

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

East Africa Vegetable Crops IPM – IL Kenya Trip Report – Revised 5/3/17

Country Visited: Kenya

Dates of Travel: 18-25 March 2017

Traveler Names and Affiliations: John Cardina, Mark Erbaugh, and Luis Canas (Ohio State University), George Norton and Amer Fayad (Virginia Tech), Yibrah Beyene and Ferdu Azerefegne (Hawassa University, Ethiopia), Amon P. Maerere and Delphina Mamiro (Sokoine Agricultural University, SUA, Tanzania), Peter Sseruwagi and Melidhia Njelekela (Mikocheni Agricultural Research Institute, MARI, Tanzania).

Purpose of Trip: Annual Meeting to review progress on the East African Vegetable IPM Innovation Lab activities, and to discuss and revise plans for the current and next year.

Sites Visited: All in Kenya – Nairobi, Embu, and three sites in Chuka County: Tharaka Nithi Mbogoni, and Mbuiru – Mwanjati.

Description of Activities/Observations:

18 March: U.S. Scientists left United States.

19 March: Scientists arrive in Nairobi, Boulevard Hotel.

20 March: Travel to Embu, checked in to Mountain Breeze Hotel; joined by participants from all countries.

21 March: Group met in the hotel conference room at 8:30 a.m. to begin the Annual Meeting of the project. Jesca started with introductions all around. A sign-up sheet was distributed (and later typed and verified – see end of document for contact information).

The first formal presentation was by Amer Fayad, Regional Coordinator for Africa programs at Virginia Tech. He started with an introduction to program objectives. Then he discussed Work plans and said we need to have a critical discussion about what we need to achieve and how we can be sure to achieve project objectives. We need to look at next steps. We also need to be sure our activities are in line with the larger objectives, in other words, Feed the Future priorities. He suggested that we consider working with packages rather than just components and that the results need to be transferred to farmers. He reminded us that if pesticides are to be used, approval is required through PERSUAP. These are registered by country, and must be approved by USAID. Among the larger objectives is the issue of gender equity. We need to be sure to keep track of impact assessment, i.e. indicators that USAID requires from all projects. We need to use these metrics to reach more farmers, build capacity, achieve gender equity. There will be a presentation on this later in the meeting. He also reminded us to be aware of pipeline – how much money is unspent. He clarified that funds are not considered spent until an invoice is received from participating institutions.

Regarding reporting, he asked participants to respond in a timely fashion and submit reports on time. Finally he discussed how the Management Entity can help, which is through connecting with value chain entities, other partners, writing success stories, and providing a newsletter to highlight aspects of the project. To make this work, he asked participants to consider providing success stories and highlights to go in the newsletter.

John Cardina, Project PI, started out by reminding the group of the main objective of the project: Build capacity for IPM research and engagement. He gave a concise overview of the project focus, approach, priority pests, need for scaling up, and addressing IPM policy. He reiterated what Fayad said about the need to focus on IPM packages. He reviewed the priority pests, but said we can realign these if necessary based on what is happening in the field. One accomplishment so far is completion of the baseline survey is completed in Kenya, Ethiopia, and Tanzania. We will have a report on this later in the meeting. Another accomplishment is the initiation of IPM communication using WhatsApp; this will be the subject of a report later in the meeting. Two successful train-the-trainer workshops so far have included the Diagnostics workshop and Seedling Health workshop. These will be discussed in a separate session later in the meeting.

Participants were asked to preview the agenda so that any need revisions can be made. Several upcoming issues were addressed: 1) Post Graduate Students – we need to know where and who (this information gathered later in the meeting); 2) There is opportunity for two more post graduate students at Ohio State - June 2017, but they must be identified and admitted soon – in the next 3 months; 3) Possible upcoming Diagnostics Workshop: Sally Miller, Bob Gilbertson, Luis Canas, Peter Sseruwagi, Danny Coyne, Ferdu, and others need to discuss; 4) FY 2017 site visit and annual report - August/September: we will select dates for this later in the meeting; this visit will provide us your FY 2017 progress report; we will visit research, demonstrations to make sure we address metrics . 5) Plans for FY18 need to be done by July 15 – reminders will be sent. Finally, he brought up a concern about the future of IPM capacity building, specifically leadership development; we need to be sure we are training the IPM leaders of the future.

Drs. Danny Coyne and Laura Cortada, IITA, presented a report on accomplishments so far regarding nematology activities in IPM. Coyne reminded us that nematology is about what you can't see. IITA nematode work in vegetables is focused on nematode biology; resistance screening; seedling systems, GAP; biological control. The work is not focused just on nematodes because nematodes frequently interact with other pests. Pesticides are over-applied in crop production and vegetables are a particular problem. Local produce, especially, is contaminated, mostly with mancozeb. One case of consumer demands is for tomatoes with pesticides visible on them because some consumers think this is better quality. Root nematode problems are especially severe in vegetables, and they interact with other pest problems. IITA is working in eastern Tanzania and northern (Arusha area). Areas of work include: Diagnosis work for targeted responses; Technology development and application; Capacity building / advocacy.

Project outputs so far include: 1) Distribution of information for or viruses, *Ralstonia* and *Meloidogyne* spp.; 2) Identification of multiple resistance; 3) Assessment of biopesticides from Real IPM; 4) Development of Healthy Seedling Vegetable production systems as the basis of the project. Research was conducted to demonstrate whether a healthy seedling really makes a difference. Healthy seedlings were studied as a package, i.e. produced with resistant varieties, microbial enhancement, grafting, sustainable production practices. They conducted

an on-farm study comparing farmer seedlings, healthy seedlings, healthy seedlings plus GAP. Microbial enhancement addressed issues of compatibility, improvement, current products, and new populations. The study was conducted in the wet season and repeated in the dry season.

Results: Dry season - Farmer seedlings ~7.5 t/ha; Healthy seedlings ~10 t/ha; HS + GAP ~15 t/ha. In other words, the combination doubled yield. In the wet season the corresponding yields were: ~8 t/ha, ~15 t/ha, and >30 t/ha. The use of GAP made a big difference. This decreased pests and diseases. GAP allowed a 4-fold decrease in pesticide use. One issue is to develop a reliable delivery system to get healthy seedlings to farmers. They are working with “Zanzibar agrid investment and development inc.,” (www.zaidi.co.tz; abdyahie@yahoo.com). This group is increasing the development of healthy seedlings.

