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

Samira Mohamed,Francis Obala and Subramanian Sevgan

Virtual TOT on FAW -IPM; 26th -28th August 2020

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?

Benefits of IPM

- Reduced application of pesticides
- Reduced costs of production
- Reduced chances of pesticide resistance
- Conserves natural enemies
- Chemical residues below maximum residue lev el (MRL)
- 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

- 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

SHORT COMMUNICATION

WILEY JOURNAL OF APPLIED ENTOMOLOGY

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

Birhanu Sisay[1,2,3] | Josephine Simiyu[4] | Peter Malusi[4] | Paddy Likhayo[4] | Esayas Mendesil[1] | Nsami Elibariki[5] | Mulatu Wakgari[2] | Gashawbeza Ayalew[3] | Tadele Tefera[1]

insects MDPI

Article

Fall Armyworm, *Spodoptera frugiperda* Infestations in East Africa: Assessment of Damage and Parasitism

Birhanu Sisay [1,2,3,4], Josephine Simiyu [4], Esayas Mendesil [5,6], Paddy Likhayo [6], Gashawbeza Ayalew [3], Samira Mohamed [4], Sevgan Subramanian [4] and Tadele Tefera [1,*]

[1] Plant Health Theme, International Center of Insect Physiology & Ecology (ICIPE), P.O. Box 5689, Addis Ababa, Ethiopia

A Guide to Biological Control of Fall Armyworm in Africa Using Egg Parasitoids

New association of natural enemies from Africa

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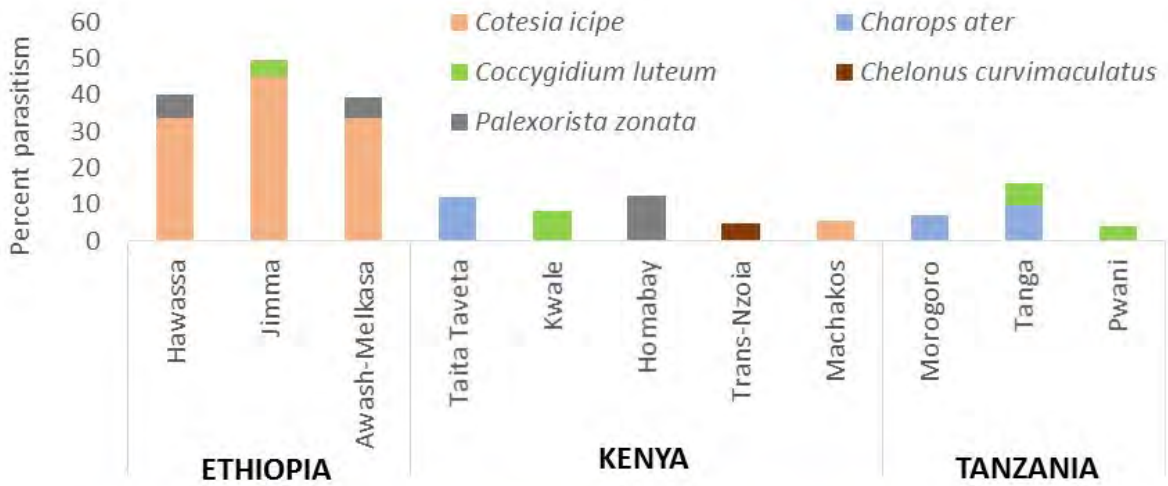


