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Fruit Fly Management Activities in East Africa: State of the art

African Fruit Fly Programme
(Programme Africain de la Mouche de Fruit)

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Technical and Socioeconomic Background

- **In East Africa** the horticultural industry is very dynamic and known to be the fastest growing agricultural sub-sector

- **Horticulture** play a major role in the economy:

  - major source of income; ensures food security

  - creates job (employs over 4 million people in East Africa)

- Kenya: Horticulture earned US$1 billion in 2008 overtaking tourism as the main source of foreign exchange

- Tanzania: US$ 9.2 million

- For example, **mango** is a lucrative crop (export valued at **US$ 42 million annually**)

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Technical and socioeconomic background

- **Fruit flies cause major production constrainst to horticulture, e.g. out of 1.9 million** tonnes of mangoes produced annually in Africa about 30-50% (up to 760,000 tonnes) is destroyed by fruit flies

- **The fruit fly species** that cause the damage are very little known (*Ceratitis cosyra, C. fasciventris, C. rosa, C. anonae* and most recently *Bactrocera invadens*)

- ***Bactrocera invadens*** is an invasive species and is rapidly displacing the native *Ceratitis* species listed above

- **All these fruit fly species** also have the potential to invade other tropical regions and are listed quarantine pests

- **The huge damage** they cause is associated to lack of local expertise and affordable technologies for management of African fruit flies.

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African Fruit Fly Initiative (AFFI) – Born in 1999

Objectives…

- **Establish a regional network** on African fruit flies and link it with similar networks existing and operating in other regions
- **Assess the economic scale** and implications of the FF problem in Africa
- **Develop an IPM package** (based on bait, biopesticide, parasitoids, orchard sanitation) for management of the fruit fly complex
- **Conduct on-farm evaluation** and demonstrations of the fruit fly management technology in several countries in Africa
- **Develop locally produced alternatives** to expensive imported products (baits, biopesticides)
- **Commercialise the fruit fly management** products: baits, pathogens and traps

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AFFI Objectives …

- **Build local capacity** by creating a cadre of young African experts trained in fruit fly biology and management at MSc and PhD level

- **Organise and train National Fruit Fly Teams** in the participating African countries

- **Train large group of trainers** for technology dissemination at the national level (NARS)

- **Produce support and training** materials to be used in the participating countries for training local trainers and broadcasting the technology (in English, French and selected local languages)

- **Provide information and tools** to build local and regional capacity for rational quarantine setting and Pest Risk Analysis (fruit fly identification tools, host range databases and fruit fly distribution maps)

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AFFI Accomplishments

- A network of AFFI established (over 10 African countries, several technical agencies, regional and commodity bodies)

- Fruit infestation levels and yield losses assessed in participating countries (10-80% on mango) and colonies of the flies established

- Control and monitoring methods based on commercially available attractants evaluated and large-scale on-farm evaluation completed in 5 countries

- Food bait effective against native fruit fly species developed, which could be locally produced from locally available materials (waste brewer's yeast at 10-15% of the costs of the imported ones)

- Entomopathogenic fungi identified and tested, which could replace pesticides used in fruit fly control (potential for pesticide-free or even organic fruit growing)

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AFFI Accomplishments

- ❑ Colonies of 3 parasitoid species established and their host relations characterised
- ❑ Parasitoids shipped to California, Hawaii, Guatemala, St Helena
- ❑ Conduct studies on fruit fly behavioral ecology, population genetics and molecular identification
- ❑ Built regional capacity for quarantine setting through production and distribution of user-friendly taxonomic tools, maps of fruit fly distribution in Africa, and creation of database
- ❑Training and capacity building in progress:
  - ❑ 8 African PhD students trained and 3 others still enrolled
  - ❑15 advanced training courses organised for NPPOs/NARs
  - ❑National fruit fly teams established in 6 African countries

