CURRENT AND EMERGING THREATS TO CROPS: BUILDING THE KNOWLEDGE BASE

PRESENTATION TRANSCRIPT

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PRESENTERS

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Adam Ahmed:

Good morning. Good afternoon. Good evening. Wherever you are in the world, we're happy to have you with us for this Agrilinks webinar on behalf of Agrilinks, Feed the Future, and the Bureau for Food Security and Resilience. I'm Adam Ahmed.

Adam Ahmed:

Welcome to this webinar on current and emerging threats to crops, building the knowledge base. So in the room you see the chat pod, you can communicate with us and with one another by using that chat pod. There are couple pods below the main presentation deck, one with links to both the Agrilinks webpage and a video that one of our presenters wanted to share with you today.

Adam Ahmed:

As well as a pod with the webinar slide deck, which you can download to have your own copy of the slide deck today. Right now I'll be handing it over to Tor Edwards from the USAID Uganda gone to mission who will give a high level overview of the webinar. Thank you for being with us. We're glad to have you.

Tor Edwards:

All right. Thank you, Adam. Good day to all of you. I'm thrilled to be joining you for this today. We are going to be talking about the current and emerging threats to crops and about specifically what research can do in the face of this.

Tor Edwards:

Let me just kind of an overview of how the webinar's going to work. We are going to have four presentations and then immediately after each presentation, we'll have a very brief time for any clarification questions. Then we'll go to the next one and then once all of the presenters have completed their presentation, then we'll have a longer question and answer session for us to go over.

Tor Edwards:

I do encourage all of you to, as questions are occurring to you, go ahead and put them in the chat box and we will try to make sure that we're able to glean them for the various questions and answer sessions.

Tor Edwards:

So the first thing that I want to say is that USAID has chosen to focus on agriculture in order to fuel economic growth and to promote food security. We started with the Feed the Future initiative, and then

when the global food security strategy was enacted, agriculture-led growth was one of the key pillars that that engaged. The programming traditionally has focused on agricultural productivity, specifically increasing production and securing the safety throughout the value chain.

Tor Edwards:

Our researchers have been working closely alongside of the development efforts in order to make sure that we were able to do that. They have also been working alongside them to address the ongoing challenges that threaten agricultural growth.

Tor Edwards:

In addition to taking a look at productivity and to the known and ongoing threats, we are repeatedly seeing emergent threats come forward.

Tor Edwards:

In 2014, for instance, I was working in the Bureau for Food Security when our East Africa regional mission had flagged a novel disease of maize that was threatening the development gains that USAID had achieved in both economic growth, livelihoods and food security due to the loss of the maize crop. And that was Maize Lethal Necrosis Disease.

Tor Edwards:

Our team ended up having to pull together researchers from across East Africa, along with US pathology and virology experts. We worked together with the private sector seed companies, with government regulators and with the USAID admissions in order to develop a rapid response to MLND. That was one disease. And so as you are all aware, we are constantly seeing new emergent threats through various invasive pathways.

Tor Edwards:

We have new diseases, we have new pathogen races, novel insect biotypes as well as other types of pests. All of these are then accelerated through international trade, through human mobility and of course through climate change. Today we want to consider our efforts to combat these threats and how we're going to be able to deploy the necessary scientific tools to develop, not just research generated and evidence-based solutions, but also solutions that are going to be scalable.

Tor Edwards:

To that end, I'd like to go ahead and start. I'd like to introduce you to our first presenter, Dr Muni. Let's see. Okay. It looks like you have pulled that up. My apologies. So Dr Muni is joining us. He's an entomologist. He has specialized in biological control at IPM in the tropics for over 35 years. He primarily works on biological control of invasive weeds.

Tor Edwards:

He also specializes in insect pests of tropical fruit and vegetable crops. He is the current program director for the Integrated Pest Management Innovation Lab and as such, he's been working with USAID and partner institutions throughout the United States and developing countries in Asia, Africa, Eastern Europe, and the Caribbean and Latin America.

Tor Edwards:

In addition to his duties at Virginia Tech, he is currently serving as the chairman of the global working group on... Dr. Muni, you're going to have to correct me on this one sorry, Chromolaena, for the International Organization for Biological Control. As a major leader in his field, Dr Muni has published over 200 research and extension articles. Take it away Dr Muni.