Coyne and Cortada conducted research to enhance healthy seedlings using microbial products. They tested *Bacillus subtilis* and *Trichoderma* and compared drenched seedlings vs application in-field. Results showed that *Trichoderma* especially improved yield. In other work they developed a Tomato Pest and Disease Identification Guide in two versions of Kiswahili. They have participated in training programs, screening for nematodes, and revision of a nematology manual with demonstrations. Finally, they discussed “Wrap and plant,” a nematocide-impregnated paper. Even the paper alone increased yield. Testing is ongoing to confirm results.

Dr. Jesca Mbaka delivered the report on progress from current activities for the Kenya Agriculture and Livestock Research Organization (KALRO). The KALRO group visited regions that they have not worked in previously. Due to politics, they were required to work in other areas. They worked with leaders to identify key problems; water was an essential component of the project. From this, Chuka County was selected (and we will visit on day-3). Here, farmers relied heavily on pesticides. Therefore, for the Baseline survey, the Chuka area was selected for study. An Irrigation Scheme is there and water has been available since 2010. The main knowledge gap identified is that the only thing known about pest control was pesticides. The priority crops and pests were identified: tomato (bacterial wilt; Tuta), French beans (nematodes, foliar diseases), brassicas (black rot, soft rot, DBM).

In on demonstration they conducted, on soil solarization, plastic was left in place for 8 weeks. After this time, no weeds germinated under the polyethylene sheets. The farmers planted a Kilele hybrid tomato variety, supposedly resistant to bacterial wilt. Germination was less than 20%. Seeds from the fruit germinate better than the seeds purchased from stockiest. They went back and used seeds from the fruit, but germination was no better.

They conducted a study on *Tuta absoluta* management in the Nazaret region. The goal was to manage Tuta at the nursery stage. They taught the farmer how to use insect-proof netting, then moved to transplanting.

For work with French beans, they had to convince the grower the value of reducing pesticide use. Some French beans have been refused for exports because of pesticide residues. An on-farm trial was initiated by Sylvia Kuria evaluating strains of *Trichoderma* and Plant-Mate. In addition, Kambo is conducting work on Tuta using Neem oil, BT, *Beauveria*, as well as some work on French beans (these will be visited on day 3). Muriuki initiated work on diamondback moth. He found that a major problem is cabbage moth. Hover fly was seen feeding on aphids. Pesticides would kill the fly; therefore, the farmer came to understand the need for biological control.

They conducted a study to compare *Trichoderma* strains from Real IPM versus those from local companies. Few farmers are using these materials; more training is needed to demonstrate their use and impact. In work with bacterial wilt and soft rot of cabbage, the variety 'Queen' is labeled resistant to black rot. It is being monitored for soft rot. They did not compare with synthetic chemicals because of their understanding that this project cannot purchase synthetic chemicals.

This led to a discussion on PERSUAP and the rules about pesticide use in the project. Fayad clarified the situation for everyone: It is allowable to use pesticides if approved through PERSUAP and registered in the country and approved by USAID. He said if a pesticide is helpful in an IPM package, we can seek approval. Delphina Mamiro asked if we can get a list of approved pesticides. There is a list available in Kenya (lists of approved pesticides were found and circulated later in the meeting). In the discussion it was noted that it is to our advantage not to use synthetic chemicals, because farmers are likely to prefer them to biological controls if the chemicals work quickly.

Back to the KALRO report, Dr. Mbaka indicated that the farmers selected are in an irrigation scheme. They are not well organized even though they presented themselves as a group. The common denominator is locality and access to water. KALRO's effort is to organize the marketing. Scientists are collecting data from on-farm trials. The idea is to bundle together the things that work. Regarding training, KALRO sent trainees to the diagnostic training in Mikocheni. They found the use of WhatsApp with smart phones is helpful. KALRO conducted its own training on the use of this system, but they need training on how to get good images. Three people from KALRO attended the Seedling Healthy Workshop in Tanzania, including one farmer. For long-term training, there is one student at University of Nairobi working on Tuta using entomopathogenic nematodes (*Celia*), and a second student proposing to work on resistance to rhizoctonia. They are hoping to send another student to Ohio State. KALRO is working with Chuka university to identify a student to look at plant extracts for control of pests of French beans. KALRO is working with KAVES, through contact with Steve New. They are doing variety testing in western Kenya.

This led to a general discussion regarding training: Amer Fayad noted that we need to report on short and long term training. Even for a couple of hours. We need information on the nature of the training, the gender breakout, how to get more gender equity. All the farmer meetings need information such as: Title, number of farmers, title of discussion, gender breakout. Participants requested a convenient form to help collaborators collect this information easily.

Patrick Mathenge presented a report on progress in work conducted by Real IPM. Real-IPM's role is to provide infrastructure so that information gets to farmers. They are advancing the use of smartphones for digital communication with networks in each country. They also provide inputs such as microbes and other bioproducts for evaluation, validation. Patrick gave a quick over of the WhatsApp working group created in August (a full discussion later in the meeting).

So far they have 64 members out of 256 possible. More members are needed from extension, NGOs, input suppliers, key farmers etc who can provide information. They are developing a Diagnosis portal, and a way to view collections of images, and then to get a diagnosis – this needs to come from this group. If local sub-networks don't get the information needed, the idea is that they can upload a photo and question to send out to the expert team.

This led to a discussion about whether it is acceptable to get products free from Real IPM. Jesca prefers to purchase. Should there be a problem with using products from different sources?

What about searching for new strains in other countries? It was noted that a registered product has gone through testing, formulation, and registration, which takes a lot of money. This project does not have money to do these things. If a product is available there is no reason not to use it; no different than any other agricultural input.

