



**FEED<sup>THE</sup>FUTURE**

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# **The Role of Integrated Pest Management in USAID's Feed the Future Initiative**

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## IPM Innovation Lab Host Countries

- **Asia**
  - Bangladesh
  - Nepal
  - Cambodia
  - Vietnam
- **Africa**
  - Ethiopia
  - Kenya
  - Tanzania





## IPM IL RFAs for the New Program

- Exportable fruit crops – Vietnam
- Parthenium biocontrol – Ethiopia, Kenya, Tanzania, Uganda
- Biodiversity and climate change – Nepal
- Modeling of insect dispersal (*Tuta absoluta* and groundnut leafminer) – Africa, Asia
- Vegetable crops IPM – Bangladesh, Cambodia, Nepal
- Rice IPM – Cambodia
- Vegetable crops IPM – Ethiopia, Kenya, Tanzania
- Rice, Maize and Chickpea IPM – Ethiopia, Kenya, Tanzania



- Seed or seedling treatment with *Trichoderma*, *Pseudomonas fluorescens*, and *Bacillus subtilis*
- Solarization of seed beds and greenhouses
- Use of VAM, neem cake and other organics
- Selecting virus-resistant varieties
- Grafting on resistant rootstock for bacterial wilt, *Fusarium* and others
- Staking and mulching
- Yellow sticky traps for thrips, leafminers etc.
- Pheromone traps for *Helicoverpa* and *Spodoptera*
- Host-free period and rogueing for control of virus diseases
- Use of Biopesticides such as neem
- Use of microbial pesticides such as NPV, *Metarhizium*, and *Beauveria*



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## Coconut pith/dust use in Vegetable seedling production





## *Trichoderma* – a Beneficial Fungus

- Its use became very popular in Asia.
- IPM Innovation Lab conducted 3 workshops.
- Planning to introduce this technology into the African countries.





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# *Trichoderma* Production in Bangladesh



*Trichoderma* Production Facility



Women producing *Trichoderma* in their backyard



*Trichoderma* Packages for Market



Tricho-leachate



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## Eggplant and tomato grafting in Bangladesh



- Eggplant yield ↑ 249% in Bangladesh
- Income ↑ 305% in Bangladesh
- Technology transferred from Bangladesh to Ohio
- Technology transferred to India, Nepal, Philippines, Uganda, Indonesia, Mali, Senegal, Honduras and Kenya



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## Bacterial wilt and soil borne pathogen control

- Grafting eggplant and tomato on resistant root stock – Bangladesh, Philippines, India, Nepal, Uganda, Kenya, Honduras
- Grafting watermelon and cantaloupe on pumpkin rootstock for soil borne disease resistance – South and Southeast Asia
- Grafting naranjilla on resistant rootstock, *Solanum hirtum*– Ecuador
- Grafting tree tomato on *Solanum auriculatum* and *Nicotiana glauca* - Ecuador

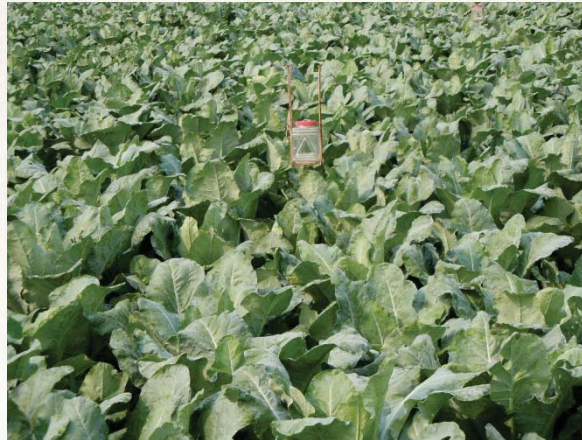




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## Pheromones for monitoring insect pests



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## IPM practice in bitter melon crop in Bangladesh

- Application of compost with *Trichoderma*
- Setting up cuelure traps
- Setting up mashed sweet melon traps
- Picking disposal of fruit fly infested fruits
- Release of parasitoids

## Area-wide management of melon fly



Cuelure trap

Mashed sweet melon trap

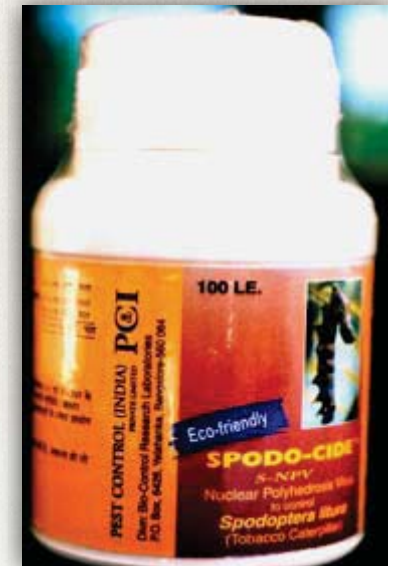




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## NPVs for *Spodoptera* & *Helicoverpa*





# Production of Parasitoids in Bangladesh





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# Biocontrol Agents Production in Honduras



Predaceous mite collection in the lab



Orius bug production



Predaceous mite production



**Neem Tree**



**Neem Flowers**



**Neem Insecticide**



**Neem seed extract production**





## Peanut bud necrosis virus of tomato

- Transmitted by thrips
- Common in India
- Rogueing is effective in controlling this virus



Peanut bud necrosis virus-infected tomato



Unrogued field



Rogued field





Healthy tomato



Virus infected tomato



Tomato yellow leaf curl virus transmitted by white flies primarily *Bemisia tabaci*

