

Feed the Future: Innovation Lab for Integrated Pest Management Trip Report

Country(s) Visited: Ethiopia

Dates of Travel: 13 April – 22 April 2018

Travelers' Names and Affiliations:

John Cardina, Ohio State University

Luis Canas, Ohio State University

Anna Testen, Ohio State University

George Norton, Virginia Tech

Jesa Mbaka, Kenya Agricultural and Livestock Research Organization

Beth Ndungu, Kenya Agricultural and Livestock Research Organization

Danny Coyne, IITA, Nairobi

Delphina Mamiro, Sokoine Agricultural University

Kalunde Sibuga, Sokoine Agricultural University

Peter Sseruwagi, Mikocheni Agricultural Research Institute

Malidhia Mjerekela, Mikocheni Agricultural Research Institute

Mark Deogratius, Mikocheni Agricultural Research Institute

Patrick Mathenge, Real IPM

Ruth Murunde, Real IPM

Purpose of Trip: Attend and make presentations to the Annual Meeting of the East Africa Vegetable Crop IPM-IL

Sites Visited: Addis Ababa and Hawassa, Ethiopia

Description of Activities/Observations:

Sunday 14 April: Arrive Addis, Friendship Hotel. Cardina, Canas, and Testen met with Ferdu and associates to review details of meeting arrangements and schedule.

Monday 15 April:

Started the meeting with an overview and introduction.

Fedu opened the meeting with a welcome to Ethiopia and introduction to vegetable production in the Rift Valley. New pests coming in tomato and onion.

Amer Fayad spoke on behalf of the Management Entity. The point here is to review the progress. Look at what has been done and how it matches the work plan. Need to see what the targets are and whether they have been achieved. Also need to keep track of the metrics. USAID has adopted updated indicators. Keep track of indicators that have been taken. When we get an update it will be made available.

- Publications. Be sure to list cooperative agreement. Can send that number.
- PERSUAP – a stressful issue regarding what pesticides are allowed. Need to submit a list of pesticides intended to be used. If not on the list, they need to be approved by USAID. Now, if wish to purchase a pesticide, need permission. Need to get approval of the purchase. If no approval, cannot reimburse. This also includes biopesticides. You can send a list of pesticides you intend to use and especially to purchase. Need AO approval.
- No need to get PERSUAP for fertilizer but need approval on fertilizer purchases.
- Link to Value chains- pressure to collaborate with them. We can ask Faith Bartz-Tarr about this in Ethiopia.
- Success Stories – The one on seedling health production has been used for publications.
- Semi-Annual reports. The dates do not change; same date each year.
- Marking and branding: if you make a presentation need to follow the FtF making and branding, plus USAID plus IPM as well as your organization.
- TAC meeting will be in Cambodia May 28-30. They need to be convinced that the work is progressing toward targets.
Had difficulty getting funds; 6 months late. Expect the FY18 funds for Ethiopia soon.

The focus of the presentations this morning was to be on successful activities. Participants had been asked for the first presentation to report on the most successful and encouraging research and/or training. The rationale was to allow them to highlight their best work and thereby encourage others to consider adopting technologies and approaches that are showing success elsewhere.

MIKOCHE NI AGRICULTURAL RESEARCH INSTITUTE REPORT

The first progress report was presented by Peter Sseruwagi of MARI.

He focused on three activities:

1. Evaluate IPM technologies in on-station and on-farm trials, especially on tomatoes.
2. Conduct short-term training and capacity building. Mostly focus on tomato, but also brassicas.
3. Knowledge sharing and transfer.

1. Pests and diseases are among the main constraints to vegetable production. Survey showed that viral diseases cause over 60% yield loss in Tanzania. Many farmers lack knowledge of viral diseases and IPM strategies.

Evaluation of IPM technologies. Evaluated prototype technologies for tomato and viral diseases. Tested these at four sites. All in eastern Tanzania, each with different

environments and different types of farmers or farmer groups. The treatments are chemical insecticides, neem oil, plastic mulch, and no treatment. They tested these IPM packages.

These are essentially “Mother – Baby” trials. The experimental design is RCBD with four replications – sites. For each site, two tomato varieties and four blocks for each variety.

Used healthy seedlings obtained from Joseph Mbuji, who attended the Seedling Workshop and is not running a commercial operation producing high quality seedlings. Controls are ‘absolute’ controls but with some farmer practice. We suggested that next time he includes a ‘technical’ control, which is what the farmers normally do.

Peter indicated that when you ask farmers what they do for pest control, they mention only pesticide, and do not include all the other things they do like weeding, staking, pruning.

Data collection: Weekly assessments for 8 weeks. Measurements included:

Disease incidence, severity on 1-5 scale.

Vectors: by species and number of adults.

Plant growth in height and time to fruiting.

Yield: number and weight; marketable yield.

Cost of treatments.

Data showed that chemical insecticides performed best, followed by neem oil.

Plastic mulch was effective for flying insects, but was a problem for caterpillars, which hid below the plastic.

Farmer response: they adopted GAPs based on what they saw working in the experiments. For example, in the next planting season, farmers used staking pruning, and better plant spacing.

Data has been compiled from four sites and will be used to design the next set of experiments.

2. Short-term capacity building

Objective: To create awareness of viral diseases, associated vectors and IPM strategies.

Understand cause, symptoms, spread of virus diseases.

Learn importance and methods for healthy seedling production.

Teach IPM practices:

Seedling production usually direct seeding into soil. Use stream water for irrigation, shade cover from grasses and tree leaves, and apply organic manure.

GAP – weeding, staking, pruning.

IPM – use insecticides etc.

Training in three sites: Bagamoyo, Morogoro, and Iringa. This was a joint training with SUA.

Participatory approach: Farmers share knowledge. Experts fill in gaps in farmers’ knowledge. This allowed the farmers to be facilitators. Focus was on extension workers but mostly had farmers. A problem we identified is that farmers were trying to grow large acreage but don’t have resources to manage large crops.

Bagamoyo: trained 74 people; Morogoro trained 69 people. Iringa had 119.

Joseph Mbuji participated as part of the training. This is the best case of capacity building because he is a ‘graduate’ of this project’s training in seedling production.

3. Knowledge sharing

MARI initiated the formation of a farmer Plant Health Network site using WhatsApp. Farmers formed a group called Kilimo cha Mboga cha Sisasa (Modern vegetable cultivation)

Location: Morogoro, Mvomero, Iringa, Ilula, Kilo, and Bagamoyo.

Dr. Hosea Mtui from SUA is participating in this effort along with Dr. Sseruwagi from MARI. This is the first project linkage between these institutions, part of our overall capacity building.

Participants: Farmers, extension, local leaders,

Communication in this network was in Kiswahili, the first example of such a Plant Health Network.

Training materials used in the trainings were produced in English and Kiswahili.

Manuscript in preparation: Farmer's knowledge of vegetable viral disease and their management in Tanzania

Success stories: Commercial farmer, Joseph Mbuji. He was introduced to MARI by Amon Maerere from SUA. Joseph started with a nursery, which he built with his own plans. He has since built four of them, and produces 960,000 seedlings per season at \$0.25 each.

Ramadhan Msafiri – a farmer who adopted IPM technologies. Sometimes only uses healthy seedlings. Other farmers follow him.

Jovin Daudi – a farmer group that uses Joseph's seedlings. After project intervention, increased yield, increased sales and income.