Dr. Amon Maerere presented the progress report from Sokonie Agricultural University. He began with a review of the meeting last April to select priority crops and pests. For the baseline survey, they identified two regions, several districts within each, and several villages from each district. There were many households from which to choose, as the region have a 53,000 total population. For the Baseline survey they selected 400 growers, 200 from Morogoro, 200 from Iringa regions. Data were collected and are being analyzed. Some highlights: 73% of respondents were male; mean age 40 years; 79% primary school, 16% secondary school; 6% lower than primary. Land owned averaged 4 acres; mean acreage last season was 3.4; 2% did not own land. Dominant crops were tomato, onion, cabbage; some cucumber, watermelon. Existing farmer groups include TAHA, MVIWATA, and SEVIA. Specific practices used include: tomato grafting, hybrid varieties for pest resistance, use of biopesticides, botanical pesticides against thrips, parasitoids against stem maggot, overhead irrigation against Diamondback moth. They are working to assess cucurbit pests and evaluate potential management practices for *Tuta absoluta*.

For production trends, most farmers reported increases in production. Most sell at the farm gate; traders come around to buy the crop. Information mostly comes from other farmers, next from ag extension. Knowledge of IPM suggested that men like going to town to buy pesticides, taking money from their wives. The most important pests: Tuta on tomato, aphids on cabbage, thrips on onion.

SUA's work in training and capacity building included the highly successful workshop on Vegetable Seedling Health. The workshop combined theory with hands-on training. Participants learned how to begin the season with healthy seedlings. They covered critical IPM issues: seed quality, seedling quality, media sterilization, irrigation and nutrition management, grafting seedlings, and others. There were a total of 63 participants. One farmer presented his experience.

Next steps for work at SUA will be to identify early adopters and set up demonstrations with them. They plan to conduct a survey about use of seedlings vs seeds, and produce extension materials. They are developing plans to test prototype pest management technologies, e.g. grafting, biopesticides, variety selection, overhead irrigation, botanical and biopesticides. For long term training they have one student at Ohio State (plant pathology).

Dr. Peter Sseruwagi presented the progress report for MARI. They conducted their own biological and sociological baseline survey on vegetable viruses and vectors. These results could be compared with those conducted at SUA, although the regions surveyed differ. They surveyed five major vegetable growing regions; 40 fields were surveyed. Demographics from the survey of 40 fields: Male – 70.8%, Female – 29.2%. Education – primary level 91.3%. Confusion was noted between virus and fungal diseases; insect pests: aphids, Tuta. The farmers know of virus symptoms but not the cause. They found major crops to be tomato, okra, cabbage, kale, green pepper, onions, African eggplant, and squash. They made assessments of symptoms, disease, and insect damage. Virus incidence (based on plant

incidence): Onion 20%, African eggplant 46.7%, okra 64.4%, green pepper 86.4%, tomato 93.7%. Potential problem is the false positives. Insect samples: Collection ready but need to identify. Training is needed to teach farmers identification and basic pest biology. MARI was the lead institution for the Diagnostic Workshop. They demonstrated virus and vector identification, and showcased disease spread and virus-vector IPM studies. Next steps for their work will be to develop IPM packages starting with tomato. They will work to train farmers and extension in vegetable plant virus symptom identification and IPM, including diagnostic primers for I.D. of viruses. They are interested in pursuing a pilot facility for production and use of healthy seedlings.

Dr. Ferdu Azerefege delivered the report for progress in project activities at Hawassa University, Ethiopia. He started with a summary of vegetable production in the Rift Valley. The main points are as follows: Onion, tomato, cabbage and pepper are the main vegetables. They are working in Meki, Koka, Ziway other locations. Additional crops are Chili and Head cabbage. Most farms are small holders; many work on contracts. Current pest problems and management include onion thrips, diamondback moth. Farmers mainly depend on pesticides for pest management. The main sources of information are pesticide dealers and fellow farmers. Only a few pesticides are available; these are used at high rates. Farmers generally do not observe safe use of pesticides and there is no regulation in the use of pesticides. Most follow crop calendar for application timing. Primary pests are as follows: for tomato – viruses, powdery mildew; *Tuta absoluta*; Cabbage: DBM, thrips, aphids. Onion: thrips. Pepper: aphids, thrips, whiteflies, ABW. Also on tomato: ABW, PTM, Tuta, whiteflies, thrips, spider mites.

For current research, their main focus is on how to reduce pesticide use, better timing. Once convince that they can be reduced, then can introduce alternatives. One MS student (Kumsa Dida) is working on peppers, on how to delay virus infection using netting. They are testing duration of netting in field to keep vectors out. Another student (Feyisa Bekele) is studying effects of weeds on onions to do MS. Mulch would work but all plant matter is used for animals. The main available pesticides are: Profenofos, Dimethoate, Lamda cyhalothrin, Spinosad. For tomato farmers are raising seedlings from own nursery or commercial farms. New pest problems are whiteflies and virus. There are few tested options for management. They work with the Ziway Plant Health Clinic, the Ambo Plant Protection Research Center, and are testing products from Real IPM, Koppert, and other sources like the Plant Protection Directorate, Ministry of Agriculture. Most seedlings come from farmers. But for expensive varieties they give the seeds to commercial farms to raise the seedlings. Ministry of Ag is very cautious about bringing a new organism for biocontrol into the country.

Dr. Cardina moderated a discussion on “Technical Training Workshops: What worked, what didn’t. We discussed the Seedling Workshop at SUA, March 2017. The workshop ran on time; facilities were appropriate; organizers adapted materials to needs of participants. As for what could be improved, the workshop surveys by participants suggest a few: “Horticultural practices are part of IPM – awareness for other aspects is needed but sometimes taken for granted. Further training is needed: Post-harvest; Weeds. More hands-on demonstrations: Seeing how biocontrol products work in comparison with conventional pesticides; Row covers and other protection methods. A visit to a seedling facility where techniques are being followed. More information on sterile technique. Lack of enthusiasm for the lecture format (powerpoints). If audience are farmers, maybe less lectures and more a hands-on approach.”

