Natural enemies of Fall Armyworm in eastern Africa: Parasitoids and Predators

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Presentation Outline

• Integrated Pest Management (IPM) of FAW

• Biological control agents
  • Predators
  • Parasitoids
    • Bio-pesticides

• Use of Parasitoids in FAW management
  • Optimization of the parasitoid production as an IPM strategy
  • Release and recovery of the parasitoids

• Conservation of the natural enemies
Integrated Pest Management Strategies for FAW
Why IPM on FAW?

- Reduced application of pesticides
- Reduced chances of pesticide resistance
- Chemical residues below maximum residue level (MRL)
- Benefits of IPM:
  - Reduced costs of production
  - Conserves natural enemies
  - Minimizes environmental pollution
Biological control of FAW
Biological control

• **Biological control**: component of IPM strategy involving control of pests (insects, weeds or plant diseases) using other organisms.

• Biocontrol focuses on **reduction of pest populations** using natural enemies; with involvement of active human role

• **Biological control agents (BCAs)**: are living organisms that infect and kill or prey on the pest
Biocontrol Cont…. 

- **Natural biocontrol**: reduces population of the pest with no human intervention

- **Applied biocontrol** involves natural enemies and manipulation by humans.

  1. **Classical biocontrol**: exotic species imported and released

  2. **Augmentation biocontrol**: periodic releases of natural enemies into the pest habitat; to boost the naturally occurring populations

  3. **Conservation biocontrol**: fosters existing natural enemy populations indirectly by making the environment more favorable for natural enemies
Advantages of biological control

- Quite specific to the target pest, related pests
- No resistance development
- No effect on non target organisms
- No build-up of toxin in the food chain
- Safe to growers, other consumers, environment and ecosystem service providers
- Can be cheaper than chemical pesticides when locally produced
Biological control agents of FAW

- The BCAs of FAW include:
  - Predators
  - Parasitoids
  - Insect pathogens
Predators as BCAs
Predators

- Earwig
- Stink bug
- Lady beetles

- Ants crawl up the plants, whorls and drag out FAW larvae
- Conserved through application of fish soup into their maize fields
Parasitoids as BCAs
Parasitoids

- They are species whose immature stage develops on or within a single insect host, ultimately killing the host.

- Many species of wasps and some flies are parasitoids.
Research on parasitoids of FAW

First report of the fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae), natural enemies from Africa

Birhanu Sisay\textsuperscript{1,2,3} | Josephine Simiyu\textsuperscript{4} | Peter Malusi\textsuperscript{4} | Paddy Likhayo\textsuperscript{4} | Esayas Mendesil\textsuperscript{4} | Nsami Elibariki\textsuperscript{5} | Mulatu Wakgari\textsuperscript{2} | Gashawbeza Ayalew\textsuperscript{3} | Tadele Tefera\textsuperscript{1}?

A Guide to Biological Control of Fall Armyworm in Africa Using Egg Parasitoids
New association of natural enemies from Africa

First report of the fall armyworm, Spodoptera frugiperda (Lepidoptera: Noctuidae), natural enemies from Africa

Birhanu Shaye1,2,3 | Josephine Simiyu4 | Peter Malusi1 | Paddy Likhayo1 | Eusayos Mendess1 | Nsami Elbariki2 | Mulatu Waniel1 | Gashawbeza Ayalew2 | Tadele Tefera1

Cotesia icipe
Chelonus curvimacularus
Charops ater
Palexorista zonata
Coccydium luteum

ETHIOPIA
KENYA
TANZANIA
Parasitoids of FAW in East Africa

- *Telenomus remus*
- *Trichogramma chilonis*
- *Charops sp*
- *Coccygidium luteum*
- *Chelonus curvimaculatus*
- *Cotesia icipe*
- *Palexorista zonata*
Performance of the parasitoids on FAW
About 70% parasitism (Kenya); in some cases, up to 90% parasitism of FAW eggs reported

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T. remus Cont……

- Native of Asia
- Present in most of the FAW distribution range in East, West and South Africa
- Each female T. remus produces about 270 eggs during its reproductive lifespan
- High reproductive rate: total development from egg deposition to adult ranges between 10-12 days
- Field releases should start in maize fields of 3-6 weeks crops; this maize is highly likely to get higher FAW infestation
- T. remus released at a rate of 100,000-150,000 wasps/Ha
- The number of parasitoids released can either be reduced or increased depending on infestation
T. remus Cont…..
Efficiency of *Trichogramma chilonis* on FAW eggs

Up to 30% parasitism of eggs in the field
**Trichogramma chilonis** Cont.....