Collaboration with Mboga na Matunda – Fintrac: Five meetings were conducted to discuss work plans and areas for interaction. Sseruwagi linked MnM with MARI and SUA people. MnM works as a private sector organization; they do not appreciate the contribution of public sector. They don't interact with SUA and MARI. Visited their fields, and there are things we think they could improve. But there is not a sense of openness to input from scientists.

Next steps:

Continue training including joint training with SUA and hopefully MnM.

Link more farmers on the WhatsApp Plant Health Network group.

Publish the research and training research.

SOKOINE UNIVERSITY OF AGRICULTURE REPORT

Presenter: Dr. Delphina Mamiro

The focus of her presentation was management of thrips and purple blotch in bulb onion.

Production of onions in Tanzania is by many small scale farmers who market specific varieties along the roadside or in farmer groups. Yields in TZ are generally half of the

world average. The reasons include pest pressure, thrips, purple blotch; poor quality seeds; lack of improved high-yielding varieties.

The objective of this research was to evaluate performance of varieties available. Resistant varieties are an IPM technology, which allow for lower pesticide usage. The study in villages also allowed for gathering information on preferences from farmers.

Methods: The study was a version of a Mother and Baby trial, with the Mother trial conducted at the SUA Hort Farm, and baby trials in five villages. It is not technical a M&B trial because full treatments were used at all sites. A total of 25 farmers, five from each village, were identified to be in charge of the experiment. There were 12 females, 13 males. For analysis of variety performance, 15 farmers were invited to evaluate the crops.

On-station trial was RCB with 18 reps.

Farmer training: the 25 farmers were invited to participate in training on onion IPM and variety selection. They were taught to use a scale of 1-7 for variety performance.

Results: The local variety is Lumuma. Red Creole were best performers for disease but not for yield. Varieties varied in earliness, bulb size, bulb color and absence of splits. Jambar and Russet were highly ranked by farmers in all villages. Varieties Tajirika and Lumuma and Red Bombay were disliked because they stay in field long time and had a lot of splits.

Conclusion: Farmers readily adopted IPM technology when they received training and observed the practicality of the technology. Farmers accepted some level of damage, suggesting that pesticide applications are not for cosmetic reasons.

There was considerable discussion about the lack of alignment between farmer preference of varieties and the ranking relative to disease. Apparently these data varied from village to village, so mean values were not useful. The finding that there is disagreement between farmer preference and disease susceptibility was of concern to some participants, but others found this an interesting observation worth of further study.

It was also suggested that there might be value in screening of more varieties to look for resistance. If some are determined to be resistant, take them to farmers. Good discussion of how this fits IPM and whether farmer preference is a component of IPM.

Next Steps: Scaling up and scaling out. Include other farmers and other partners.

Manuscripts: 2 for this conference, 2 from MS research ready to submit; 2 from baseline.

Other IPM technologies used in these villages: mulching; timing of planting to avoid pests.

HAWASSA UNIVERSITY REPORT

Presenter: Ferdu Azerefege

Vegetables are important in the economy and diet in Ethiopia. Project area is Rift Valley, where there is intensive production of onion, pepper, cabbage, tomato, and other vegetables. There are different scales of production and different levels of knowledge among farmers in this region. The main difficulty is overuse of pesticides. Many depend on a single pesticide.

1. Training for Farmers and extension workers at Butajira. The main crop is dry pepper production. Training topics: Healthy seedling production, seed collection and preparation; and seed treatment.

Training started with an assessment of farmer knowledge. Site selection for most farmers was based on irrigation water; crop rotation is minimal – some plant tomatoes repeatedly in the same field. Some use heat treatment; they don't use crop residues. Farmers stopped pepper production due to root rot and disease. Dry pepper is most lucrative crop. Covers are available for greenhouses but not for field. Demonstrated this for farmers. Root rot is a major problem; so are onion thrips; high pesticide use; dependent on one or two pesticides.

In an on-farm study, tested a threshold of 10 thrips per plant. Results showed that farmers could reduce pesticides. This was during wet season; hope to repeat during dry season.

Efficacy of netting to control viruses. This is MS student Kumsa's work. He scouted for EPMV symptoms; no Elisa or other tests available.

About 100% of fields have viruses. More than 50% of plants have virus.

An experiment was conducted with treatments of no covering, and covering for 20, 40, 60, 80 days and full season covering.

Viral incidence was greatly lowered with netting: half the incidence with netting than if just using insecticide. Adding insecticide to netting did not add much.

Temporal dynamics of viral incidence was studied at Meqi. Covering with netting delayed development of disease and incidence. Netting was more effective than spraying.

Next Steps: Maybe we can get farmers to use low tunnels.

Weed control in onions; this is MS student Feyisa's work.

Hand weeding is most common method. Labor is becoming more expensive: 250 Bir per day plus lunch for weeding. He conducted a survey to determine what kinds of weeds were present and at what relative density. Several areas were surveyed.

Most of the production furrow irrigated. This makes use of herbicides difficult because irrigation essentially floods the fields resulting in herbicide movement off-site.

Main weeds are *Portulaca* and *Cyperus*; these are very problematic in all areas. The *Cyperus* is mostly *rotundus*, but also *esculentus* in some areas.

Due to political situation, could not go to the field for 3-4 weeks. This was a critical time for the experiment. As a result, no data could be taken and weed treatments were not applied as intended. The study will have to be repeated.

For *Tuta absoluta*: 2 or 3 insecticides that dealers are selling. Difficult to make rotations if only 2 or 3. Plant protection directorate now allowing use of biocontrol agents. Now planted tomato with trichoderma in the field.

Discussion is ongoing with commercial greenhouse to make seedlings. Farmers trying trapping. Using some homemade traps.

New problem: onion bulb rot. Maybe *Sclerotium* species, possibly *Sclerotium cepivorum*.

Planned activities: Management of onion thrips with action thresholds to reduce insecticide use. Training of farmers, extension workers to continue to make up for training cancelled during political troubles.

GRADUATE STUDENT REPORTS:

Hellen Kanyagha: expected to finish her PhD at Ohio State by Dec 2020. She has conducted a survey of *Ralstonia* in Tanzania. 55% of farms had bacterial wilt. She made a collection of *Ralstonia* and is looking for resistant cultivars. She is producing resistant seedlings through grafting.

Anaerobic Soil Disinfestation (ASD) treatments are being evaluated to inhibit *Ralstonia* with some success.

MT56 was tested for the first time targeted for *Ralstonia* in Tanzania.

Denis Nyamu: MS student at Ohio State University, with Dr. Luis Canas. He is working on populations of *Tuta*. Big gap is level and scale of resistance of *Tuta* to insecticides. The same insecticide molecule applied in different regions can give different results because of difference in intensity of use. He will travel to Kenya for sampling and testing. He will bring samples back to OSU lab from Kenya for genetic characterization. He will connect with Jesca Mbaka to work with growers to see what IPM options are being used by farmers. He will also work with development of a new Health Network node in villages where he works in Kenya.

Cecillia Ngugi: PhD student at University of Nairobi. She is working on use of entomopathogenic nematodes for management of *Tuta*. Specifically, she is looking at 5 indigenous EPN isolates on *Tuta*. She intends to isolate bacterial protein toxins and evaluate their effect on *Tuta*. She has developed methods for culturing the isolates in the lab as well as for rearing the insect. She has completed an experiment to evaluate infectivity of selected EPNs using Greater wax moth. All of the EPN isolates caused mortality. She has prepared a manuscript based on this work.

Joshua Kinene at Chuka University. His research is on "Use of Tithonia, Tephrosia and neem for management of root knot nematodes of French beans." He is now engaged in the phytochemical analysis of extracts showing activity of secondary products. His next steps will be in-vitro studies to confirm activity.