We then discussed the Diagnostics Workshop: August 2016. It was noted that there was little time to organize. Institutions – especially MARI’s organization - helped make it a success. They used a lecture format. People liked the depth of knowledge. The audience was more technical people and few farmers. They used Pre-quiz and Post-quiz using clickers and participants liked this approach. They paid attention because we were evaluating their performance. Then they went to the field and used what they had learned in the lab. The WhatsApp worked well. As for what can be improved, participants said: “Provide time for participants to present; Maybe say what they know and interact with the presenters; Include students if possible; Post questions that people ask and have responses. Move away from lecture format. The person coming to learn can also present with experts and within themselves. This is a participatory approach that gives everyone a chance to have input.”

In summary: training needs to match needs of the audience, but even with technical audiences, hands-on is best and lecture format should be used judiciously. Quizzes and feedback help to modify the workshop on-the-go to meet audience needs.

Then we discussed next areas of training. Many were listed, including:

Biological control

Post-harvest management

Pest identification with farmers

Pesticide safety

Pest management decision making

Diseases and nematode identification

Develop small training booklet (from workshops)

Training manual or other material that stays behind

High and low tunnels

Early warning system –prediction and anticipation of pest problems

Regional training on *Tuta absoluta*

Maybe concentrate on audience critical to improve impacts

Need info on other production phases.

Consider post-harvest management or weed management – these often taken for granted.

Dr. Luis Canas led a discussion session on “Progress on the WhatsApp Network” with support information from Patrick Mathenge of Real IPM. Canas started by describing reasons to use WhatsApp: it allows for easy international communication; users can send files, messages, and images and it is a very easy platform to learn and use. He showed data indicating it is the most popular messaging app in every country in Africa. WhatsApp dominates South America, Asia (except China), Africa, India. He described the introduction of the network to the Diagnostic Workshop participants. The audience here included experts, ministry people, technicians, and some students. They started using it right away and were presented with ‘rules’ for the network in terms of professional use as well as how to take images of the field and individual plants and symptoms. He then presented data on Message Density. Most messages were sent in September after the August workshop. Messaging tapered off from October through January, in part because this was not the main growing season. A small increase occurred in February following the Seedling Health workshop. This shows that the network gets active when a few people engage the audience. We need a way of engaging people. We can ‘seed’ this activity by sending something out periodically – it could be a question or an educational piece, or a pdf of a factsheet. A recent example is a factsheet about seed sterilization sent recently by Bob Gilbertson.

Canas reviewed data on who the participants are. Remarkably, results showed that 64% are female. This suggests that this technology is a way for women to have a voice and should be considered a way to enhance gender equity. So far, 88% of participation has been from Tanzania, 7% from Kenya, 5% from US. A search by key word showed that they most frequent subjects were: Bacteria, symptom, seeds, all of which had at least 20% occurrence. Data on message content, participant identity, time of message and similar information can be extracted and used different ways. The hope is that this should lead to other branch networks involving farmers. There is a potential multiplier effect. 256 is max number of participants for a given network. The hope is to have farmer groups to form their own network, and to be connected to the Expert Network, possibly through group leaders or participating partners (e.g. TAHA etc). Those who work with farmers can create a group and then they would be a link to the expert network.

We discussed the need for Real IPM's help with this. Regarding database connection: If we connect to a database, it would allow us to search all aspects of the text and images. There are other diagnostic programs. However, it makes sense to work with Real IPM because their online database is external. Other databases are by subscription. Our project should have free access. A question was raised about availability of more elaborate system and why we need to create our own. Canas responded that the point of this network is to build a support community that can take on a life of its own beyond the duration of the project. This is what building capacity means. If all we want is information we could tell farmers the link to an encyclopedia. But this network focuses on IPM and allows for give and take among participants to answer questions that might change over time. The network also allows us to connect participants to publication – guidelines for control can be connected We can do a filter and search for various subjects and use that to find the big questions about various crops, pests etc.

Fayad asked how this helps build capacity; is there some kind of analysis to see that you are building capacity? Canas responded that yes, we can get data on who is asking questions and who is answering. Over time, we hope answers come increasingly from host country and from discussion among participating agencies, and this is capacity building. At the end of the project this network should still be active and growing, and that doesn't happen with a research publication or factsheet.

George Norton observed that this is innovative. Other Innovation Labs – e.g. in Asia - could benefit from connection to this network, as these same issues and pests arise in the Asia, South Asia etc. This goes back to the structure, which is still a work in progress.

Ferdu mentioned that there are many initiatives. "Plantwise" is a program that trains farmers to be plant doctors. From this one we can learn. He needs to know the best advice to start a network in Ethiopia. First they will have to learn how to use WhatsApp, and then figure out how to make a network that works for Ethiopia. Language might be an issue, although there is no reason not to develop the network in Amharic.

A discussion ensued beginning with Fayad asking about IPM packages for different pests being put out by the management unit. These could go out by this network. There are other diagnostic tools, which we all know about. But the key is connecting to the grassroots level. Canas clarified that it would be great if that happens. That's up to the country coordinators to make that happen.

Patrick Mathenge indicated that IPM has worked with this system and it does go down to the farmer level, but we need to give it time and continue to find ways to keep it alive and spreading.

Peter Sseruwagi noted that the fact that farmers can use it and ask what a problem is, gives farmers links to each other and to expertise. They can write in their own language. This has the potential to make this network especially useful at the grassroots level.

Dr. George Norton delivered the Baseline Survey Report. He noted that objectives of the survey were to confirm what the farmers think and understand, and for use to know what the current practices are now. We can use the data to ask why technologies are adopted or not. Menale coordinated this survey in Kenya and Ethiopia. Dr. Beth Ndungu was heavily involved in designing the survey. She also conducted a survey in another county in Kenya. The survey was pilot tested after training enumerators, then started in Kenya first. Maerere already conducted a survey in Tanzania, so this can save us expense and effort. Amon will send survey questions and results to George. Therefore, we have now completed a survey in each country. The Kenya survey has the following characteristics: 403 farmers from four counties. The survey was conducted in June/July 2016.