Tor Edwards:

(silence)

Dr Muni:

[inaudible 00:06:34] Papaya mealybug and the invasive weed Parthenium. Papaya mealybug and Parthenium are native to Mexico. Parthenium and Papaya mealybug in 1990s, started to invade their neighboring countries, [inaudible 00:07:17] the distant continents. In process of invasion [inaudible 00:07:24] transferred to the invaded countries, not their natural enemies.

Dr Muni:

So they became invasive alien species in the introduced countries. Invasive alien species are known to cause millions of dollars in damage all over the world. In US alone, invasive species caused about $120 billion in damage and also in the management costs. Invasive species, since they invade the countries without their natural enemies, they become very easy targets. Are very amenable for classical biological control.

Dr Muni:

Classical biological control is introducing natural enemies from the native range into the invaded area so that they will be able to suppress the invaded place. This technology has been widely used all over the world and some of the examples I have studied, there are several of them. Papaya mealybug control, Parthenium control in Australia, Cassava mealybug control in Africa and Southeast Asia, Mango mealybug control in Africa, are some of the examples. Papaya mealybug scientific name is Paracoccus marginatis. Even though it is called as Papaya mealybug, it has several hosts. It has over 60 different species as host plants.

Dr Muni:

When it got introduced to Florida, USAID scientist... Sorry, USDA scientist... I think I went one slide ahead... And they have found three parasites. I will come to that little later. And currently the Papaya mealybug has invaded several countries in Africa and Asia. So when this mealybug got introduced to Florida, USDA [inaudible 00:09:49] scientists went to Mexico and found three effective parasites [inaudible 00:09:54] this mealybug. They shipped these parasites to the beneficial insects laboratory in Delaware, and there they were screened for [inaudible 00:10:03] and also host species were tested. Then they were all shipped to a laboratory in Puerto Rico. And in that laboratory, they were mass multiplied and supplied to the countries wherein Papaya mealybug became an issue and a problem. This Papaya mealybug showed up in Guam, one of the Western Pacific islands that I was working in 2002. When it became a problem over there, I contacted USDA APHIS scientist, Dr [Bill Myrick, 00:10:39] and he was kind enough to send me these three parasites, and we released these parasites in June 2002 in Guam.

Dr Muni:

Within four months this parasite controlled this mealybug. In 2006, I moved to IPM Innovation Lab in Virginia Tech. And in 2008, I was traveling to Indonesia and India for the IPM Innovation Lab activities. At that time, I found this mealybug occurring in Bogor, Indonesia and Coimbatore, India. When I found this mealybug in Coimbatore, India I went to Delhi and informed the Indian agriculture research institute administration that this mealybug is a new introduction to India, and they should take up biological control activities to suppress this pest. And they worked around and tried to get the parasite from Puerto Rico and it took about two hours. By the time this mealybug moved from Coimbatore to all over Southern India.

Dr Muni:

And in August 2010, the parasites were introduced to India from Puerto Rico, and they were imported to Bangalore. From there it was tested and cleaned for hyperpastise [inaudible 00:12:05] and then they were field released. By February 2011 these parasites, [inaudible 00:12:11] controlled the mealybug. By 2011 there was a big celebration in India for achieving the control of Papaya mealybug. Dr George Norton of economics department at Virginia Tech did impact assessment study for introduction of these parasites for controlling Papaya mealybug in India. He came up with a figure of 500 million to 1.34 billion in benefits to India.

Dr Muni:

Papaya mealybug also moved to Western Africa. It invaded Ghana in 2009 and then in around 2011 and what [inaudible 00:13:00] and IATA took up biological control activities and suppress this pests in West Africa within two months.

Dr Muni:

Coming to Parthenium. Parthenium hysterophorus is the scientific name. It originated in Mexico. It's common name in Ethiopia is Faramsissa meaning "sign your land away". That is how serious this weed is in the introduced areas, countries. This is a very quickly growing plant. It completes its life cycle within six to eight weeks, and it produces lots of seeds, about 25,000 seeds per plant. And it is highly allopathic. It's center of origin, I mentioned Mexico. That is its primary center, but it also has a secondary center in South America. But the population of the Parthenium that migrated from Mexico to the other parts of the world, started only from Mexico, not from South America.