Kumsa, MS student at Hawassa University. His research is on the efficacy of netting to control viruses. He conducted a survey of farms for EPMV symptoms (described above). He conducted experiments with netting duration treatments. His thesis is almost done. Peter will help him with Elisa assays and identification of the virus.

Feyisa finished a survey on weeds on several farms. He initiated onion weed control experiments, but was unable to carry this out due to the political instability that restricted movement in the country. He will repeat the experiment this next season.

At SUA in Tanzania, in addition to Hellen (at OSU), there are five graduate students pursuing the MS degree. Several undergrads are undertaking research projects as part of their curriculum.

KENYA AGRICULTURAL AND LIVESTOCK RESEARCH ORGANIZATION REPORT

Presenter: Beth Ndugu

Dr. Ndungu presented an analysis of the baseline survey in Tharaka-Nithi County. She described constraints to vegetable production, where pest insects and diseases rank very high. The objective of the analysis was to prioritize major vegetable pests, evaluate farmers' experiences in pest identification and management.

Data were collected using a structured questionnaire of 108 farmers. She used color pictures of vegetable pests. The groups included 57 males, 43 females. Most were relatively poor; 66% had inherited land, 29% purchased, and 5% rented. The average holding was 1 ha and land ownership 92% male. Forty-two percent of households had a member belonging to a farmer group whose main activity was crop production and marketing. They reported group benefits as welfare activities, better prices, easier access to market. Average acreage per crop was 0.01 ha; tomato 0.02. Main tomato pests: Bacterial wilt for 80%; *Tuta* "no longer so much of a problem to farmers, mostly because they are using insecticides." For French beans, the main pest was thrips; for cabbage it was black rot, diamond back moth and aphids.

Control methods used include: 56 % spray pesticides; 43% stake tomatoes; 26% use resistant varieties. Reasons not using pesticides: 27% say health/safety; 25% cost. Status of pesticide use: 55% say pesticide use has increased; 18% decreased. Factors influencing choice of pest control: 55% effectiveness; 28% advice from dealer; Cost not so important. Sixty-one percent of crop production is done by males. Pest management decisions are made mostly by males. Forty-six % had heard of IPM; of these, 40% had IPM training, mostly by ministry of agriculture.

Dr. Ndungu has connected farmers with common interest groups. KALRO initiated a training program to help identify and manage pests. The farmers have not used grafting because farmers were not growing tomatoes for commercial use. Now that they are commercial it makes sense to train them in grafting. They will use MT56. There were some problems with graft seedling height, but these can be resolved. Jomo Kenyatta University is also doing work with grafting.

Presenter: Dr. Jesca Mbaka, KALRO

Dr. Mbaka made a presentation on Evaluation of biopesticides for management of tomato pests in Tharaka-Nithi County. The goal of this project is to build capacity of farmers and conduct on-farm experiments. In this way, combined objectives 2 and 3.

Main pests: *Tuta*, African bollworm; whiteflies; thrips, serpentine leaf miner. Conventional management is 12 to 24 application of synthetic pesticides. Farmers report the following consequences: health concerns; increased cost of production; pest resistance; crop losses; negative effect on environment. The insecticide Corragen, commonly used for *Tuta*, costs \$300.00 per acre. They are applying 3-x the rate; twice per week instead of 21 day interval on label. Some farmers are reporting that *Tuta* is resistant to Coragen. They need bees for pollination in that area, so this is major conflict.

The objective of the research was to evaluate selected bio-pesticides for efficacy in management of tomato pests. The bio-pesticides are locally available, but often not for the specific pests or crop.

The experimental sites were chosen by farmers based on availability of irrigation and other factors. Seedlings were grown using good practices. They used insect-proof netting in a low-tunnel and the medium included cocoa peat and peat moss. These worked for tomato, but the cabbage got P deficiency.

Methods: RCBD with four reps. Treatments included nimbecidine; pyrethrin plus garlic; BT; Petroleum spray oil; untreated control. They combined research with teaching by demonstrating when researchers did applications and teaching farmers how to do the same. Farmers were trained on pruning and staking as IPM technologies. The scientist visits to the farms were scheduled ahead of time so that farmers would be available.

These are essentially Mother and Baby trials. For the Mother trials, researchers are working with farmers; the Baby trial will be the farmer doing the some of the treatments by themselves.

Other activity involves work with the agro chemical companies and the pest control products board. The idea is to get more effective enforcement of pesticide use regulations. We are also trying to train farmers on use of biopesticides. Unless we teach them, the farmers will mix bio products with standard pesticide products.

Presenter: Patrick Mathenge – Real IPM

Real IPM contribution: 1) Expand Pest Health Network to farmer groups.

2) Develop a web based portal to act as a repository based on images from the network.

WhatsApp is the best low cost subscription alternative to carrier-billed text messaging.

It supports international or group messaging and collaboration. Internet penetration in Africa is on the rise. “Master group” was formed for technical diagnosis. From this main group we will have other groups. Each group can have up to 256 members.

Approach to scale out: Farmer trainings. First was in Meru: three counties: Meru, Tharakanita, and Embu, on 28 February 2018. Another training will be 8 May 2018. A third one will be Thinka-Kiambu County. Most farmers have a ~\$40 smart phone. Not i-phone.

Online portal- www.realipm.com Build knowledge with data from network traffic. Photos with diagnosis are being collected. We can sort the output by diagnosis, pest, crop, location etc. From farmer connections to other online platforms, over 4000 contacts that can be leveraged.

Presenter: Ruth Murunde – Real IPM

Use of biological control agents in management of pest and diseases: Success stories in vegetable crops. She reported success stories reported by two farmers in Kiambu County. They raise horticulture crops and market locally. Major challenge diseases – fusarium wilt. Solution: Biocontrol agent started management the greenhouse. Used a very simple technology: combination of *Trichoderma* and *bascillus*. They used Bio-priming, i.e. soaking the seeds in the mixtures.

Presenter: Danny Coyne - IITA

“Sometimes it’s not what you can see that’s important, it’s what you can’t see.” This of course pertains to nematodes. His goal is to encourage farmers to appreciate nematodes and their impacts.

One output from the project is IITA’s book (reprint) about how to study nematodes. Through recent connections there is now a critical mass of nematologists in East Africa. Related activities: Uganda project pest diagnosis, technology development and application. For capacity building: Getting healthy seedling units constructed. Solanaceae trap crop. Potato cyst nematode. Some solanaceous leafy vegetables are being used as trap crops.

Workshops held: Kenya (5 trainings); KU in Ghent; Prof Perry; Syngenta; Ethiopia.

Potential EU proposal for Kenya on commercial seedlings: growing seedlings for small scale farmers. Farmers bring the seeds that they’ve purchased and the commercial outfit grows them to seedling height. Transport cost is high; this serves ~250 Kilometer radius around Nairobi.

Presenter: Feyisa Bekele-

Healthy Seedling Systems for Sustainable Vegetable Production of Capsicum and Tomato in Ethiopia. They are engaged in screening of local varieties for resistance to nematodes. They are testing mixed culture products. Seedling preparation involves compost mixed with bacterial and fungal products with periodic aerial spray of entomopathogens and antagonistic microbes.

Presenter: George Norton, Virginia Tech, USA.