Highlights of results:

Participants: Half male, half female – farmers and enumerators. Most (90%) were literate. Half had earth floor; half tile; this is an indicator of poverty. 46% had electricity. Only vegetable growers were interviewed. Everybody also grew maize; all had at least one vegetable. One third were members of a farmer organization. Ag Extension, radio, and neighbors are key sources of Ag information. Tomato and onion are the highest revenue crops among the vegetable sampled. Bacterial wilt and canker diseases were felt to be worst pest problems for tomatoes; black rot, soft rot, and aphids worst for cabbage; rust, blight, and white flies worst for French beans. Cost is the number one factor influencing farmers' decision to use IPM rather than pesticides. Only about 20% of farmers have received IPM training. Removing damaged plants and resistant varieties are most common non-pesticide pest management practices. They claimed approximate gender equality in pest management decision making. Most farmers agree pesticides harm the environment, but still many do not seek alternatives.

22 March: The meeting resumed in the hotel conference room at 8:00. The schedule was modified to allow time for country participants to coordinate work plans. Presentations originally scheduled for the afternoon were moved to the morning.

Dr. Fayad presented a session on “Metrics and Indicators for Reporting.” He passed out a list of 8 indicators. These include the following:

Number of rural households benefiting directly from interventions

Number of individuals who have received short-term training in agricultural sector productivity or food security

Number of individuals who have received degree-granting training in agricultural sector productivity or food security

Number of for-profit private enterprises, producers organizations, water users associations, women's groups, trade and business associations, and community based organizations (CBOs) receiving food security related organizational development assistance

Number of technologies or management practices under research, under field testing, or made available for transfer

Number of farmers and others who have applied improved technologies or management practices:

Number of hectares of land under improved technologies or management practices:

Number of for-profit private enterprises, producers organizations, water users associations, women's groups, trade and business associations and community-based organizations (CBOs) that applied improved organization-level technologies or management practices:

Fayad noted that all sites need segregated data – by gender, new/old etc. Also, note that individual components of a package are separate technologies; if for another crop, that, too is different. He repeated: segregate all data.

A discussion followed with these points;

Participants asked for an Excel spread sheet to keep track of this information? For example create something like this for the WhatsApp network. They asked if Fayad could maybe provide example. For area data, add hectares even if in the research phase. Gender inform for improved technologies refers to the main owner of the land being used. Fayad also requested a 2-pager with major accomplishments, challenges, outputs, capacity building, linkages with the mission, gender integration, top challenges to implementation, integration nutrition and agriculture, any major progress in terms of making vulnerable people and communities more resilient. A bulleted list is acceptable. He reminded participants to use the Feed the Future logo for presentations at top. At bottom is USAID and Institution.

Dr. Jesca Mbaka led a discussion on “Critical Pests.”

First we discussed *Tuta absoluta*. Mbaka noted that proper crop and pesticide rotation information is needed for growers. She said we need lists of available insecticides for each country. This is difficult because efficacy tests and rotation have to be conducted by each country. Validation of products is required for each country as well as effects on natural enemies

Slowing down resistance is critical, but not sure how. The question was raised whether an area wide management approach would help. This requires integration and it is not clear that this is possible. The regional approach issue resurfaced in discussion of virus diseases across the region We discussed developing guidelines that could be published. For example, enough information is probably available to put together guidelines on IPM for Brassicas, at least a start that could be updated.

We then revisited the issue of the subject for the next workshop. Only Tanzania is reporting viruses as a major issue, because understanding and perception are poor elsewhere. Multiple virus infections are sometimes present and many undescribed species. There is a need for virus training and understanding vectors. Nevertheless, the discussion suggested that training on pest identification might not be so critical. The consensus was that there is a need for a workshop on the tomato IPM package, in other words, integration of the many practices involved in tomato IPM, from variety selection, seeds, seedlings, to transplanting to post-harvest. What is needed is data on treatments. Maybe a combined pest identification and management and biology training.

Mbaka suggested a workshop on IPM systems for tomato, not just on one pest. There was general interest in designing a tomato IPM workshop. This could lead to booklet or other resources.

Ferdu indicated that in the greenhouse, predators are effective against tuta. In field not realistic. Farmers know how to identify most common diseases. Some things that work in lab don't always work in the field. There are no good new options. For DMB on brassicas, in

Ethiopia a parasitoid is controlling it in upland areas; the parasitoid is from icipe; otherwise we don't hear much about it; in other areas it is controlled by insecticides.

The discussion did not go in a linear fashion. But the exchange among people from different countries was new and good.

Dr. Mark Erbaugh led a discussion on "Linking with Farmer Groups." He advised participants to prioritize crops, suggesting a maximum of three given the budget and time constraints. He reminded use to focus on Feed the Future focus areas. In the proposal we talked about hub and spoke approach to do tech transfer. For our purposes the hubs are: KALRO, SUA, Hawassa. The spokes include value chain partners, TAHA, SEVIA, KAVES, MVIWATA. He then discussed technology transfer and scaling out approaches. He indicated that experimental design is critical.

Make sure to distinguish demonstration site from an on-farm experiment. Keep on-farm experiments simple. Make sure there are good controls and replication. On-farm trials work well to evaluate a system, and use farms as replicates. On-farm trials for individual technologies would have replications within farm. Discussion ensued on experimental design. Our objective is to come up with packages. In these, that package itself is the treatment. Rather than looking at one pest, look at IPM as a strategy, where the package is the treatment, compared with conventional farmer practice. An example is the Tomato IPM package with various strategies developed previously. For new steps and ideas he discussed assisting trainers in how to work with farmers. Identify early adopters and work with them. The idea was raised of a program for certification for seedling producers; this is something that could be explored in conjunction with partner entities. Another suggestion was mapping adoption of technologies and challenges/bottlenecks that could lead to focused attention on pests and even better adoption.

The afternoon session began with within-country consultation on work plans and discussion of possible revisions. One hour was allotted to this, but more time was given due to the good discussion and interactions. This was followed by the Report out on work plans by country.

Dr. Jesca Mbaka presented the KALRO work plan. She started by discussing on-farm and on-station trials. She made clear the KALRO and Real IPM are not in conflict about testing of biological products. KALRO will use Real IPM products; if available they can also compare these with those of other companies. Real IPM will provide smart phones where needed in Chuka. They agreed on working together on the WhatsApp network. She indicated that they had discussed with IITA about having training in nematology, nematode extraction; IITA will help with identification. When they collect isolates they agreed to collect GPS coordinates and send the samples to IITA. They are conducting studies to evaluate varieties for resistance and grafting in management of nematodes and bacterial wilt. For *Tuta absoluta* management KALRO will evaluate selected options.

