Kenya

Integrated Pest Management Innovation Lab country profile

Map courtesy CIA World Factbook

Population: 45 M
GDP per capita: $1,800
Feed the Future country? Yes
Involvement in this country since: 2006

Challenges:

- Weak value chains and poor IPM coordination
- Insect pests (whitefly, leaf miners, fruit borers)
- Over reliance on chemical pesticides
- Diseases (bacterial wilt, viruses, fungi)
- High postharvest losses
- Lack of clean planting material
- Water use inefficiency
- Weak disease diagnostic capacity

Related project name: Regional IPM Project in East Africa

Project overview: In Kenya the project that was started in 2006 has advanced IPM by developing technologies that improve productivity and enhance environmental and food safety of marketed horticultural crops (tomato, passion fruit, onion and banana). Dissemination of knowledge and information led to environmental safety awareness, reduced malnutrition especially among women and children, and led to higher economic benefits as a result of reduced pesticide applications and increased yields. Tomato value increased by US $8.8 million (from 2006 to 2013) in the project area (Kirinyaga County). The IPM-IL team developed a high tunnel tomato production package that contributes to sustainable intensification and food security, and whose adoption has led to increased youth involvement in agriculture.

Tomato: Grafting technology was introduced to combat bacterial wilt (BW) disease in tomato. BW resistant tomato variety MT56 received from Ugandan IPM-IL collaborators was used as the rootstock. The use of high tunnels with insect proof netting and double doors reduced pest entry and infestation. This greatly reduced pesticide use and resulted in increased marketable yields. Soil solarization using a plastic sheet cover significantly reduced bacterial wilt incidence in the high tunnel. The beneficial fungus *Trichoderma harzianum* was successfully introduced for controlling soil-borne fungal pathogens.

The IPM-IL Kenyan team developed a high tunnel tomato production package that increased marketable yields thereby contributing to sustainable intensification and food security. Comparing the effects of pest and disease incidence between grafted and un-grafted tomato in high tunnel and open field tomato production indicated that use of a high tunnel significantly reduced crop infestation by major arthropod pests specifically whiteflies, thrips and aphids and increased tomato yield. Grafted tomato resulted in significant yield increases with both production systems with incidence and losses attributed to bacterial wilt being significantly lower with grafted tomato. This demonstrates that properly managed microclimate high tunnels can limit the incidence and severity of diseases and pests and the prevalence of weeds and have a key role for small and limited-resource farmers in reducing the need for pesticides.

Low Tunnels	For seedling production, prevents diseases caused by insect-transmitted viruses and when combined with sterilized soil prevents transmission of soil-borne diseases.
Grafting	MT56 is resistant to bacterial wilt and can be used as rootstock for grafting
Varietal Screening and Registration of Resistant Variety	MT-56 resistant to bacterial wilt
Mulching	Reduces rain splatter of pathogens; reduces fruit rots and preserves moisture; reduces weed load
Staking	Keeps fruit off of the ground; reduces rain-splash infection of soil born pathogens
Weeding 1-2 times	Need for weeding reduced by mulching
High Tunnels	Prevents foliar blights transmitted by rain-splashed inoculum - Septoria blight, bacterial leaf spot (Xanthomonas); reduces rainsplatter of bacterial wilt pathogen (Ralstonia) from reaching susceptible scions of grafted plants
Soil Solarization:	Seedling damping-off (Fusarium, Pythium, Rhizoctonia, Phytopthora), bacterial wilt, Fusarium, Verticillium, root knot nematodes – limits movement of pathogens from seedbeds to field.
Chlorinated Water (100 ppm) for postharvest treatment	

Impact assessment of tomato IPM technologies in Kenya showed that soil solarization improved tomato yields by 13%. There was a significant yield increase between farmers who participated in the IPM farmer field school and non-participants at 10% level. High tunnels improved tomato yields by about 8% and there was a significant difference between participants and non-participants at the 5% level of significance. Other IPM technologies, such as grafting, improved tomato yields by 13% while proper nursery bed management improved yields by 27%. The implication of the above results is that IPM technologies improve tomato yields and that farmers who adopt the technologies are better off compared to non-adopters.

In the past year (2013-2014) two hundred (200) small scale growers, extension staff and scientists (106 males and 94 females) were trained on tomato IPM strategies which included use of superior indeterminate varieties, seedling establishment in germination trays with coconut moss and covering with insect proof netting to exclude arthropod pest infestations and soil borne diseases, use of biopesticides such as *Trichoderma* spp, and solarization of seed beds and high tunnels to manage soil borne pathogens, need based sprays with biopesticides such as Biopower (*Metahrizium anisoplae*) and Achook (Neem). Grafting with wilt resistant variety Mt 56 and production under high tunnel, mulching and staking, host free period and rogueing for control of virus diseases, post-harvest handling and value addition.