Baseline survey analysis. Summary of Ethiopia an Kenya vegetable IPM survey results. Unlike Kenya, maize counties are different from vegetable counties. He presented a summary of the Ethiopia baseline survey, including preliminary results of analysis of

factors affecting IPM adoption and pesticide use. They identified current pests, severity, management practices, and knowledge. The sample included 299 farmers in the Oromia region and was conducted in January 2017. Respondents were 96% male; 4% female. Demographics: mean age is 36 with 7.4 years of education and 8.1 years of farming experience. Farm size is relatively small; they have a mean 16 head of livestock. About 42 % are members of farmer or community organization; these are not marketing groups; 43% are members of a credit group. Vegetables are mostly sold to non-local traders; 74% for local traders; only 1% home consumption. The wet season crop was mostly tomatoes.

Leaf miners were the most important pests. They reported high disease pressure; bacterial wilt most important. IPM practices: Healthy seedlings; remove damaged plants; nursery nets. But they made an average 17 pesticide applications per season.

For cabbage the main pest is Diamondback moth, but severity is relatively low. IPM practices: Healthy seeds; pesticides used in 10 applications per season. Only 1 had IPM training.

Conclusion: Males are dominant in farming, though money decisions are said to be joint. There is a big opportunity to focus IPM training on marketing groups. The current adoption of IPM is low, but there is some, though not identified as such. Distance from town has influence on IPM adoption: those farther from input supplier had positive relation on pesticide use. Maybe those far from town are larger farms with more labor shortage and therefore more pesticide use.

Now to Kenya data analysis: Regarding factors affecting IPM adoption and pesticide use. This was a survey of 263 vegetable farmers. There were different levels of adoption. If level of IPM is only based on numbers of practices, it doesn't reflect sophistication of the practices. For example, Biopesticide use was by 57% of farmers for tomato. The biggest effect was location.

PROGRESS ON PLANT HEALTH NETWORK

Presenters: Patrick Mathenge and Luis Canas

Dr. Canas started by describing the history of the network, starting in 2016 in Tanzania. The workshop started teaching how to take a picture so that a diagnosis is possible. Temporal pattern of activity goes along with workshops; we also see changes in questions depending on crop season. This is about the expert group. With over 1000 entries, 64% are from women. Over a year the questions on tomatoes increased. Few people are leaving the group. Other than getting info from experts there is the value in peer learning, which is capacity building as well.

More participants are being included especially in Kenya through the efforts of KALRO, Real IPM and soon through graduate student Denis Nyamu, who will be working with a farmer group. There is beginning to be networks with farmers. There is a multiplier

effect as farmer groups are added, because this links whole villages. The village groups will eventually connect to a database.

Brief, concise publications can be put on the network; we need to put everything into some form for easy access.

Peter Sseruwagi indicated that he is hoping to bring extension workers on to the network. They can be the interconnection between English and Kiswahili speaking messages.

Tuesday 16 April:

Luis Canas moderated the day.

Introduced Dr. Faith Bartz Tarr from the USAID mission.

Dr. Canas discussed Meeting Proceedings. Put together a draft by the end of May. This will include proceedings papers and powerpoint presentations. We will send a draft back for approval and then will print, put on web site, send relevant info to the ME.

Next we discussed scientific papers. He proposed that we use the period from May to August to get publications prepared. Canas and Cardina are willing to help anyone with statistical analysis and editing for publications. Be sure to include proper acknowledgements.

Don't be attracted by predatory journals; use a Thompson listed journal.

For papers intended for publication in Crop Protection, we still need to get papers in good shape. The Journal of IPM is another good option for extension oriented publications.

Peter asked which data goes into meeting proceedings and what goes into a scientific journal. Canas said the proceedings is a brief summary or preview of what will later be put into a paper.

Relative to data: send to the ME, which is required.

Based on the presentations from yesterday, here are some suggestions of possible publications:

Ethiopia onion thrips thresholds.

Ethiopia effect of netting on viral incidence.

Tanzania: SUA evaluation of onion varieties.

MARI: the tomato IPM package evaluation.

KALRO: Evaluation of biopesticides for management of tomato pests.

IITA: already published the reprint of the book. See this for the language for acknowledgements.

Beth and George: Survey data.

Highlights of work for success stories:

Ethiopia training on seedbed preparation; SUA student projects; Plant Health Network IITA workshops.

Presenter: Dr. Faith Bartz-Tarr is a plant pathologist who joined USAID 3 years ago. Her office is involved in multiple processes. Food security Act drives their activities. In the process of translating this to country level.

Focus is on reducing poverty and malnutrition.

ILs contribute by telling what works, to be more resilient and provide evidence about how increase productivity can enhance nutrition.

Working on 5-yr strategy.

Gender analysis, youth analysis, environmental and climate risk analyses, urbanization analysis.

Goals:

By 2040: Ethiopia is prosperous, resilient and inclusive, capable of addressing its own socioeconomic needs and managing crises.

Themes that guide all investments:

Local ownership and capacity building of local systems.

Leveraging resources and expertise among all the diverse investments.

Achieving sustainability to end the need for US foreign assistance and transform systems so aid is no longer needed.

Growth and transformation plan of Ethiopia is aligned to the USAID plan. They are encouraging the following: State facilitated, private sector driven investment; Providing employment opportunities for the youth; Transformative investments in agricultural inputs, market linkages, productivities technologies, employment diversification and food safety; Agriculture to provide inputs for growing industrial sector.

Value chain targeting: provide nutritious foods and may be commercialized.

Focus on maize, chickpea, coffee, livestock, dairy, and poultry.

Also avocado, the only 'horticulture' aspect of the program.

Aim: to increase investments in private sector led horticulture production, which has growing demand, profitability, and employment.

Role of Innovation labs: Create new technologies. Help inform what works. Inform investment strategy and identify points of synergy or potential partnerships.

Also, institutional development and capacity building, including students and sharing of information.

Fall armyworm: arrived in Ethiopia. More needs to be done on communication and dissemination of information.

Question was raised about movement of pests from one country to another. The strength of the collaboration is that we can be ready to respond.

Policy issues: links with private sector can facilitate technology transfer if a country system is not in place.

Fintrac value chain organization is now getting into place; it does not deal with vegetable pest management. However, they need training in pesticide safety.

Ferdu: All students coming through Hawassa have training about how to use pesticides. Pesticide safety and legislation is available. But the dealers don't sell the safety equipment. Also have lots of technologies that can work but don't know how to scale up into business. How to make innovations work at a large level. Putting findings into the field.

The group engaged in a long conversation about interaction with value chains and the frustrations this project has encountered.

PRIORITY PESTS

Prof. Sibuga led a discussion on priority pests and methods that have been successful. Tomato – Tuta and whiteflies, Ralstonia, RKN, Late blight, IPM Practice that works; trapping, insecticide rotation. Netting does not work perfectly. Exclusion nets are promising. Netting can work if done properly. In Ethiopia, *Tuta* forced agriculture inside under tunnels or some enclosure. Insecticides will kill any predatory mites. Fallow one or two seasons helps reduce populations. KALRO has had some success with neem. *Metarhizium* isolates could be used according to Real IPM. In Nepal the light traps and pheromone traps have been helpful, along with biopesticides and neem with Bt and Beauveria bassiana. Traps are working and popular. *Tuta* population has been reduced enough that pesticide use highly reduced. It was suggested that there is a complex of pests, so getting good management of virus vectors will also suppress *Tuta*.

The point is to consider this information when putting together plans for FY19. Think of designing studies based on this discussion. Remember to include an absolute control at least on station. For on-farm studies, the farmer practice will be the control. Need package that is universal baseline: Healthy seedlings. Farmers need to be aware of the options.