Dr Muni:

Currently Parthenium has invaded 48 countries in the world in Africa, Russia and Australia. This slide shows the climax model of Parthenium in Africa. All the red shaded areas are suitable for Parthenium invasion. Currently Parthenium occurs in the Western part of South Africa, Southern Africa, and also in the Eastern African countries. Currently IPM international lab is working in Eastern Africa to suppress this weed so that this way, the chance of this weed moving into central and western African will be less. Even if it gets more spread into central and western Africa, will be in a position with the technologies to suppress this weed, by developing them in the Eastern African region. Parthenium weed can infest both cultivated areas, pasture lands, wastelands, homesteads, roadsides, railway tracks, and everywhere. So in developing countries, mostly they use human labor and also mechanical means of controlling this pest because the herbicide is very expensive and also they have to come up with repeated ones, but human labor is cheap so they add up this technology.

Dr Muni:

By doing this, they get their mortalities. Parthenium is very toxic and also it is allergic. The pollens are allergic to human beings and they cause [inaudible 00:16:10] and asthma in humans. Australia has done a great job in controlling this pest using natural enemies. It started biological control of Parthenium in 1970. Since then it has introduced 11 natural enemies from central and South America. These natural enemies attack flowers, seeds, leaves, stems and roots of the Parthenium. Around 1970, Parthenium was controlled as a serious weed in, or a noxious weed in Australia. Now it is considered just a weed, not a noxious one.

Dr Muni:

IPM Innovation lab [inaudible 00:16:55] control of Parthenium in Ethiopia in 2005. It established quarantine facility for [inaudible 00:17:01] specific testing in Ethiopia. It sent scientists from Ethiopia to South Africa to get trained in biological control of weeds. And also it has tested the natural enemies and got permission from the government of Ethiopia and USAID for field releases. Biological control of Parthenium. The major activity is taking place in Australia and the second is in South Africa and third is Ethiopia. Most of the activities is supported by the IPM innovation labs supported the USAID.

Dr Muni:

So far two natural enemies have been established in Ethiopia. The first one is Zygogramma bicolorata. It is a seed feeding beetle. The beetle isolates its grubs to feed on the leaves and defoliate them. The second one was a stem-boring weevil. Listronotus setosipennis. It lays eggs on the flowers and the grubs bore into the stem and reach the roots and in that process this weevil will kill the plant. Zygogramma beetle was introduced in wet area in Wollenchiti in July, 2016. You can see Parthenium is growing along this road side, and by September, 2016, Zygogramma defoliated all the Parthenium. In the next two years, natural vegetation took over that area.

Dr Muni:

Similarly, Listronotus was introduced in a dry area, modal area in central Ethiopia, because this beetle, this weevil likes dry area and it was introduced or released in 2017 in the Parthenium infested area. In 2018 Parthenium got cleared and native vegetation started to take over that area. This slide shows cost benefit ratio of [inaudible 00:19:15] in Australia for implementing biological control of Parthenium in Australia. The cost benefit ratio was $2,9 cents for each dollar spent [inaudible 00:19:25] of Parthenium in Australia.

Dr Muni:

Now I want to thank Dr John [Woolman 00:00:19:29], [inaudible 00:19:35] of USAID for the IPM innovation lab for supporting this project for the last 10 years. And also Dr Wondi Mersi from Virginia State University for implementing Parthenium biologic controlled program in Eastern Africa for the past 15 years. And also I want to thank our IPM innovation lab staff and faculty for supporting IPM innovation lab program and above all I want to thank all the collaborators in these two projects. Thank you very much. Tor, back to you.

Tor Edwards:

Thank you, Dr Muni. We do have one question for you. First of all, I want to say to Dan with the meaning of life, everyone knows is 42, but so, and to Steven Walsh, I think what we'd like to do is, I think that your question is broader. So I'm looking to save that for once we've had all of the presentations and give all of the presenters maybe a crack at that, because it is a really complicated one regarding the measuring the counterfactual, so we will come back to that. In the meanwhile, we do have a question for you, Dr Muni from [Eugene Forey 00:20:54] and Eugene is asking, "Can the same parasitoid be used to control the Cocoa mealybug?"

Dr Muni:

No, it is very specific to Papaya mealybug. It won't work on Cocoa mealybug. If you know the scientific name of the Cocoa mealybug, then we can suggest effective parasites.