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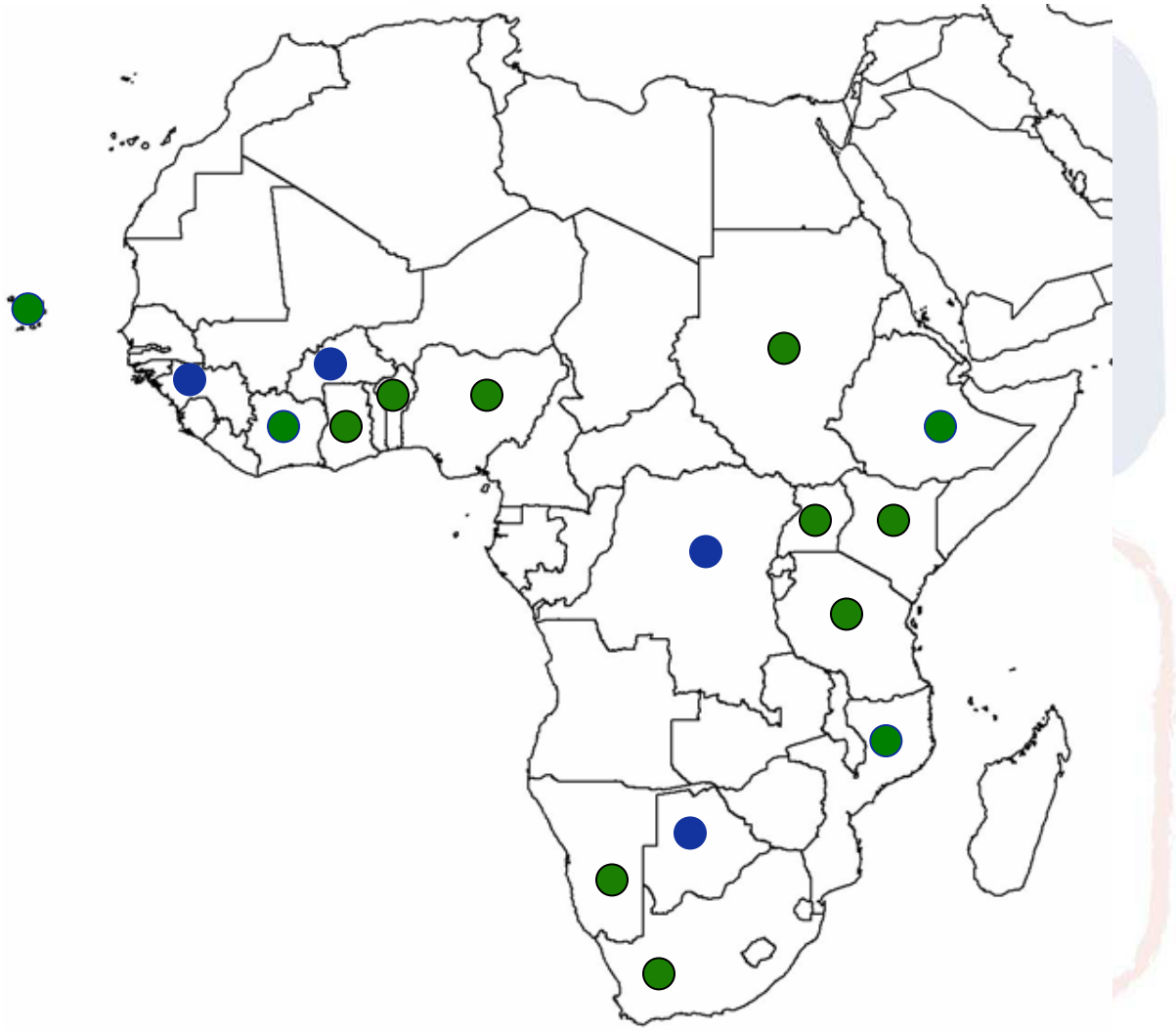
Network of AFFI Collaborators in Africa

- Kenya
- Tanzania
- Uganda
- Sudan
- Nigeria
- Cote d'Ivoire
- Benin
- South Africa
- Namibia
- Ethiopia
- Ghana
- Mozambique
- Cape Verde



Request

- Guinea
- Burkina Faso
- DRC

Core operations: Kenya, Tanzania, Uganda, Nigeria, Cote d'Ivoire

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AFFI Re-named

In 2005, AFFI was renamed African Fruit Fly Program (AFFP)

- **Core Operations (Monitoring, suppression, postharvest, capacity building)**
  - Kenya
  - Tanzania
  - Benin
  - Uganda
  - Mozambique

  } GTZ/BMZ, FAO, IAEA

- **Limited operations (Monitoring/Surveillance, MAT, Capacity building)**
  - South Africa
  - Rwanda
  - Swaziland
  - Botswana
  - Ethiopia
  - Sudan
  - Nigeria

  } USDA/APHIS, USAID, CRI, SAAGA

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Challenges

- IFAD grants ended (Main donor to AFFI)
- Follow-up funds from the CFC was put on hold
- Extensive request for network expansion and collaborators
- Increasing threats of invasive species
- Re-assessment of IPM package against new invasive
- Limited donor funding

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Project operational block

- Block 1: Bio-ecological studies
- Block 2: Classical biological control
- Block 3: IPM
- Block 4: Post harvest treatment
- Block 5: Capacity building
- Block 6: Managerial structure

2007-2010

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Accomplishments – Block 1

Block 1 – Bioecological studies

- *B. invadens* is now known from 28 Africa countries and still extending its range
- It is an emerging polyphagous pests recorded from over 40 host plants (cultivated and wild)
- Spatio-temporal distribution shows clear preference to field borders
- Morphometric studies completed and depicted that *B. invadens* could not be separated from other *Bactrocera* within the *B. dorsalis* complex.
- A total of 11 polymorphic microsatellite loci have been isolated and characterised from *B. invadens* – relevance for quarantine officers
- Annual population dynamic of *B. invadens* show a clear peak abundance between October-December with a small peak in Jun-Jul (mango fruiting period).
- Fruit infestation from the ground were generally higher than fruits collected from the tree; highlights importance of orchard sanitation

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Accomplishments – Block 2

Block 2- Classical biological control

- No native parasitoid have been found attacking *B. invadens* in over 70,000 fruits collected across sub-Saharan Africa
- Exploration of natural enemies of *B. invadens* initiated in Sri Lanka – Seven parasitoid species recovered and biological studies on target pest initiated
- Two parasitoids species (*Fopius arisanus* and *Diachasmimorpha longicaudata*) imported from Hawaii – pre-releases studies conducted and experimental releases initiated in 3 target countries
- Recovery of released parasitoid documented from Kenya and Benin.