SPECIAL PRESENTATION ON NEW TECHNOLOGY

Dr. Anna Testen presented a description on Anaerobic Soil Disinfestation –ASD. This is a relatively new technology that has been tested in Europe and USA but not in Africa. It consists of: Adding carbon source; watering; covering with a tarp. This excludes oxygen and leads to buildup of anaerobic organisms that produce organic acids that are toxic to many pathogenic organisms; it also controls some nematodes and kills weed seeds. This works on a wide variety of high-value crops. It is effective against a variety of pathogens. ASD can be used against fungi, oomycetes, and nematodes. Carbon sources are variable depending on what is available; this includes rice bran, wheat bran, cover crops or residues. ASD relies on beneficial microbes in the soil. Add carbon, the microbes use up the carbon, use up all the oxygen, causing buildup of toxic byproducts. It is especially useful in protected culture. The amount of carbon material is 10-20 tonnes per ha; 8-12 g per kg of soil. When tarp is removed, need a week to let the soil breathe.

OPEN DISCUSSION

Luis presented examples of IPM packages. He showed three examples, which will be sent to participants.

In Ethiopia, *Tuta* drove farmers to protected culture. This allowed for introduction of IPM techniques like biocontrols and made farmers more open to IPM approaches.

METHODS FOR MOTHER AND BABY TRIALS

Anna and Delphina discussed testing the whole system from seed to harvest. How to test combinations of the package components. Anna explained the design of Mother and Baby trials. The Mother trial is a RCB trial on station or on a farm with a trusted farmer, with 4 reps comparing farmer practice with low, medium, and high IPM integration. The idea is to let farmers see these on station and they observe them in the field. The Baby trials are conducted in the village. Farmers choose the level of IPM that fits their farm. These are un-replicated trials with one or two treatments and the standard farmer practice as a control. The output is whether farmers see them as acceptable.

Beth: In Kenya, can have key farmers conduct the mother trials. Then group members do the baby trials.

Canas: These are difficult experiments to conduct. There are many possible combinations of tactics. It can be unmanageable if too many treatments. Keep them simple.

Discussion:

When in the crop cycle is it most important to implement IPM: need to start with healthy seeds and healthy seedlings. IPM cuts across all stages so it should be fundamental to the cropping system, including crop rotations.

For a particular pest that comes in mid-season there might be preventive practices or post-introduction practices.

Question of how to handle the “farmer’s treatment” since these vary considerably. Often the farmer starts to use the test practices.

Resistant varieties are one of the keys.

ENSURING EFFICIENT USE OF PESTICIDES WHERE APPROPRIATE

Presenter: Peter Sseruwagi

We have emergence of new pests because pesticides not used effectively. Lack of farmer knowledge of new pests. New pests are emerging all the time. The dealers are bringing in new pesticides to agro-dealers. There is little coordination among dealers, regulators, and farmers. How are these stakeholders coordinated and how can the project work with these?

Dr. Sibuga told us that in TZ there is a pesticide research institute that handles all registration. The TPRI has labs to test pesticides and verify quality. For importers, they need to test any new pesticides with TPRI. Two seasons of trials are required for field testing. Registered and restricted not allowed to sell; or Registered and available for sale. TPRI also has responsibility to inspect to see what is being sprayed. They do training for extension workers. The approved pesticide list is available online. Also find

pesticides being sprayed being brought in by way of neighboring companies, and there are some poor quality products.

For bio pesticides, somebody did a test on what is on the market and found that only 5% had the correct ingredients.

Training input suppliers on pesticide application is a need but difficult to implement. Some are not educated in how to handle the product and store it, especially bio products. They are a strong force in the things that are being applied to the field.

Peter suggested calling a stakeholder meeting. Many extension workers don't have an understanding of basics of pest identification. So can't expect more of agro-dealers.

Jesca: In Kenya, they don't have a structure for bringing dealers together. In the villages, they came together because of access to irrigation water. After the training the farmers revealed that they went an entire season without using pesticides. There is so much pesticide misuse that for the project, when Jesca talks about pesticides they only refer to bio-pesticides.

Ruth: Real IPM trains their sales force and farmers. They set up trials with farmers. For IPM they have 'promoters' who sit with the farmer to develop a whole strategy.

Jesca: Meru Greens will not take French beans that have any pesticides applied.

Ferdu: In Ethiopia, most registration is done by ministry of ag. They don't have labs to test pesticides. There is no assessment after registration. The first introduction will be an effective product; after a while the quality might go down.

There is a lot of smuggling from Somalia and Sudan. Many pesticides brought in and used which are not registered for a particular crop. There are many laws and regulations but no enforcement.

Peter suggested that we begin a discussion with regulatory people and private sector. We discussed the possibility of looking at organic labeling. We understand that organic is not the objective of this project, but if through IPM a grower is able to develop a system that could be labeled as organic and get a better price, this only encourages more use of IPM.

Ferdu asked about organic certification. There is such labeling in Tanzania and Kenya. In Ethiopia there is public interest in purchasing items destined for the European market because they know the products are not sprayed.

Patrick: The people who buy flowers in Europe demanded that they be produced without pesticides. If there this demand on flowers, why not on things people eat? So there is a need for more awareness. Real IPM used to try to distribute to agro-dealers. But they stopped because the dealers did not have the motivation because the dealers did not get a big enough profit.

Based on a question about Mother and Baby trials, Anna made elaborated with a drawn description of field plots. The idea is that there is a trial with quantitative data on

several treatments and a control. Then there is a Baby trial with comparisons of particular treatments. The Baby trials give qualitative data on farmer acceptance.

PLANS AND ONGOING ACTIVITIES FOR FY18

SUA - Sibuga

Review of the survey.

Work in progress: Two manuscripts from the survey data.

Student work

Activity 3

Conduct on-farm trials.

Will collect more onion germplasm.

On-farm trial for evaluation.

Activity 4

Treatments for tomatoes.

Control

Trichoderma

Neem cake

Bi-slurry

Intercropping with marigold.

Data collection completed; draft manuscript is ready.

Activity 5

On farm evaluation of overhead irrigation to interrupt mating. To be started in May.

We asked for more information on the need for this and who is in charge.

Activity 6

Conduct on-farm demonstration of IPM packages: Mulching, pesticide use only when needed, adapted varieties, harvesting at appropriate ripening stages, postharvest treatment with sodium hypochlorite and proper packages.

We discussed the need to remove the post harvest component as an experimental component. Use hypochlorite for seed treatment only.

The baseline for the control will be farmer practice.

There will be three treatments:

Control

Standard pesticides

Alternative practice

Technology transfer

A-Z textile mills. Demonstration at SUA. Provided netting for three villages.

Technologies ready to scale-up and out:

Healthy seedlings

Protected vegetable production

Mulching
Plans for 2018-19
Continuation
Publication
Long-term training
Add student for management of dodder

Piloting IPM technology packages with innovative farmers.

MARI – Peter Sseruwagi

Continue short term training in healthy seedling production and IPM.

Joint training with SUA.

Location: Morogoro, Mvomero, Iringa and Kilolo.

Timing – May – July. Timing could change depending on weather.

Crop: Tomato

Pests: viral diseases, whiteflies, aphids, thrips

Outputs – Healthy seedling production; IPM packages

Target group: vegetable farmers; extension.

Visit two villages per day.

Validate best combinations of IPM strategies in participatory programs with farmers.

Participants include joint participation with SUA.

Locations: Bagamoyo Morogoro, Mvomero, Iringa, and Kilolo.

Timing: May to September.

Crop: Tomato

Priority pests: viruses, whiteflies, aphids, thrips.