Field without host free period



Field with host free period



Host free period for 3 months is effective in reducing the incidence





## Pests of Amaranthus

Beat webworm:

- *Spoladea recurvalis* (Lep., Pyralidae)

Weevils:

- *Hypolixus pr. haerens* (Col., Curculionidae)
- *Gasteroclisus pr. rhomboidalis* (Col., Curculionidae)
- *Neocleonus sannio* (Col., Curculionidae)





## An Invasive Pest, Papaya Mealybug

- **Origin:** Mexico
- **Spread:**
  - **1990s** – Caribbean, Florida and South America
  - **2001-5** – Micronesia and Hawaii
  - **2008-9** – India, Indonesia, Malaysia, Thailand, Sri Lanka.
  - **2010-11** – Re Union Island, Ghana, Benin, Nigeria
  - **2014** – Tanzania, Mauritius, Mozambique





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## The Spread of the Papaya Mealybug

1955





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*Acerophagus papayae*, introduced for control of papaya mealybug in India, resulted in a benefit of \$500 Million to 1.34 Billion





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*Acerophagus papayae* searching the  
papaya mealybug for egg laying



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## *Tuta absoluta*

A native of South America.  
Introduced to Spain in 2006.  
Now it has spread in Europe,  
Mediterranean, Middle East,  
West and East Africa .  
Nov. 2014 – Reached India.





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## *Tuta absoluta* in Eastern Africa

Recorded in Kenya,  
Tanzania and India in 2014







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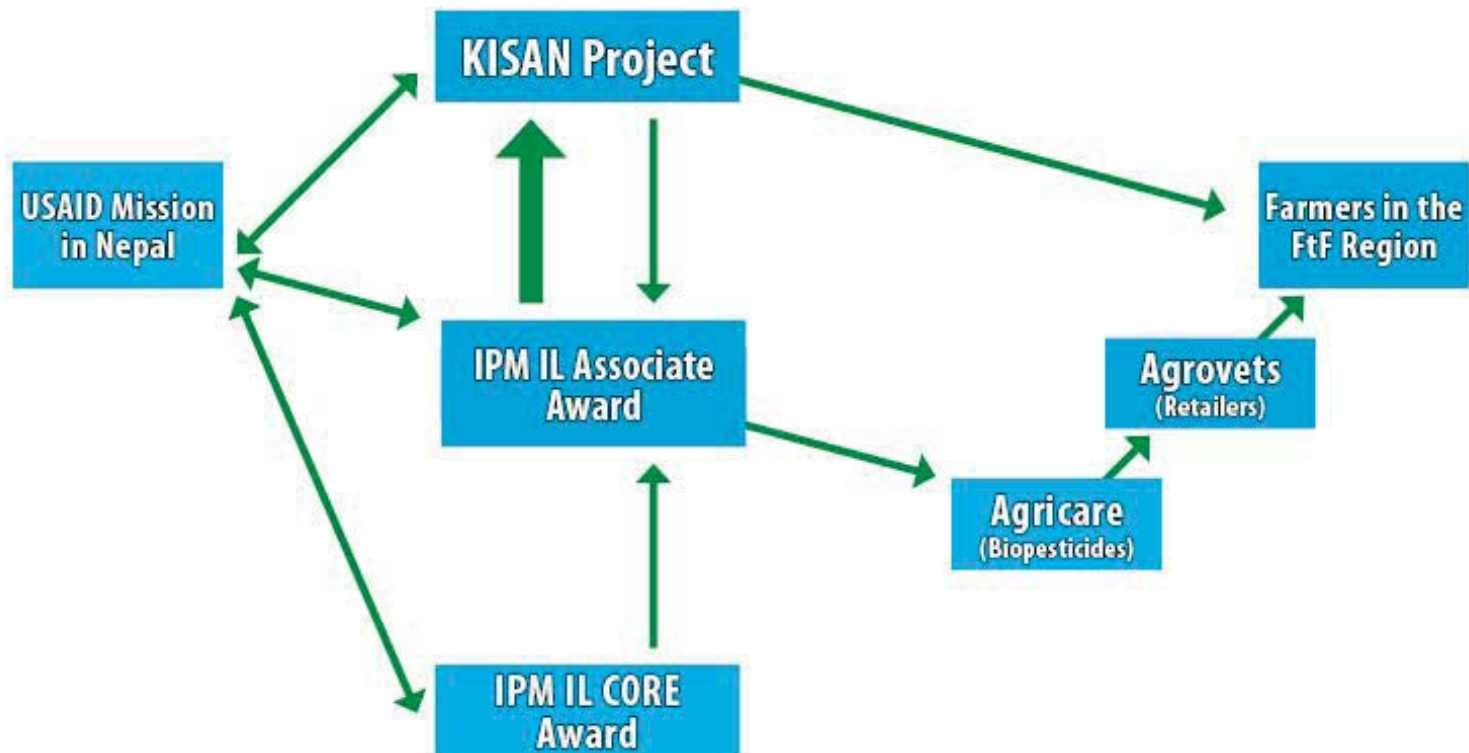
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## Spread of *Tuta absoluta*





## Technology Transfer of Trichoderma in Nepal





## Groundnut leafminer

- A native of Asia
- Introduced to Uganda in 1996
- Now covered East and South Africa
- IPM IL is working with Peanut and Mycotoxin IL.
- IPM IL issued a RFA to model spread of this insect in Africa





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# Spread of Groundnut leafminer





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## Pearl millet headminer damage in Niger





## Augmentative parasitoid releases

- Parasitoids cultured in jute bags and dispersed in millet fields
- A set of 15 bags are used to cover 5km<sup>2</sup> area





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Thank You