On-farm trials include the following:

1. Validation of biopesticides in the management of cabbage moth.
2. Evaluation of selected IPM options for control of red spider mites, thrips, and whiteflies in French beans.
3. Evaluating technologies for management of root rots, rust and other foliar diseases of French beans.

Dr. Ndungu is working on a benefit-cost analysis of IPM options. She is looking at costing of inputs and yield changes in response to inputs, then assigning costs and returns. She is training farmers in record-keeping, to do basic cost benefit analysis.

Studies are being conducted on validation of biopesticides for cabbage moth. They have learned that 3x3-m plot is too small. Now they will consider a farmer as a replicate. Biopesticides have not yet been included.

For experimental design, the following points were made: For on-farm experiments, need to compare farmer practice with the IPM package. For an on-farm trial this would be the minimum treatment set. For on-station experiments, need also to include an absolute control.

KALRO is working to develop packages They have compare solarized vs non-solarized soil. The package is intended to include everything e.g. solarization, netting etc. Now they want to introduce biopesticides. The first step is to validate biopesticide. Next is combining the biopesticide into the package in the right way.

Other KALRO activities include: 1) Stakeholder Workshop; 2) Long and short-term training; 3) Development of brochures, fact sheets, posters, laminated field cards for teaching symptoms.

Dr. Mbaka Proposed that KALRO would conduct a Tomato IPM train-the-trainer workshop. It would be located in Kenya and conducted over three days in September. Content would include: package components eg solarization, clean seedlings, high tunnel, pest ID and control.

Dr. Danny Coyne presented the IITA work plan. It includes the following:

Objective 2): Conduct long- and short-term training and capacity building.

Activity 1 - Attend and provide training workshops in Nematology techniques as follows:

Jimma University, Ethiopia - June 2017; Hawassa Ethiopia – Diagnostics workshop, September, 2017; Chuka University – April.

Objective 3): Test prototype management technologies

Activity - Technical Advisory oversight; Ethiopia – Addis Ababa University. Identify suitable microorganisms, assess compatibility with tomato and pepper, determine improved enhancement of seedlings, and determine protection against nematode pests.

Objective 4): Evaluate packages to determine project impacts.

Activity - Provide integration and links to IITA activities at Planning Meetings and Evaluation Meetings.

Ferdu presented the Ethiopia Work Plan. It includes the following:

Survey on Healthy seedling production – survey nurseries to see what practices are being used and what gaps are. Include farmers raising seedlings for own use and commercial nurseries (seed source, types of beds and media, common pests, Pest management, seedling health and quality).

Physical observation by the investigators/ researchers / students

Analysis on gaps to good nursery practice.

Training on healthy seedling production for farmers. They will select vegetable growing farmers with different capacities: about 40 farmers (Alaba, Butajira, Meki, Ziway, Hawassa). Train farmers on seedling production: Seed treatment; Soil sterilization with burning and solarization;
Crop and pesticide rotation; Netting; Protecting from pathogens and pests with pesticides; Good nursery practices (seed rate, watering, shading, mulching, sanitation, roguing symptomatic plants etc)

Identification of Healthy for seedling producers. They will visit nurseries with good practices. The intention is to raise seedlings with good practices for demonstration to farmers

Training extension workers, and early career crop protection workers (graduate students, junior researchers): Raising healthy seedlings; Diagnosis of major pests of vegetables; Methods of scouting; Current practices and gaps on pest management; Options for pest management.

Research will include the following:

Evaluate the performance of pepper and tomato seedlings treated with Trichoderma. They will focus research on use of Trichoderma for pepper and tomato. They will start with lab and greenhouse experiments, then field studies with farmers. They will conduct studies on farms around Hawassa and Ziway with problems with soil borne diseases. Seedlings will be treated with Trichoderma from Real IPM, Kuppert, and Ambo Research Center. These are initially greenhouse pot experiments by graduate students.

Pepper virus studies: They will start with healthy seedlings treated with Trichoderma. Treatments include different durations of netting and protection of vectors, mostly aphids. A no net barrier control will be included. The pepper will be covered with net for 20, 40, 60, days and until flowering; this will be compared with repeated spraying with dimethoate 40% EC.

The location is a field near Hawassa. They will assess the disease prevalence and severity, and population of vectors, pepper performance.

Evaluation of available IPM packages for pepper: They will compare healthy seedlings + Trichoderma treated + border plants + roguing symptomatic plants + monitoring for pests + applying approved pesticides when necessary. They will observe proper agronomic practices and monitor ABW, whiteflies, thrips, mites; Powdery mildew, and bacterial spots. This will be conducted at Hawassa, Ziway, Butajira and Alaba n farmer fields (200m sq). The goal is to compare IPM with farmers practices. There will be a minimum of four farms in each location. They will use a border of maize to delay virus transmission; only approved pesticides will be used. They will monitor different pests, comparing farmer practice and the package including healthy seedlings, Trichoderma, border plants, roguing, monitoring, approved pesticides when necessary.

Development of threshold for aphids: Needs to be easy, presence / absence based. But make sure they can be used by farmers. Maybe something simpler such as a calendar based application. Then they can provide a list of pesticide rotations to use. This will be tested on-station in Hawassa.

Control of weeds in onion: They will continue ongoing studies on the efficacy and economic evaluation of weed control methods on onion. Treatments are combinations of hand weeding

and herbicides, compare with farmer practice. This will help train a student. The study is being conducted at Ziway and Meki; there are four farms with 200 m sq. Data are collected on onion growth and yield, economic analysis, as well as farmers' evaluation.

Onion thrips management study: The objective is to reduce frequency of pesticide use. They will conduct a field trial on rotations of insecticide application compared with farmer practice. Six farms are involved, and it will be conducted both in wet and dry seasons. Data will be collected on pesticide use, plant growth and performance, economics of pest management.