Tor Edwards:

Okay, great. Thanks so much. If no one has any other specific or clarification questions for Dr Muni, we'd like to go ahead and have Dr Prasanna step up. He leads CIMMYT global maize program. It's focusing primarily on maize improvement in Sub Saharan Africa, Latin America, and Asia. He provides technical oversight for an array of multi-institutional projects, specifically on the development and deployment of improved stress resilient maize germplasm, as well as novel tools and technologies for enhancing genetic gains and breeding efficiency. Dr Prasanna also leads MAIZE, which is a CGIAR alliance of more than 300 research and development institutions worldwide that's seeking to mobilize global resources in maize research and development to achieve a greater strategic impact on maize-based farming systems globally. Under his leadership CIMMYT has established a state-of-the-art maize doubled haploid facility in Kenya and he and his team have been at the forefront in tackling the maize lethal necrosis epidemic in Eastern Africa, which is where I met him. And they've also been working on the Fall Armyworm challenge across Africa. So thank you.

Dr Prasanna:

Thank you so much, Tor. I hope you can hear me. This is great pleasure to interact with colleagues on this important forum on countering the future threats, the pest and disease threats to crop plants. I will specifically focus on.

Dr Prasanna:

...it's to crop plants. I was specifically focused on the maize lethal necrosis management, through intensive multidisciplinary research for development and multi-institutional efforts. A number of institutions are there as told initially introduced the topic, were involved, right from public sector to private sector institutions encountering this major threat in eastern Africa. MLN for those colleagues who are not so much aware is a combination, is a co-infection of maize plants with two different viruses. One is the Maize Chlorotic Mottle. Another is any member of the Potyviridae, especially the Sugarcane Mosaic Virus has been extensively co-infecting with Maize Chlorotic Mottle virus in Africa. Since 2011, it first appeared in Kenya and then rapidly spread to several countries in eastern Africa, including Uganda, Tanzania, Rwanda, DR Congo and finally Ethiopia in 2014. There were what we call unsubstantiated reports of MLNs presence also in South Sudan and Burundi. The losses to maize production in the farmers fields due to this devastating disease could go as high as 80 to 100%, depending upon the time of infection and the severity and the environmental factors.

Dr Prasanna:

Economic impact MLN has been estimated by CIMMYT colleagues in Africa, especially in Kenya and Ethiopia. In Kenya itself the disease was mapped to several counties. The aggregate national loss of maize production due to maize lethal necrosis in 2013, was about half a million tons at a value of almost US dollars 180 million. So, MLN was indeed quite strong in terms of its socio-economic impact in eastern Africa.

Dr Prasanna:

How do you tackle such a complex challenge? When the virus is first time introduced, the Chlorotic Mottle virus especially, and has such a devastating effect, spreads very rapidly, probably due to seed contamination as well as due to insect vectors and maize is grown continuously in many parts of Africa. We deployed a multidisciplinary and research effort here. Not only breeding and deploying MLN resistant varieties, working together with international partners, especially USDA, Ohio State University, and University of Minnesota, KALRO, the Kenya Agriculture and Livestock Research Organization on MLN diagnostics and epidemiology.

Dr Prasanna:

MLN [inaudible 00:25:53] commercial seed production and exchange is a very critical component to mitigate this stress within the impacted countries in eastern Africa as well as to prevent its spread to the major maize growing countries in Southern or West Africa. That was done in close collaboration with the National Plant Protection organizations, seed companies, AGRA, African Agricultural Technology Foundation, rigorous monitoring and surveillance. CIMMYT trained a lot of NTPO personnel in several countries across sub-Saharan Africa on digital surveillance coupled with immunostrip based analysis right in the farmers' fields and as well as in the commercial seed production fields. Agronomic management is quite important.

Dr Prasanna:

Recommendations were passed and Africa endorsed this and capacity building, communication and outreach within every of research and development partners. The MLN screening facility was established very rapidly, thanks to the support from the Bill and Melinda Gates foundation and the Syngenta foundation for sustainable agriculture. State of the art facility was established with the generous support of this land ALRO at an MLN hotspot in Kenya, that in Naivasha. Today, this particular facility offers MLN phenotyping service from CIMMYT to an array of partners, both in public and private sector institutions.

Dr Prasanna:

More than 200,000 germplasm entries have been screened against MLN, since its establishment. Of these 61% come from CIMMYT, 17% from the national program and 22% from the private sector, array of seed companies again. And thanks this intensive work, from less than four to five inbred lines with resistance to MLN, especially against MCMV, today we are very proud that more than 50 elite and genetically diverse CIMMYT lines with MLN resistance are available and disseminated very widely to partners across the world, especially in sub-Saharan Africa.