Brief description of tasks:

Develop experimental protocol/design

Establish the validation

Knowledge sharing and transfer/scaling out

Expand the local Plant Health Network using WhatsApp to more villages or farmer groups per district to enhance communication on vegetable production and IPM for farmers and extension in Morogoro and Iringa.

Within-village/group networks were linked to PI organizations.

Produce handouts for IPM management such as leaflets.

Strengthen policy on efficient and safe use of pesticides and biopesticides in stakeholder workshops. This will be in five districts; aiming for August 2018.

Use data from baseline survey and IPM trials to share knowledge on efficient IPM strengthen policy on efficient and safe use of pesticides in a stakeholder workshop jointly organized by MARI and SUA.

Targeted group: Farmers, dealers, etc.

Real IPM – Patrick Mathenge

Continuation of support for the Plant Health Network.

Lead farmer training on use of WhatsApp.

Goal is to train lead farmers in four counties, 20-30 farmers per county.

First one will begin 8 May.

Outcome expected is formation of regional networks.

Develop collection of web-based images for pests and diseases of vegetable crops. Expect to get this done by July.

Continue the collection of images.

KALRO – Jesca Mbaka

Objective 1 survey: Work on paper for publication.

Make the survey report a product that is well written and usable for others.

Activity 2

Organize a one-day workshop to share findings. This will be by the end of June.

Audience includes anyone working with bioproducts. We will discuss inclusion of bio pesticides in vegetables.

Discuss policy implications.

Objective 2

Long-term training of grad students.

Continuation of support for Cecilia Ngugi; Joshua Kiene

Activity 2

Short term training of farmers and trainers

Include IPM systems technologies including high tunnels and grafting.

Compost making using Trichoderma at the farm level.

Training in pest, disease diagnostic and use of WhatsApp for pest and disease diagnostics.

Over 200 farmer representing three groups in Chuka county; include 15 extension staff workers.

Obj 3: Evaluate prototype IPM technologies

On-farm evaluation of Trichoderma and bio-fertilizer for efficacy in management of bacterial wilt of tomato.

The experiment will be conducted with 2 groups.

Treatments:

Tridhoderma harzianum

Trichoderma asperellum

T. h Plus T. aspergillum

Plantmate (biofertilizer)

Control – drenching with water only

This will be done with 4 reps.

Acivity 2

On-farm validation of biopesticides.
This experiment will be repeated.

Activity 3:

On farm validation of trichoderma and Bacillus strains for management of black rot and soft rot of cabbage.

Activity 4:

On-farm evaluation of four biopesticides and a trap crop in the management of cabbage moth and aphids in brassicas.
Five treatments, including a control.

Activity 5. On farm validation of biopesticides for arthropods on French Beans.
Five treatments including control; now will add farmer practice.

Objective 4: Evaluate packages.

Beth will do a cost-return analysis on promising vegetable technologies.

Activity 2: Adoption of IPM for selected vegetables
George, Beth and others will participate in this.

Activity 3: Publications

Success stories.

Fact sheets. Put into 1-2 pages and get a review from farmers.

Hawassa University - Ferdu

Training of farmers and extension workers.

Small and large sale farmers.

Training on pest diagnostics

Healthy seedlings

Best practices for the crop;

Pesticide use: safety; selection, rotation and sequence.

Gaps in management practice and introduction to new IPM components e.g. monitoring and decision making; use of traps; biocontrol agents.

Focus: Gather information on the farmers' practice, understand their decision making processes; what works best and what does not. Aim is to reduce pesticide use.

Introduce specialized traps and other new IPM components.

Onion thrips and how to monitor.

Management with monitoring of thrips.

Tuta on tomato:

Use pheromone traps. Demonstrate how to use these. Have one type; seeking other types. Get this to 10 farms.

Sequence of insecticides vs with the conventional method.

For pepper: Health seedlings treated with trichoderma, compare performance with

Ongoing studies to be repeated:

Biological survey on pests and diseases of pepper

Informal reports of new pests.

Prevalence and incidence studies not less than 100 farms of green pod and dry pod producers.

Detailed studies on representative 10 farms of producers.

Detailed biological survey of bacterial wilt. Sometimes mis-diagnosed. Especially a problem with flooding irrigation.

Also look at viruses and confirm with ELISA.

Capacity building

Two students; Hope to add one more working on trichoderma.

Training for Faculty

Trichoderma with compost

Tomato grafting

Vegetable production innovations

Bring the trainer here or send faculty outside. If bring here, can train many more.

MS theses

Manuscripts on netting for protection of pepper against viral diseases

Reduced insecticide use

Weeds in onion – experiments to be repeated.

Leaflets and brochures for IPM on onion, tomato, and pepper

Other activities

Engage with Florensis greenhouse.

Engage with companies and MoA for registration of Trichoderma.

IITA:

Intention is to provide oversight and supervision for nematology capacity building, awareness raising etc for the project.

Interaction continues with Jesca and Chuka University. The interaction could be better.

Available to work with labs.

Training course planned for later in the year. This will be in Kenya.

LESSONS LEARNED FROM ANNUAL MEETING:

Giving each entity the opportunity to present their 'best' activity in detail was an effective way to identify strengths and weaknesses.

Several groups made changes to their work plans as a result of feedback from the meeting.

Giving time for in-country discussions was effective for coordinating planned activities for those who took advantage of it.

The meeting was useful to clarify basic understanding of certain project components, such as the makeup of a success story, the design of a Mother & Baby trial, differences between 'absolute' and 'technical' controls in experiments, reporting requirements and timelines.

There is an interest and desire to work with value-chain partners, but some frustration in how to make the connection with them. Attempts initiated by the project participants has not generated much response and there is a sense that 'they should come to us' as a source of expertise.

Participants were asked to name something they learned from the meeting. Responses were as follows:

1. Ethiopia worked well as a good place for a meeting.
2. Learned about effective management for Tuta
3. Appreciated how to do a success study
4. When planning, the more detail the better
5. Multi-country contributions were really helpful to share learning outcomes (what works and what does not)
6. Learned about ASD technique
7. Important to understand control and "technical control"
8. Network communication very interesting and important
9. Great to have young leadership
10. Mother and baby trials
11. Interaction between industry and academia
12. IT team idea and interaction was useful
13. Discussions were really useful
14. In future include Plant Health leadership. Stimulate collaboration and competition.

Day 1. 16 April: INTRODUCTION & PROGRESS STATUS	
8:30 - 8:50	Welcome, introduction and meeting overview – Ferdu Azerefegne
8:50 – 9:15	Remarks from the Project PI – John Cardina
9:15 – 9:30	Remarks from the Management Entity – Amer Fayad
9:30 – 10:15	Tanzania, MARI: Progress Report – Peter Sseruwagi
10:15-10:45	Break
10:45-11:30	Tanzania, SUA: Progress Report – Delphina Mamiro, Kalunde Sibuga
11:30- 12:15	Ethiopia, Hawassa University: Progress Report - Ferdu Azerefegne
12:15-12:45	Capacity building: Progress report on student training- Mamiro, Mbaka, Ferdu, Cañas
12:45-2:00	Lunch
2:00-2:45	Kenya, KALRO: Progress Report – Jesca Mbaka, Beth Ndungu
2.45–3.15	Kenya, Real IPM: Progress Report – Patrick Mathenge, Ruth Murunde
3:15-3:45	Break
3:45-4:30	Kenya, IITA: Progress Report – Danny Coyne
4:30-5:00	Virginia Tech: Report on the survey data from Kenya and Ethiopia- George Norton
5:00-5.30	WhatsApp Network Discussion: progress and plans – Patrick Mathenge and Luis Cañas
5.30-6:00	Discussion
	Dinner