Ongoing research is being conducted at Melakssa Research Center using rotations of insecticides + adjuvants. Applications are based on monitoring of thrips and will compare with farmer practice. There are four farms with a minimum plot size of 200 m sq. This will be conducted both during dry season and wet season. Data are collected on pesticide use, growth and performance of onion, economics of control.

Studies on tomato pests: The focus is on Tuta and also powdery mildew, and the goal is to reduce pesticide use. Currently growers are using Coragen. The study will include healthy seedlings. Tests will be conducted at Meki and Ziway districts, involving six farmers. They will compare with farmer practices. The test system will introduce traps to monitor using attractants. A student is working on rotation of insecticides. Farmers are using Indoxacarb and emamectin benzoate registered for use in greenhouses.

Tomato IPM: This study will examine a package with healthy seedlings, trichoderma, border plants, removal of solanaceous weeds; roguing symptomatic plants, monitor early detection of vectors, pests, disease; pesticide application will be based on monitoring. It will be conducted at Melkassa research center in plots with RCBD and four replications.

Support for pest diagnostics and management: They will start on vegetable pest management brochures which will eventually develop into IPM manuals at the completion of the project.

Introduce the use of WhatsApp: The goal is to link plant health clinics and persons involved in this project to WhatsApp IPM groups in Ethiopia. This will be linked to the pest web page on Hawassa University web site.

Hawassa is working in collaboration with Maize IPM, IITA, other universities, commercial producers. An example is Professor Fasil Assefa's Project. They are also working with commercial producers (Ethio Veg). There are so many NGOs and projects like this one, there is competition among them to work with the farmers. So for us to work with them, we have to pay them.

Dr. Delphina Mamiro presented the Tanzania Work Plan, beginning with work at Sokoine Agricultural University.

Short-term training and capacity building:

Activity 2: Collaborate with MARI to deliver train-the-trainer education. The hope is to take this to the villages. The focus is on tomato, cabbage, onion, cucurbits. Four trainings will be conducted; one at beginning where nurseries will be established, then training on vegetable crops. The audience includes input suppliers, farmers, extension. Include TAHA, SEVIA etc to share the training expertise. As this is demonstrating an IPM package, it needs to be called

a technology transfer activity. This is Technology Transfer, according to Fayad. Title of training: Healthy Vegetable Seedling and Crop Production IPM Practices. Location: Morogoro, Mvomero, Iringa, Kilosa and Kilolo districts. Timing: May-July 2017. Crops: Tomato, cabbage, onion, cucurbits. Priority pests: *Tuta absoluta*, viruses, whiteflies, aphids, thrips, blights, wilts (nematodes, bacterial, fusaria), mildews, mealybugs. In each district at least 3 groups of farmers will be trained on healthy seedlings to healthy vegetable crops and produce IPM practices. For seedlings, they will focus on healthy seedling production practices including GAP. Training will include hands-on identification of pests (insects, pathogens, nematodes, weeds) as well as the pests natural enemies. There is also interest in discussing safe use and disposal of pesticides

Testing IPM prototype technologies: The objective of this activity is to conduct on-station and on-farm evaluation of pest management technologies/practices for their potential yield and environmental benefits. Five technologies have been identified for evaluation during the coming production season: Grafting of tomato and cucurbits for bacterial wilt and root disease; slurry, biogas, and microbial biopesticides, botanicals for onion and cucurbits; for bacterial wilt, root diseases, white grub, and thrips; variety selection for resistance to thrips. Overhead irrigation is intended to interrupt mating flights of DBM to protect cabbage. Botanical and biopesticides will be used for tomato leaf miner (*Tuta*).

Dr. Peter Sseruwagi presented information on the work plan for MARI as follows:

Activity 1: Evaluate IPM practices for vegetable virus diseases and vectors. The timing of the activity is April/May 2017; priority crops are tomato, cabbage and cucurbits. Priority pests are viruses, whiteflies, and aphids. They will use IPM practices such as healthy seedling production in an insect proof screen house, isolation, roguing, biological control. Expected outputs will be a package for healthy seedling production as part of an IPM package. The target audience is vegetable producers, extension personnel, and consultants.

Activity 2: Develop diagnostic primers for identification of vegetable viruses. The timing of this activity is June to December 2017. The priority pests are vegetable plant viruses and insect vectors. They will design and optimize diagnostic primers using the sequence data for efficient detection and identification of vegetable viruses. Field-based detection tools such as immune-strips for use by extension workers will be developed for early detection and control viruses in vegetable crops. The target audience is scientists and crop inspectors.

Activity 3: Evaluate IPM packages and agronomic practices for management of vegetable viruses and vectors. The timing of this activity is June-December 2017. MARI will develop handouts for IPM management such as leaflets, fliers and posters explaining the IPM diagnostics. A guide on good agronomic practices for vegetable viruses and vector management will be produced. The targeted audience include: vegetable producers, extension staff, and crop protection officials.

Activity 4: Train in use of IPM packages technologies. The timing of this activity is March 2018. The priority pests are vegetable plant viruses and insect vectors. MARI will provide training in use of new IPM packages and technologies for management of vegetable viruses and vectors. They will disseminate leaflets, fliers and posters on IPM packages. The goal is training in good agronomic practices for vegetable viruses and vector management. The target audience includes farmers, extension workers and crop inspectors.

23 March: The group joined a bus at 8:30 for departure to Chuka county to visit three research/demonstration sites.

The first stop was Tharaka Nithi farmer group, also called “Nthambo group.” This group has 288 members of whom 91 are women and 51 are youth. The main crops are: kale, cabbage, okra, other vegetables. The main problem they face is overuse of pesticides, pesticide drift, and health concerns. They request information from KALRO about pests and farm safety.

Mr. Eston Jamleck (estonjamleck@gmail.com) addressed the group. He is the farmer here, and he attended the Seedling Health Workshop at SUA in Tanzania. He is the youngest farmer in the group. He uses soil solarization and netting. Problems are aphids and DBM. He scouts often and is interested in trap crops and intercrops. He planted tomato as a trap crop in cabbage. Hover fly fed on aphids, so he does not want to apply spray that will kill the predators. He is especially interested in seedling production. He does not have elaborate facilities. Therefore, he contracts with an Israeli company to produce his seedlings. Seedlings are very high quality. He must pay transportation costs. The cost relieves him of the time and stress of seedling production. He is considering being a middle-man between the Israeli company and farmers, to order and deliver seedlings.