Dr Prasanna:

Deployment of MLN tolerant and resistant hybrids, again, we have within a span of three to four years released 19 CIMMYT derived, MLN tolerant resistant hybrids. And out of this again, Bazooka, a drought-tolerant and MLN tolerant hybrid released in Uganda has reached a scale of almost 1500 tons, and today

it is marketed extensively not only in Uganda, but also in DR Congo and Burundi, and Naseco has plans to, has recently registered it in Rwanda too. Another major success is partnership with the Kenya Seed Company and where we have, again, a major hybrid being the H5606. It's substituting MLN susceptible hybrid in Kenya. So one more hybrid from SeedCo is beginning to be commercialized. In 2021, we will see its commercialization across eastern Africa. The genetic architecture of MLN resistance in maize has been extensively studied by team and a series of publications came out. Thankful to Manje Gowda and the team for analyzing the MLN resistance across diverse tropical germplasm, identifying the key genomic regions and validating them within a very short period of time.

Dr Prasanna:

And that led us to identification of a major QTL for MLN resistance in one of the highly resistant lines, KS23, and this QTL started working across diverse recipient genetic backgrounds and is a very powerful tool in our armory to fight against this disease. And once this QTL with a major effect was discovered on chromosome six, we started introgressing MLN resistance into diverse, elite, drought-tolerant but MLN susceptible CIMMYT lines and this is a massive effort. 52 such lines have been converted in the last few years and they have been analyzed for their efficacy as well as equivalency. And very soon, we'll come up with a series of inbred lines that can potentially substitute those old, drought-tolerant but MLN susceptible lines, the resistant versions. And you can see here the distinct difference between what happens then the resistant QTL is not present versus what happens when the resistant QTL is introgressed with fast tracked marker-assisted [inaudible 00:07:33].

Dr Prasanna:

And genome editing for MLN resistance, again, has been possible or is becoming possible now. And thanks to the partnership we have now with Corteva, we are very grateful to Corteva's partnership here, together with the KALRO, the USDA because it's a service. And this project is being funded by Bill and Melinda Gates foundation. The chromosome six QTL has been fine-mapped and today Corteva team together with the CIMMYT team is targeting different regions within that six kb interval to identify which edits could be more successful, in terms of converting a susceptible line into a resistant line.

Dr Prasanna:

And we plan to establish a strong pipeline to edit for MLN resistance. In the MLN susceptible lines that are parents of CIMMYT derived commercial maize hybrids in Africa. Another major objective of this project is to strengthen the capacity in Africa for genome editing in a crop like maize, which is so important. And strengthening the local capacity, our success did not come only through breeding. Extensive efforts have been made on strengthening local capacity for MLN diagnostics, surveillance using modern tools and the management overall in sub-Saharan Africa. You can see at the bottom of this slide, the number of National Plant Protection Organization personnel that have been trained in different countries, not only the MLN impacted countries but also in three major maize growing, commercial seed producing countries like Malawi, Zambia and Zimbabwe. Similarly Seed Company personnel, National Agricultural Research and Extension staff, seed growers too. So together, this is a

massive effort in terms of strengthening the capacity of local institutions in countering a trans-boundary disease like MLN.

Dr Prasanna:

So what is the result of all this? Today we have much reduced presence of MLN in eastern Africa. You can see that red dot there. That means these are still MLN hit spots in eastern Africa, but you can still, you can see here, these Malawi, Zambia and Zimbabwe are still free from MLN. That to me is a major achievement, in terms of this collective effort, not permitting MLN to go into southern Africa or West Africa and saving millions of dollars, which could have otherwise socio-economically could have deeply impacted the small holder farmer. Very thankful to the USDA East Africa office for funding this MLN diagnostics and management project.

Dr Prasanna:

So MLN is firmly kept under control but let's remember that it's not eradicated and we need to keep continuous vigil like what we have done so that we maintain this status. There is a comprehensive MLN information portal. You can see the website address there. One can visit that. And a review paper has been published in Virus Research recently, which outlines all these efforts. My final thoughts. Intensive breeding as well as multi-disciplinary and multi-institutional efforts are key for containing the spread and impact of trans-boundary diseases. And this will not be the first or last instance. There could be other diseases that could potentially impact continents like sub-Saharan Africa and Asia. We need to have increased capacity for foresight and proactive measures.