Day 2. 17 April: WORK PLANS for 2018	
8:30-9:00	Reporting & Publishing Plans for FY18 – Luis Cañas
9:00-9:20	Remarks from USAID Ethiopia: Faith Bartz Tarr, Ph.D. Office of Economic Growth and Transformation
9:20-9:50	Discussion 1: Best practices for sustainable management of priority pests – Sibuga
9:50-10:20	Discussion 2: Best practices for sustainable management of viral diseases – Yibrah
10:20-10:45	Break
10:45-11:30	Discussion 3: Testing the whole system: IPM from seed to harvest – Mamiro & Testen
11:30-12:15	Discussion 4: Success stories from trials, training, and technology transfer – Cardina & Mbaka
12:15-12:45	Discussion: Sharing experiences of key stakeholders working to ensure the efficient use of pesticides in pest control – Peter Sseruwagi
12:45-2:00	Lunch
2:00-3:00	Within-country consultation on work plans and discussion of possible revisions.
2.00-3.00	Tanzania: Plans and ongoing activities for 2018 – Mamiro, Sseruwagi
3.00-4.30	Kenya: Plans and ongoing activities for 2018 – Mbaka, Mathenge, Coyne
4:30-5:15	Ethiopia: Plans and ongoing activities for 2018 - Ferdu
5:15-6:00	Meeting Outcomes and Next Steps – Cañas, Cardina, Ferdu

Attendees: 2018 Annual Meeting – Addis Ababa, Ethiopia

Name	Title/Organization	Email	MOBILE
ETHIOPIA			
Ferdu Azerefegne	Hawassa University PO Box 770 Hawassa, Ethiopia	azerefegnef@yahoo.com fazerefegne@hotmail.com	011-251-911-87-6563
Yibrah Beyene	Hawassa University, Ethiopia	Yibrah_beyene@yahoo.com yibrahb@hu.edu.et	251316823637
Alemayehu Chala	Hawassa University, Ethiopia	alemayehuchala@yahoo.com	0912163090
Faith Bartz Tarr	USAID-Ethiopia	email fbartz@usaid.gov	office +251-(0)-11-130-6007 mobile +251-(0)-94-474-9432
Fasial Asef	Healthy Seedlings	Asefafsil2013@gmail.com	+251-(0)91-1407094

Kumsa Dida	Hawassa University	kumsa@gmail.com	0924789947
Selamawit Araya	IITA	Selamhorti2008@gmail.com	0911315102
Feyisa Bekele	Hawassa University	Fayisabekele2008@gmail.com	0123241067
KENYA			
Dr Beth Ndungu	KALRO - Gender expert	Beth.ndungu@kalro.org	254722295272
Jesca Mbaka	KALRO – Plant pathologist	jesca.mbaka@kalro.org	+254 722882422
Patrick K. Mathenge	Real IPM	Patrick.mathenge@realipm.com	+254-722-630-969
Ruth Murunde	Real IPM	ruth.murunde@realipm.com	2540721763345
Danny Coyne	IITA-Nairobi	d.coyne@cgiar.org	+254-714-782-436
TANZANIA			
Delphina P. Mamiro	SUA	mamirodelphi@gmail.com	+255-757-724-447
Kallunde Sibuga	SUA	sibuga@suanet.ac.tz	255754974528
Peter Sseruwagi	MARI	psseruwagi@yahoo.co.uk	255753297544
Njelekela Y Malidhia	MARI	malnjelekela@gmail.com	+255-716-928-333
USA			
Luis Canas	Dept. Entomology OSU	canas.4@osu.edu	1 330 263 3818 Cell 614-746-2429
John Cardina	Dept. Horticulture & Crop Sci. OSU	cardina.2@osu.edu	1 330 263 3644 –office 1 330 466 6531 - cell
Anna Testen	Plant Pathology, OSU	Testen.2@osu.edu	330-263-3838 612-991-2845
George Norton	Department of Agricultural and Applied Economics Virginia Tech	gnorton@vt.edu	540-231-7731
Amer Fayad	Virginia Tech	afayad@vt.edu	540-231-9668

Gender makeup: 9 female, 13 male; of presenters, 9 were female, 9 male.

Wednesday 17 April: Travel to Hawassa.

Thursday 18 April: Diagnostic Workshop Day 1

The Pest Diagnostic Workshop began at 9:00.

Ferdu introduced the meeting and the guests from outside of Ethiopia.

Dr. Tesfaye Abebe, Director of Research for Hawassa University presented an overview of the university and the place of research in agriculture in the university. He described his own interest and association with integrated pest management. There are 48,500 students at Hawassa University.

Luis Canas distributed ‘clickers’ to the participants and conducted a pre-test.

Dr. Anna Testen presented a brief overview of plant diagnostics.

Learn what causes diseases, what to look for, key symptoms and signs. This is a preliminary talk to prepare for the field visit tomorrow. She addressed causes of plant diseases, especially biotic causes, and contrasts these with abiotic disorders, such as environmental conditions, genetic disorders.

For some question and answers, the questions were understood in English but answers given in local language and then translated, or answers were provided in English.

She explained the importance of diagnostic technique, beginning with preliminary information on what the crop is, the history, timing of the problem, what growth stage, what were the environmental conditions, crop variety, pesticide and fertilizer applications, rotation, soil type, irrigation and drainage, incidence or severity, distribution and pattern in the field.

She delivered a comprehensive overview of diagnostic, leading to types of symptoms and what the underlying causes are likely to be associated with them. Then she went through major sources of disease and the possible signs that indicate presence of those causes, e.g. fungi, bacteria etc. She described tools used in diagnostics and have an overview of what is to come in the program.

Luis Canas conducted a brief follow-up test using clickers. This approach got the attention of the audience and they enjoyed participating in this way.

Dr. Peter Sseruwagi delivered a presentation on virus diseases, field symptoms, distribution, impact, associated vectors, and their management. He started with an overview and then got into specific symptoms. He presented diagrams of symptoms and then specific examples of how the symptoms appear on different crops. He distinguished between mottling and mosaic symptoms in particular.

Dr. Luis Canas presented information about insect pests and how they vector virus diseases. He provided information about how to identify the most common insects, and how they usually acquire and transmit plant viruses. He discusses insects such as whiteflies, aphids, thrips, leafhopper and others.

Deogratius Mark, from MARI Kenya then presented information about using molecular techniques to identify which virus are affecting particular plants. He went into a lot of detail about the process necessary to correctly find out which viruses are causing plant problems.

Dr. Ana Testen presented information about common diseases of vegetables and recommendations for their management. Dr. Testen gave practical recommendations in order to manage specific diseases.

Dr. Canas and Dr. Ferdu Azerefegne discussed in detail the tomato IPM package and the different components that can be selected to manage important pests. They provided specific examples of practices that are used in the region that have been successful in

managing the most important vegetable pests. They also provided information about sources that can help identify products useful for pest management.

Dr. Ana Testen showed techniques that can be used with a cell phone to try to identify important plants diseases.

Dr. Ferdu Ferdu Azerefegne gave detailed information about the field trip that was going to be taken the next day to see tomato IPM packages components being used in the field.

Friday 19 April: Diagnostic Workshop Day 2

Dr. Ferdu Azerefegne led the group to a field day where two tomato fields that were using different IPM approaches to managing pests and diseases were visited in Hawassa (3 hrs away from the city). The first farm was using IPM components that include clean seedlings, raised beds, stacking among others. And despite a severe infestation of whiteflies and clear signs of virus and diseases, the tomato plants were producing a good number of healthy tomatoes. However, the participants discussed ways that could be taken from the IPM tomato packages that could improve the farms overall approach to pest management.