Four scientists were trained on the identification and management of the new invasive tomato pest *Tuta absoluta*. Eight hundred and sixty (400M: 460F) farmers, extensionists, policy makers, agro-chemical dealers and tomato traders were trained on identification and management of *Tuta absoluta* during a national symposium on the new invasive pest in Kenya.

Training on fungal biopesticides, *Metarrhizium anisoplae* and *Beauveria bassiana* was received by one scientist in Nepal. One thousand people (policy makers, farmers, students, scientists, extension workers and tomato traders) were exposed to training on Tuta absoluta and high tunnel tomato production during the Nairobi International Trade Fare 2014.

Passion fruit: Previously farmers lost up to 100% of their passion fruit orchards within 2 years of establishment due to diseases. Soil-borne fungal diseases including Fusarium wilt, collar rot, and stem canker were effectively controlled at farmer-managed research sites using biopesticides containing *Trichoderma* spp, sweet yellow varieties (KPF 4 and KPF 12) that were tolerant of the diseases, and grass mulch to reduce insect pests and soil-borne inoculum. Foliar diseases including brown spot and woodiness were managed through scouting and need-based biopesticide use in combination with field sanitation and pruning. Additionally, virus indexing of passion fruit planting materials can now be done comprehensively using specific primers developed under the program. Through training on the developed technologies, 60% of 1,010 farmers sampled are now able to maintain a productive crop for 4 years. Two hundred extension officers received training on technologies for integrated pest management of passion fruit. Three thousand brochures and 200 training manuals on diseases affecting passion fruit and their management were distributed to 3,000 farmers and 200 extension officers respectively. The adoption of sweet yellow varieties promoted through IPM IL led to an increase in acreage planted from 270 ha to 353 ha between 2010 and 2012, while the value of the crop increased from USD 1.8 million to 6.6 million, respectively.

Virus detection procedures were validated for establishing clean virus free passion fruit mother block seedling nursery at KARI Thika. Two primer pairs were designed and used to determine the presence of KPF virus in diseased plants using the RevertAid Firststrand cDNA synthesis kit. The two primer pairs are being used to screen and clean passion fruit plants at the KARI-Thika nursery to establish clean planting materials for distribution to growers.

Banana: Banana production in the region was threatened by a destructive disease, banana xanthomonas wilt (BXW) *Xanthomonas campestris* pv.*musacearum.* Initial studies concentrated on developing diagnostic tools for the causal bacteria and ascertaining the level of pathogen diversity. Specific primers were developed and successfully used to identify the causal bacteria and determined that the population of Xcm was highly uniform. The primers were then used to monitor the progressive movement of *Xanthomonas campestris* pv. *musacearum* in apparently healthy banana suckers, and established that (i) Xcm migrates fairly quickly from top to bottom of the plant before any observable symptoms develop, (ii) By the time banana wilt symptoms are recognized, *Xcm* has moved, in most cases, into the suckers, although it remains latent, making such suckers dissemination vehicles for the disease. The recommendation is for plants exhibiting xanthomonas wilt symptoms to be destroyed along with their suckers, even if these suckers appear to be healthy. A research guide on the detection of Xcm in banana plants using PCR along with the procedures from field sampling, through DNA extraction, was developed.

Onion: Two hundred (200) small scale growers, extension staff and scientists (106 males and 94 females) were trained on onion IPM. The IPM onion package included use of superior pest and disease tolerant varieties, establishment of seedlings in germination trays with coconut moss and covering with insect proof netting to exclude arthropod pest infestations and soil borne diseases, use of biopesticides such as *Trichoderma* spp and solarization in seed beds and high tunnels to manage soil borne pathogens, need based sprays with biopesticides such as Biopower (*Metahrizium anisoplae*) and Achook (Neem). Curing

onions prior to harvesting was added to avoid soft rot infections and high post harvest losses and onion storage was on raised benches under shade after harvesting.

Diagnostics support: Effectiveness of integrated management strategies against pests and diseases of target crops was enhanced by increasing the diagnostic/identification capacity of farmers and agricultural extension staff through training and sensitization in field demonstrations and in workshops, with further technical support in diagnostic laboratories at KALRO Kabete. These achievements were greatly enabled by the pest diagnostic standard operating procedures (SOPs) and fact sheets developed and tested through the IPM- IL global theme on International Plant Diagnostics Network (IPDN). The SOPs, and associated technical knowledge, on bacterial wilt and root knot nematodes have particularly been widely applied in ascertaining soil infestation status in tomato production systems.

Relevant Websites
http://www.oired.vt.edu/ipmcrsp/our-work/projects/east-africa/

Local Implementers
Kenya Agricultural and Livestock Research Organization (KALRO)

Regions/Provinces
Mwea, Kangai Tisa, Thika, Kirinyaga, Bungoma, Loitokitok

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