Dr Prasanna:

The systems and platforms should be sustained, capacity strengthening needs to be continued and in fact, expanded in light of this increasing occurrence of devastating trans-boundary pathogens and pests, especially in the tropics. Many thanks to USAID, Bill and Melinda Gates foundation, Syngenta foundation, as well as the CRP maize window 1, window 2 donors. KALRO has been an extremely important partner in our efforts, National Plant Protection Organization, commercial seed sector partners, USDA, Ohio State University, Minnesota university, AITF, AGRA, Aarhus University in Denmark provided tremendous support for our MLN portal, as well as IITA, which implemented the efforts to prevent the spread of the MLN into West Africa. And finally, my CIMMYT colleagues for their dedicated work in this whole mission. Thanks a lot.

Tor Edwards:

Great. Thank you, Dr Prasanna. As you guys have been seeing in the chat, there've been a lot of questions coming in. We only want to do a couple that are specifically about this particular presentation now, and then the rest of them we'll bring up at the end. So I'm going to go ahead and ask you, Dr Prasanna, Richard Tinsley has asked, "You mentioned hybrid lines. Do you also have some composite

lines for which the seed can be retained from season to season and avoid the massive logistic of getting hybrid seeds to these remote areas?"

Dr Prasanna:

Yeah. Since, now we have several genetically diverse inbred lines with some including good combining ability amongst them, it is possible for national programs or interested companies to even synthesize composites using those inbred lines, especially the synthetics we call it. Because like for example, you can take eight to 10, such diverse inbred lines with good combining ability and synthesize composites. This kind of works is just done by national programs and then disseminated in countries where hybrid seed systems is weak. But to me, the real challenge here would be how best to scale up and deploy improved varieties that are already available. And for that we need support from commercial seed sector in a big way.

Tor Edwards:

Great. Thank you. And we'll do one more for you before we go on to our next presentation. [Gene Ristaino two 00:13:58], for some reason, asked, "Since MLN is primarily transmitted through seed, what efforts are being made by CIMMYT to track the spread in African seeds and prevent future introductions of this or other viral problems? Second, what strains of the virus have emerged in Africa and will CIMMYT lines be resistant to most of them?"

Dr Prasanna:

Yes. So first question is about the efforts to prevent contaminated seed to flow. That's the reason why we established the MLN quarantine facility at Harare in Zimbabwe. For almost three years, we stopped even sending CIMMYT lines seed from Kenya to southern Africa partners, because we need to have a multi-layered system of quarantine in place together with excellent diagnostic tools. Even then, we do need to have quarantine facilities established, not just for MLN, for any disease, any trans-boundary disease. And [inaudible 00:38:00] established this in partnership with Zimbabwe. Again, thanks to USAID support. And today we've seen at multiple levels, any seed that goes from Kenya, an MLN impacted country like Kenya, first of all, we need to make sure that the seed is not contaminated in the seed production fields. Second, we need to have an internal system of diagnostics to check whether the seedlot is free from the virus. Third, it goes through the regulatory agency like KEPHIS to ensure that the seedlot is indeed virus-free.

Dr Prasanna:

Of course, you can't take any chances. You still need to introduce the seed in a quarantine facility like what we have established in Zimbabwe. So that that's a final check. Only when you're ensured all these systems are in place and then the seed is multiplied and designated to partners. Similarly, the project, BMGF funded MLN epidemiology project, we established an MLN quarantine facility in Nigeria, so that the West Africa also introduces the germplasm. Germplasm flow should not be curtailed, but we need to

be cautious in terms of ascertaining that every seedlot, whether it is a research lot or a commercial seedlot, is free from MLN viruses.

Tor Edwards:

All right, great. Thank you. And we'll bring up the rest of the questions that you guys have at the end, in the final question and answer period. For now, I'd like to go ahead and introduce you to Dr Pressoir. He currently serves as the Dean for the Faculty of Agriculture and Environmental Sciences at Quisqueya University. He founded the Haitian center for innovation and biotechnology and sustainable agriculture in Port-au-Prince, Haiti, back in 2010 with sorghum and edible, I apologize for this, Jatropha breeding programs. He is a Haitian national who's trained as a sorghum breeder and a applied plant geneticist with the French Research Institute for Development, CIMMYT and Cornell University. He has steadily expanded Haiti's crop improvement research portfolio into his current team of more than 40 staff members led by seven new research faculty members at the Quisqueya University. Welcome Dr Pressoir.