The 2nd tomato farm was using even more IPM components to manage pests and diseases. They were using clean tomato seedlings, raised beds, staking, good irrigation practices and good insecticide rotations. The field was very clean and had very few whiteflies and thrips. Therefore, the plants looked very healthy and the farmer expected a really good production from the plants. The participants were able to see examples of the IPM tomato package been implemented and giving very good results.

After the visit to the fields the group stopped at one plant health clinic where Drs. Testen, Canas and Fayad used diagnostic techniques that include microscopes, and computers to train the participants in recognition of major tomato problems, including insects, and diseases. Dr. Ferdu Azerefegne began using a microscope camera attached to a computer to show images of insects attacking various plants.

Saturday 20 April: Diagnostic Workshop Day 3

The next day every instructor discussed with the participants the tomato IPM package and connected with the ideas and observations they had from the previous day's field visit. Many participants included examples from their own experience, and added comments about how they would use the information they had learned from the tomato IPM package to improve their recommendations to their growers.

At the end of the session, Dr. Canas used the clickers to evaluate the knowledge gained by the participants. All information is included with the list of participants. There were a total of 40 participants, but only 29 participated in both the pre and post-tests, 20 were male and 9 were female. Overall the group increased in knowledge and average of 30%,

being pretty similar between males and females. There were a few participants that did not increase in knowledge, while the highest increase was 77%. Overall it seemed the participants were able to gain a lot from the workshop and from the comments we expect they will apply the knowledge gained in the future interactions with growers.

Depart for Addis.

Late pm: Depart Addis for USA.

List of workshop participants (30 male, 10 female)

No	Last Name	Name	Institution	Gender	Grade pre (%)	Grade post (%)	Improvement (%)
1	Zewdu	Ayele	MOANR, Ethiopia	Male	.	.	.
2	Bekele	Mutuma	MOANR, Ethiopia	Male	30.8	84.6	53.8
3	Nemie	Abu	ATJK, Ethiopia	Male	53.8	76.9	23.1
4	W/Yohanes	Yemane	APHE, Ethiopia	Male	76.9	100.0	23.1
5	Tesa	Nura	ATJK, Ethiopia	Male	53.8	53.8	0.0
6	Mbaka	Jesca	KALRO, Kenya	Female	76.9	100.0	23.1
7	Mamunde	Ruth	ReallPM, Kenya	Female	46.2	100.0	53.8
8	Mathenge	Patrick	ReallPM, Kenya	Male	53.8	76.9	23.1
9	Adane	Abiwa	Hawassa University, Ethiopia	Male	53.8	100.0	46.2
10	G/Tsack	Meseret	Hawassa University, Ethiopia	Female	38.5	84.6	46.2
11	Adnew	Etenesh	Hawassa University, Ethiopia	Female	53.8	84.6	30.8
12	Gilma	Endale	Hawassa University, Ethiopia	Male	38.5	92.3	53.8
13	Getahun	Temere	Hawassa University, Ethiopia	Male	46.2	100.0	53.8
14	Mamiro	Delphina	SUA, Kenya	Female	76.9	100.0	23.1
15	Abebe	Tesfeye	Hawassa University, Ethiopia	Male	.	.	.
16	Diriba	Tolosa	Ministry of Agriculture , Ethiopia	Male	.	.	.
17	Shebelle	Markos	APHC, Ethiopia	Male	38.5	76.9	38.5

No	Last Name	Name	Institution	Gender	Grade pre (%)	Grade post (%)	Improvement (%)
18	Moti	Shelema	Ministry of Agriculture , Ethiopia	Male	38.5	69.2	30.8
19	Asfaw	Taye	ZPHC, Ethiopia	Male	84.6	100.0	15.4
20	Nigussie	Alebel	ZPHC, Ethiopia	Male	61.5	100.0	38.5
21	Hede	Negash	Irrigation Ale, Ethiopia	Male	38.5	38.5	0.0
22	Abishu	Hailu	Agri Off, Ethiopia	Male	23.1	100.0	76.9
23	Abdeta	Dejene	ZPHC, Ethiopia	Male	61.5	84.6	23.1
24	Gudeti	Dejino	Ministry of Agriculture , Ethiopia	Male	46.2	69.2	23.1
25	Debesay	Tsion	APHC, Ethiopia	Female	.	.	.
26	Tekle	Tsion	Hawassa University, Ethiopia	Female	69.2	69.2	0.0
27	Garuma	Germame	BOANP, Ethiopia	Male	.	.	.
28	Mersha	Mulualem	APHC, Ethiopia	Male	76.9	100.0	23.1
29	Tadesse	Biya	APHC, Ethiopia	Female	61.5	92.3	30.8
30	Bedada	Abera	Hawassa University, Ethiopia	Male	76.9	76.9	0.0
31	Mamo	Taye	Hawassa University, Ethiopia	Male	61.5	76.9	15.4
32	Tilahun	Beniam	Hawassa University, Ethiopia	Male	.	.	.
33	Buta	Sisay	Hawassa University, Ethiopia	Male	.	.	.
34	Chala	Alemayehu	Hawassa University, Ethiopia	Male	.	.	.
35	Dida	Kumsa	Hawassa University, Ethiopia	Male	46.2	84.6	38.5
36	Zerihun	Zerihun	Hawassa University, Ethiopia	Male	.	.	.

No	Last Name	Name	Institution	Gender	Grade pre (%)	Grade post (%)	Improvement (%)
37	Araya	Selamwait	Hawassa University, Ethiopia	Female	38.5	100.0	61.5
38	Dele	Bekelech	Hawassa University, Ethiopia	Female	84.6	84.6	0.0
39	Guda	Degmawi	Hawassa University, Ethiopia	Male	.	.	.
40	Bekele	Feyisa	Hawassa University, Ethiopia	Male	.	.	.
				AVERAGE	55.4	85.4	30.0
				Average Male	53.1	83.1	30.0
				Average Female	60.7	90.6	29.9
				Male	20		
				Female	9		

Training Activities Conducted:

Program type (workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Workshop	Apr 19-22, 2018		30	10	Ohio State University; Virginia Tech University; KALRO, Kenya; MARI, Kenya; Hawassa University; RealIPM, Kenya SUA, Kenya	Obj 1: Understand connection between diseases and their vectors Obj 2: Understand the components of the tomato IPM package

Suggestions, Recommendations, and/or Follow-up Items:

[List any suggestions, recommendations, and/or follow-up items you may have.]

List of Contacts Made:

List of contacts made are included in the list of participants for the meeting and workshop.

Name	Title/Organization	Contact Info (address, phone, email)

Conclusions:

- Groups from the three countries are working together more effectively as they get comfortable with each other and understand what each is trying to accomplish.
- There is general acceptance of Healthy Seedlings as essential for IPM. This is due to the attention given to this subject by the Seedling Health Workshop we conducted in 2016. Two participants from that workshop are now in commercial production and profiting from this training.
- There is growing connection and outreach in development using WhatsApp for the Plant Health Network. There are now villages in Tanzania using this approach in Kiswahili, and at least three villages in Kenya that are connected.
- Participants are beginning to take action to address the policy issues. MARI is especially active in this regard, as is Hawassa, although their issues are different.
- By focusing on success and emphasizing the successful activities that are happening, there was a positive sense of progress and interest in moving forward.