

“Green Bridge” provides food for insect pests year around
Thank You!

Antonio Álvaro Corsetti Purcino
cnpms.chgeral@embrapa.br
+ 55 31 3027-1101
Questions and Answers
Coming up on Agrilinks!


3. Join the Conversation on Trends & Challenges in Ag Extension on Agrilinks this September! Follow [agrilinks.org](http://agrilinks.org) all month for special events, a blog series and more.
Contact: jmaccartee@usaid.gov

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