Cotesia icipe

Chelonus curvimaculatus

Charops ater

Palexorista zonata

Coccygidium luteum

Parasitoids of FAW in East Africa

Telenomus remus

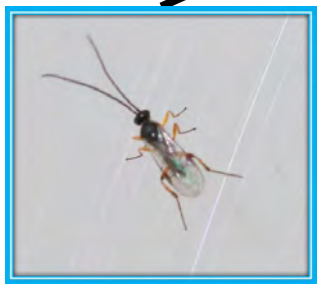
Trichogramma chilonis

Charops sp

Coccygidium luteum

Palexorista zonata

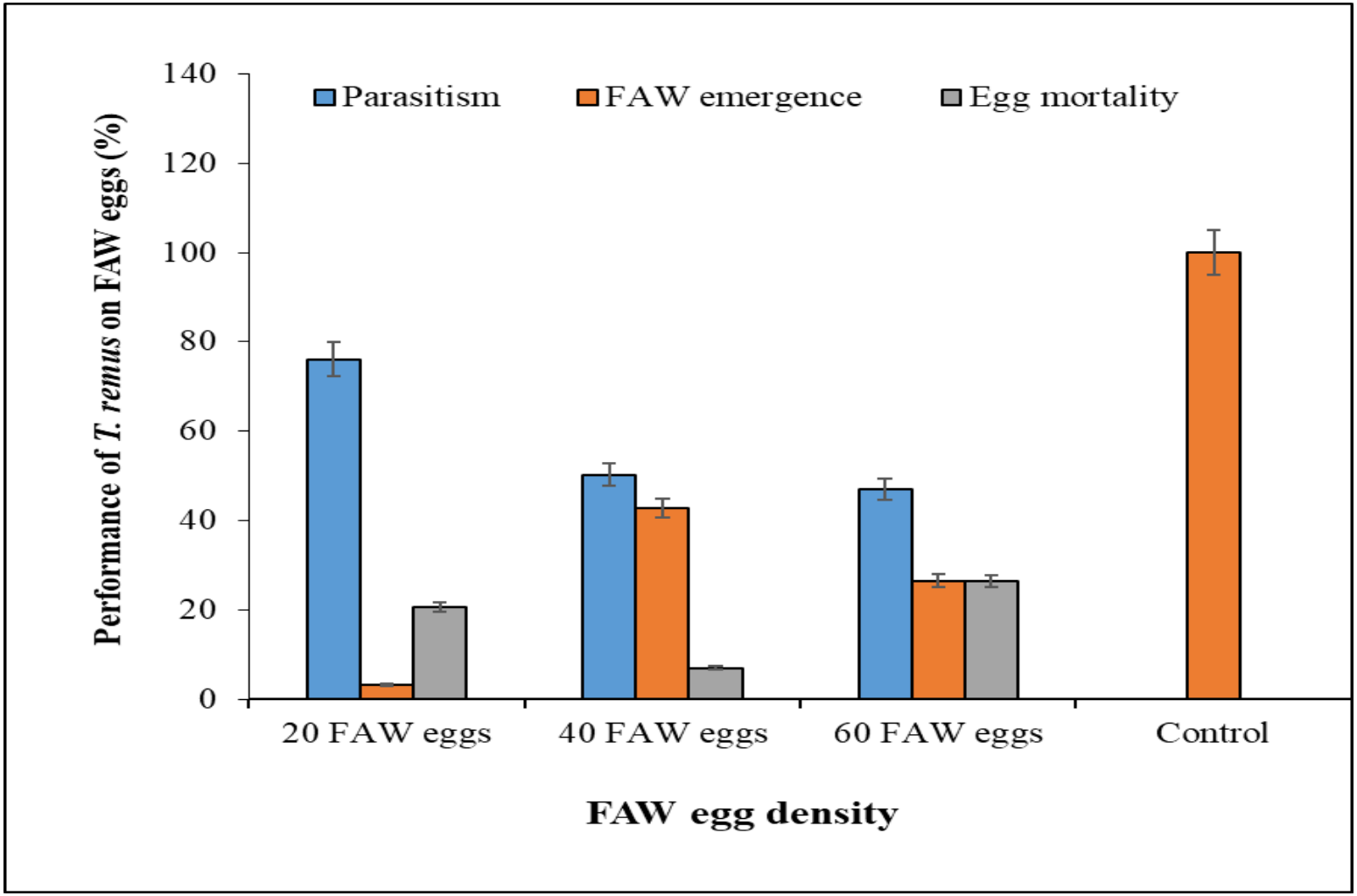