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Accomplishments – Block 3

Output 3 – IPM technology

- Food baits effective against *B. invadens* identified, which could be produced from locally available waste brewer's yeast at 10-15% of the costs of the imported ones
- Several isolates of entomopathogenic fungi have been identified and tested, which could replace pesticides used in fruit fly and MSW control (potential for pesticide-free or even organic fruit growing)
- Application of M. anisopliae in bait stations utilizing waste brewer's yeast resulted in over 80% suppression of *B. invadens* populations
- Field suppression trials revealed up to 77% suppression of *B. invadens* and native *Ceratitis* species by combined application of GF-120 and *M. anisopliae* and mazoferm and locally available soft pesticides
- **Mazoferm** is locally available and cheap but GF-120 is not registered in E/Africa
- Male annihilation also hold significant promise in management – product not yet registered in Kenya and several African countries

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Accomplishments – Block 4

Block 4- Post harvest treatment

- On citrus, *B. invadens* development assessed
- The 3rd instar found to be the most cold tolerant stage at 1.1^{0}C
- Assessment of duration of exposure to achieve probit 9 level of mortality (99.9968) completed
- Similar protocol is being applied to avocado
- Hot treatment trials on mango underway

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Accomplishments - Block 5

Effect of soil application of different formulations of *Metarhizium anisopliae* on African tephritid fruit flies and their associated endoparasitoids

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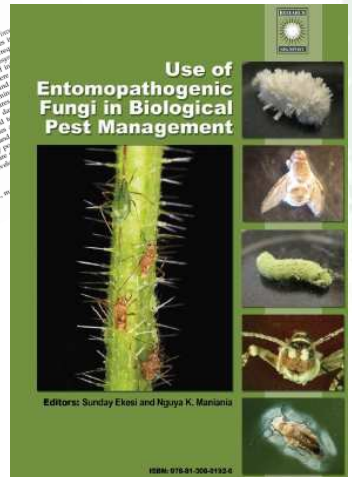

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Block 6: Managerial structure

Committee and responsibilities

1. Project Coordination committee (PCC)
2. Technical Advisory Committee (TAC)
3. Project steering committee (PSC)
4. National Fruit Fly Team (NFFT)
   - ✓ Coordination and supervision
   - ✓ Policy issues and funding mobilisation
   - ✓ Technical oversight of operations and international/national recognition
   - ✓ Monitoring and evaluation
   - ✓ Priority settings and adjustment according to resources
   - ✓ Budget control and accounting
   - ✓ Contact with donors, reporting
   - ✓ Maintenance of AFFnet

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Summary of available control options

Proven pre-harvest management options based on AFFP*icipe* research

- Systematic monitoring for pest population/trapping in key partner countries
- Baiting techniques (use of food baits such as **waste brewer's yeast**, **mazoferm, GF-120**) – apply on 1 m^2 of canopy weekly
- Male annihilation with methyl eugenol as an IPM component
- **Soil** inoculation of the fungus *Metarhizium anisopliae* at the onset of fruiting and use in **baiting stations targeting adults**
- Orchard sanitation – weekly collection of fallen fruits into augmentorium
- Release of *Fopius arisanus* (egg parasitoids) – Parasitoid culture available at *icipe* and IITA
- The above could bring down the population of *B. invadens* by over 70% (67% reduction in rejection at one benchmark site – Embu)
- **However for quarantine sensitive market, post harvest treatment will be required. Parameters are being generated for citrus, avocado, mango!**

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Lessons

- ❑ There is the need for understanding and synergy between different development partners
- ❑ Single bullet management approach is inefficient
- ❑ Interventions should be geared towards compliance with export market (also help boost domestic urban market)
- ❑ Standard required for export market increase adoption of new technologies
- ❑ Certain management packages are expensive for smallholder (need for local product development)
- ❑ Stringent market requirement (certification) threatens smallholders
- ❑ There is the need to link farmers to marketing channels
- ❑ Identify and work with successful functional farmers group to help technology diffusion
- ❑ Poor phytosanitary management skill threatens invasion by alien pests
- ❑ Commitment by regional bodies crucial to all efforts

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Proposed synergies/partnership – East & West

Subject area	*icipe*	IITA/CIRAD	CIRAD
Bioecological studies	X	X	X
Local Bait development	X	X	
Entomopathogens	X		
Classical biocontrol	X	X	
Ant technology		X	
Post harvest treatment	X		X
Technology transfer	X	X	
Capacity building	X	X	X
Databasing	X	X	
Phytosanitary magt.			X

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Thank you!