Dr. Pressoir:

Hello. I'm going to tell the story about raising sorghum in Port-au-Prince, Haiti. It's a work that has been going on now for about seven years. And I was being supported by a great number of donors, partners, [inaudible 00:40:48] part of the breeding, [inaudible 00:40:49] our partners. It all started with CIRAD and followed by IADB and FSAE, more research is done in Future Innovation lab. We were now called the Innovation lab for crop improvement because we have been sustained. So saving sorghum from disappearance in Haiti. So Melanaphis sacchari sorghum bio-type of sugarcane aphid appeared in Haiti in 2015 after the breaking out in the United States in 2013. And the spread has been very fast. From 2015, a lot of regions in and around Port-au-Prince in the central plateau were affected. And by 2016, all sorghum growing areas, here indicated as percentage of agricultural land, across Haiti were affected and yields plummeted as we'll see in slides after. So here's the little beast, and you can see that it's an asexual. And even the wing type is, is affected by, is also asexual and it spreads very rapidly.

Dr. Pressoir:

So we're going to talk about now our success story, University Quisqueya, our unique success story of solving the aphid resistance. And it all started actually way before the aphid strike broke, it started in 2010 with the initiation of our breeding program. It was supported by the French National Research Agency. And it's key to what happened after. What we did is that we evaluated a very large set of diverse lines from all over the world. And then we set up a rapid cycling project in which we were doing one generation of recurrence selection every year. And what you can see is in this slide, is that it's S1 recurrence selection scheme in which we're doing three generation a year or close to every year and then catching up. But the fact is that we generated a large number of crosses in generation actually before the aphid struck, even if it was a short breeding program.

Dr. Pressoir:

So here is what happened and that's work supported by the Sorghum Millet Innovation lab. This is what we pictured after going through selection. And then we'll see the results of the selection. It's that our current population is very highly related to the East African caudatums, because we were actually using a lot of staygreens from Ethiopia as a source. But not only that. We have here in the population structure in the D, we can see that we have some Kafirs, we have some duras and mostly some caudatums with East Africa being the largest contributors and some guineas and wild types into the mix. So it's a pretty diverse population, almost as diverse as the Ecuador gene pool, a little less than Texas A&M, but a pretty diverse population.

Dr. Pressoir:

We did map the aphid resistance and we mapped it not through classical mapping, but detection, the selection, the signature of selection. That's also work that we did with passport of SMIL. A paper is being prepared by Kebede Muleta from Geoff Morris's lab in collaboration with us. And it's in short armed chromosome six, which was confirming a previous paper from China, mapping the arm on the S1 locus. And it has helped us to refine an array of five to six genes, which comprise about three nbs-lrr genes. And so that's the fine-mapping that we did.

Dr. Pressoir:

What's interesting is that the Haitian material you can see in the figure in the lower right, there's a predominance of a very rare haplotype now after the selection in sorghum. So there was a total selected sweep. It's a very rare allele, that's a little present in the United States in a few aphid resistance lines and is only a frequent allele in Ethiopia and especially in the zera-zera material were able to independently confirm the gene, developing a diagnostic markers and the lower left, you can see the confirmation of the allele genotypes related to aphid damage rating in an American population that was developed independently from our material using our diagnostic markers. So that was great. So, now let's go back to the impact on farmers. So now sorghum, Pitimi as we call it in Haiti is back in our field.

Dr. Pressoir:

Sorghum, [foreign language 00:00:01] as we call it in Haiti, is back in our fields and in our plates. These are two extreme regions in the upper South and the North West of Haiti, where Sorghum was back. And that was after a significant and dramatic [inaudible 00:46:21] the years. So in 2015, so that's the red arrow, you can see that's when the aphid appeared. And from the first year the aphid was identified, production plummeted, especially in the second open season. And then the following year in 2016, and 2017, production of sorghum went from over 100,000 tons to under 20,000 tons, with 14,000 tons in 2017.