Chelonus curvimaculatus



Cotesia icipe

Performance of the parasitoids on FAW

Telenomus remus on FAW eggs in lab and field



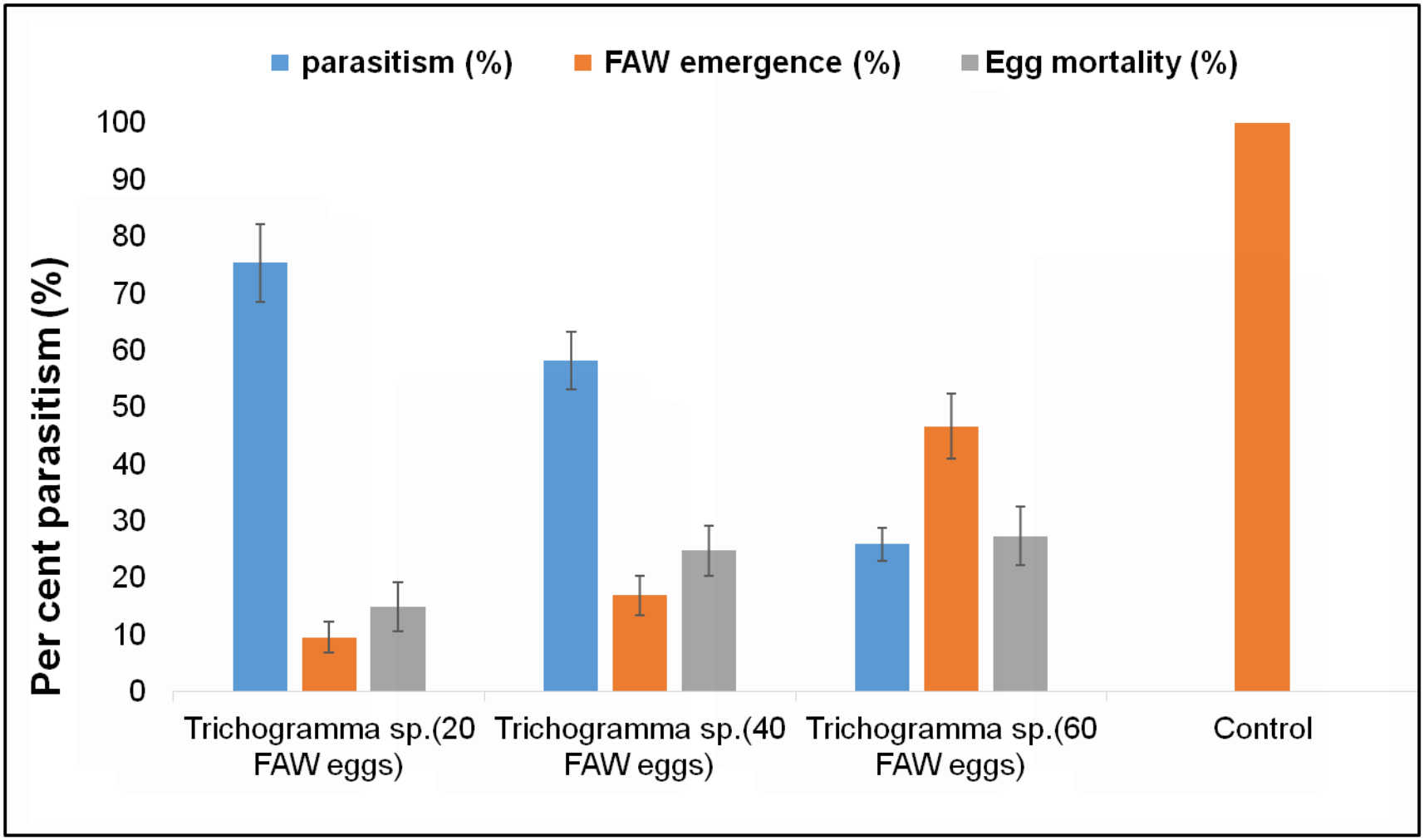
About 70% parasitism (Kenya); in some cases, up to 90% parasitism of FAW eggs reported

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).