- Native of Asia
- Present in East Africa
- Each female *T. chilonis* produces about 40 - 50 eggs during its reproductive lifespan
- Field releases should start in maize fields of 3-6 weeks crops; this maize is highly likely to get higher FAW infestation
- *T. remus* released at a rate of 50,000-200,000 wasps/Ha
- The number of parasitoids released can either be reduced or increased depending on infestation
Chelonus curvimaculatus on FAW eggs

- Solitary egg-larval braconid parasitizing eggs of FAW and *Spodoptera littoralis* and develops in the FAW larvae
- In the lab, up to 90% parasitism recorded (Host larval to parasitoid ratio of 1 egg mass:1 ♀, for 8 hours).
Cotesia icipe

- Solitary braconid parasitizing early FAW larval instars (L1, L2 and L3)
- Short life cycle
- Released in the form of cocoons and/or wasps
- Release ≤500 wasps or ≤600 cocoons/Ha
Parasitism of *Cotesia icipe* in the lab and field

Up to 45% parasitism of larvae in the field
**Palexorista zonata on FAW**

- Gregarious ectoparasitoid, attacking late larval FAW instars (L4, L5 and L6)
- Percent parasitism of up to 42% in the laboratory
- Mass production of the parasitoid involves the use of natural plant/artificial diet
## Diversity of Indigenous parasitoids forming new association on FAW in Africa

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Order</th>
<th>Family</th>
<th>Host Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telenomus remus</td>
<td>Hymenoptera</td>
<td>Scelionidae</td>
<td>Egg</td>
</tr>
<tr>
<td>Trichogramma sp.</td>
<td>Hymenoptera</td>
<td>Trichogrammatidae</td>
<td>Egg</td>
</tr>
<tr>
<td>Trichogrammatoida sp.</td>
<td>Hymenoptera</td>
<td>Trichogrammatidae</td>
<td>Egg</td>
</tr>
<tr>
<td>Chelonus curvimaculatus</td>
<td>Hymenoptera</td>
<td>Braconidae</td>
<td>Egg - larval</td>
</tr>
<tr>
<td>Charops sp.</td>
<td>Hymenoptera</td>
<td>Ichneumonidae</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; and 2&lt;sup&gt;nd&lt;/sup&gt; larval Instar</td>
</tr>
<tr>
<td>Cotesia icipe</td>
<td>Hymenoptera</td>
<td>Braconidae</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; and 2&lt;sup&gt;nd&lt;/sup&gt; larval Instar</td>
</tr>
<tr>
<td>Campoletis sp.</td>
<td>Hymenoptera</td>
<td>Ichneumonidae</td>
<td>Larval</td>
</tr>
<tr>
<td>Coccigydium luteum</td>
<td>Hymenoptera</td>
<td>Braconidae</td>
<td>Larval</td>
</tr>
<tr>
<td>Palexorista zonata</td>
<td>Diptera</td>
<td>Tachinidae</td>
<td>4&lt;sup&gt;th&lt;/sup&gt;, 5&lt;sup&gt;th&lt;/sup&gt; and 6&lt;sup&gt;th&lt;/sup&gt; larval Instar</td>
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Augmentative release of the parasitoids
Release of parasitoids in the field

What should you assess for before release of the parasitoids?

- Farmers’ knowledge on natural enemies; and train them accordingly
- Use of synthetic pesticides
- Level of FAW infestation in the field and the host stage (egg/larva/adult)
- Presence of the natural enemies (which parasitoid?)
- Stage of the crop
- Distance between the rearing facility and the field for transport of either cocoons or wasps

Synthetic pesticides used by farmers in Kenya

Assessing farmers knowledge and training

Stage of the crop and level of damage
Conservation of the parasitoids
Conservation of the natural enemies

• This strategy is one of the most important and readily available biological control practice available to growers

• It is essential if biological control is to work at all

• Manipulation of the environment to favor natural enemies
  1. Removal or mitigation of adverse factors
  2. Provision of lacking requisites

• Modification of adverse agricultural practices e.g. discourage pesticide applications

Disruption of natural biocontrol contributes to increased pest problems and in most cases, pest problems made worse
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