The second stop was the Mbogoni Irrigation Scheme. The Mbogoni Farmer group has 15 female, 26 male farmers. Charles Mutege is the resident farmer. The main problem is pests on French beans; previous crops were rejected by export market due to excess pesticide residue. Some farmers are using pesticides twice per week even though they don't know if the pest is present. We viewed an on-farm experiment (conducted by Sylvia Kuria) on tomato. The tomatoes were in good shape; Tuta was present, but an application of Neem oil had suppressed them. Trichoderma treatment looked promising.

The third stop was the Mbuiru – Mwanjati Group. In the audience were 38 males, 20 females; 10 youth. This area has been on relief food. Now they are getting water to produce their own food. They need information on vegetable production. The host was Ms. Stella Kageru. The group formed in 2007, with 257 members of whom 90 are women; 80 youth. This is an irrigation scheme; irrigation finally provided in 2010. The group's main goal is to be employed on the farm. The group selected the main crops as onion, tomato, kale, and French beans. Their current challenge is to manage pests and disease. Farm inputs are expensive. They developed a relationship with KALRO and participated in the baseline survey. They were selected for demonstration sites. Unfortunately, they initially did not succeed with tomatoes due to pests. Therefore are now growing French beans. We visited an on-farm experiment with French beans; there are ~4 treatments including a control. Trichoderma (Real IPM) plots looked healthy. From a control plot was pulled a root showing severe root-rot nematode problems. On this farm there is a netted seedling bed. It had been solarized for 21 days. Tomato seedlings looked very healthy and uniform. The seeds are very expensive, ~\$0.75 per seed.

At all three sites, the experiments are ongoing. There is clear farmer involvement, especially since travel to these sites is expensive and time-consuming. The farmers have been trained in pest identification and data collection.

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

- The baseline survey in Kenya had remarkable gender equity. The survey in Tanzania had a gender mix that more realistically reflects the farming population. These are both useful but

we need to keep this in mind in interpreting the results and in planning a follow-up survey at the end of the project.

- The WhatsApp digital network is progressing well. Here, too, we have excellent participation from males and females, with females involved in 64% of messages. It would be good if gender specialists could study this to determine if this is a consistent trend, and if so, what is the basis for it. The network allows for messages any time of day and any day of the week, so it is flexible for participants' schedules. Most participants are identified by phone number and only include a name or image if they desire to, so this gives the participants some anonymity. Whether these factors play into the gender distribution, or if other factors are involved, could be the subject of interesting study. This network generated a lot of discussion. It is relatively novel and should function to build capacity in that it connects everyone from farmers to consultants to researchers at the same level, which enhances communication. We also are seeing communication among countries and agencies that did not happen before. Building this community of IPM participants is something that can be left behind after the project termination, and it can continue to grow and expand to the extent that it is useful. It would be especially helpful if all project participants were on the network. The next step here is working with farmer groups to develop their own networks and to link them to the 'expert' network. Real IPM has the best opportunity to help us with this and will be engaged in this activity.

- On-farm demonstrations and research are in progress or being planned for all three countries. The issue of design for a demonstration in contrast to research was discussed thoroughly. Requesting experimental designs of all participants would not be regarded favorably and does not appear to be necessary at this time.

- The level of interaction among entities and countries at this meeting was quite favorable and should be encouraged. Giving country groups time to discuss among themselves was helpful in making personal and professional connections, and should be repeated at subsequent meetings as part of building capacity.

- On-farm visits were good and well organized. In future visits it would be helpful to have a handout with a map of experimental treatments. Also, the rationale and interpretation of results of the demonstration/research should be explained by the farmer. This would give credibility to other farmers for this project activity. The on-farm visits could also be a place to connect farmers to the digital network. The three farmer groups we visited could be among the first to be connected. The group leaders, who have good connections with KALRO, could provide a link to the expert network.

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MEETING SCHEDULE

Day 1. 21 March: INTRODUCTION & PROGRESS STATUS		
8:30-8:50	Welcome, introduction and meeting overview	Jesca Mbaka
8:50-9:20	Remarks from the regional coordinator	Amer Fayad
8:50- 9:20	Remarks from the Project PI	John Cardina
9:20-10:20	Kenya Progress review, success stories and new IPM activities.	Jesca Mbaka, Danny Coyne, Patrick Mathenge
10:20- 40	Discussion	All
Break		
11:10-12:00	Tanzania Progress review, success stories and new IPM activities.	Amon Maerere, Peter Sseruwagi
12:00 – 12.30	Discussion	All
Lunch		
2.00 – 3.00	Ethiopia Progress review, success stories and new IPM activities.	Ferdu Azerefege
3:00-3:20	Discussion	All
3:20-4:00	Technical Training Discussion: what worked, what didn't	Peter Sseruwagi Amon Maerere
Break		
4:30-5.00	WhatsApp Network Discussion: progress and plans	Luis Canas Patrick Mathenge
5.00-5:30	Review of results from Baseline Survey	George Norton
5:30-6:00	Discussion	All
Day 2. 22 March: WORK PLANS for 2017		
8:00-8:30	Metrics and Indicators for reporting	
8.30-9.30	Metrics and Indicators for reporting	Amer Fayad
9.30-10.00	Break	
10:0-11:00	Critical Pests: opportunities for regional management.	Jesca Mbaka
11:00-12:00	Linking with farmer groups: Discussion on On-farm trials, on-farm training, and technology transfer.	Mark Erbaugh
12:00-12:45	Begin country discussion and revision of work plans	
Lunch		
Country discussion and revision of work plans		
Kenya Work Plans for 2017		Jesca Mbaka, Danny Coyne
Break		
Tanzania Work Plans for 2017		Delphina Mamiro
Ethiopia Work Plans for 2017		Ferdu Azerefege
Wrap-up discussion		All
Day 3. 23 March: On-Farm site visits		