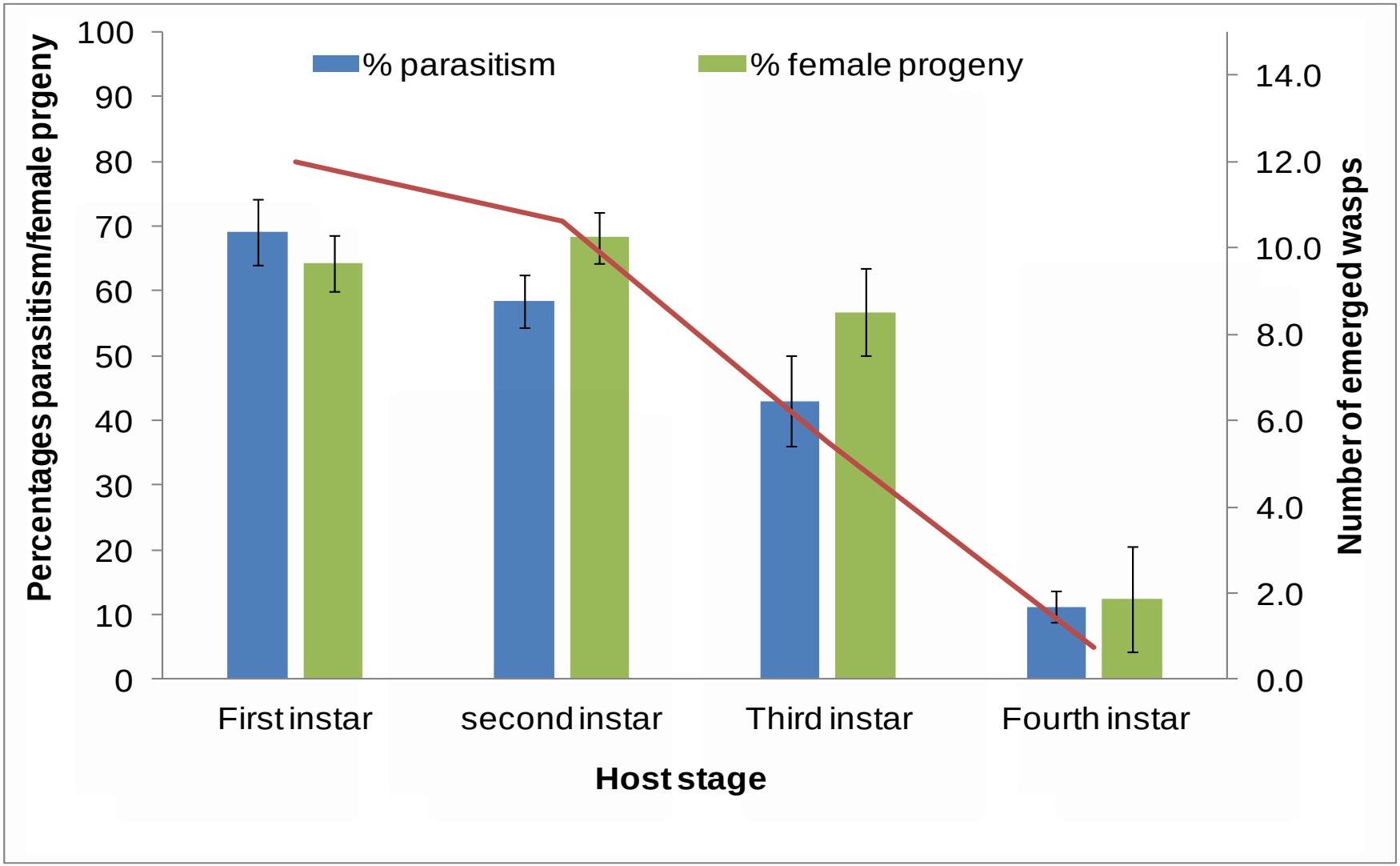
Cotesia icipe

- 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

www.icipe.org

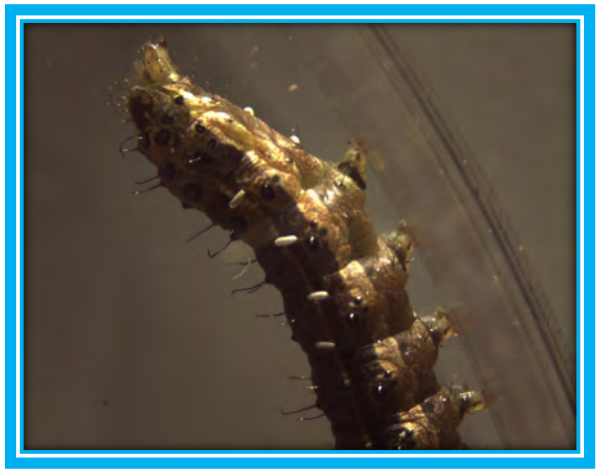
Photo: ©Francis Obala

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

Scientific Name	Order	Family	Host Stage
Telenomus remus	Hymenoptera	*Scelionidae*	Egg
Trichogramma sp.	Hymenoptera	*Trichogrammatidae*	Egg
Trichogrammatoidea sp.	Hymenoptera	*Trichogrammatidae*	Egg
Chelonus curvimaculatus	Hymenoptera	Braconidae	Egg - larval
Charops sp.	Hymenoptera	Ichneumonidae	1st and 2nd larval Instar
Cotesia icipe	Hymenoptera	Braconidae	1st and 2nd larval Instar
Campoletis sp.	Hymenoptera	Ichneumonidae	Larval
Coccigydium luteum	Hymenoptera	Braconidae	Larval
Palexorista zonata	Diptera	Tachinidae	4th, 5th and 6th larval Instar

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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International Centre of Insect Physiology and Ecology

P.O. Box 30772-00100, Nairobi, Kenya
Tel: +254 (20) 8632000
E-mail: icipe@icipe.org
Website: www.icipe.org

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