Dr. Pressoir:

Late 2017 is when we really introduced [inaudible 00:00:57], our first [inaudible 00:47:00] and that is work that I'll show that we did with the support of Canada, Global Affairs and in partnership with Laval

University. After the beginning of our breeding program was sorghum. And now 90% of the product sorghum acreage is now grown with Shabbat resistant varieties.

Dr. Pressoir:

Some farmers do not like the non-probiotic type, and we'll see that we're now developing the probiotic type. And that because of the way they do really cropping with the quarter probiotic varieties. So production recovered, this was the official release with the distillery culture, the president of the Republic and the Canadian ambassador of Canada have supported the development of the resistant line and the release of the [inaudible 00:47:51] varieties. So now the challenge is not completely over because there are different demands from our growers initially developed grow purpose sweet sorghum. One of the varieties that was latest selected for your stability and the upper left is about two more years after [inaudible 00:48:11] show that was selected through the short millet Innovation Lab.

Dr. Pressoir:

We're now developing with the support from a local brewery, and mechanization ready to a dwarf. So this is a dwarf and a lower, but we have shorter dwarf,but this is a lower dwarf and here, and, and it's very striking. You can see that this probiotic sorghum, and this is picture from this year. We're not selecting an aphid resistance, and these are a selection of crops. So you can see how it looked in the beginning when we started selection, this is the damage that aphid causes it's pretty dramatic and you can see the resistance are very striking.

Dr. Pressoir:

And although it's a major gene, we now know that there are all the factors affecting resistance, and you can see and put a probiotic tide that not everyone is as resistant. And this is work supported by actually our project from the minister of agriculture, with the entire American developing bank support and the selection of probiotic, FTE resistant sorghum, and it's going very well there also. It takes a team to succeed. Here are the picture of a couple of my members and the lists. Given time, I won't list everyone.

Dr. Pressoir:

So I would like to thank everyone on my team, but also people from the Morris Lab that came and stayed with whom we called our Millet Innovation Lab from the Buffalo Lab that provides a lot of support on developing [inaudible 00:49:43] and our DHL Lab. University Laval Canada, that after thrive, allowed us to develop a lot of material. And she arrived in France it helped us with the security funding to get it all started after the [inaudible 00:49:57]. So now we're working on other emerging passing disease, hoping to replicate our sorghum success. As I mentioned, the development of the FTE resistance in Probiotics sorghum, and that's a big farmer demand, and we're going to be working with support from ministry of agriculture, but also the Innovation Lab for crop improvement for the genotyping. We hope to be able to work in Richard's room in pigeon pea. We're starting work there, power-wise almost as it appear from Haiti because of the introduction of new on [inaudible 00:04:35].

Dr. Pressoir:

Starting of some defensive breeding in cassava, African mosaic viruses. And as you can see, there are a number of emerging trends that are a threat to Haiti, I stayed to all of our donors because breeding takes time. And it's hard to find donors to breed, to find only a part of the breeding. So a French National Agency,I can see we mentioned them Canada Global Affairs, the Feed the Future Program, and now, the entire American Development Bank and the minister Haitian ministry of agriculture. Thanks to them. And thank you all for your attention.

Tor Edwards:

Thank you, Dr.Criswell. We have just a couple of quick questions for you before we go into the final presentation. First of all, Patrice Thomas asks, "how do you commercialize the improved varieties since you're a university, what is your market channel to allow this improved variety to reach farmers?"

Dr. Pressoir:

Now, time is a big challenge because we don't have a speed arm although we are allied with an organization that does speed production and we do minimal speed production ourselves. So we had a project for the large mass production of feed [inaudible 00:51:58] for the first... Now we're trying to develop the model integrated with mechanization to develop new models of service providers that serve as intermediary. We do have producers, but there is definitely a gap in Haiti for basically selling and the network of getting to growers. So we're trying to develop a middleman service provider, coaching small scale mechanization. That's another program which we're actually hiring right now for docs and everything, all mechanization. So thank you for your question, but it's something that's not entirely solved, but we all working in it trying to develop models for diffusion, not only in sorghum but in other crops.

Tor Edwards:

Great. Thank you. And we have a related question. Steven Walsh asks, "Can you comment on the pest impacts of diversity in Haiti."

Dr. Pressoir:

On certain diversity I mean yes, production plummeted to 220,000 tons? So all the former language, a lot of them might have appeared. So we're actually trying to rescue them and it's a simultaneous goal of our probiotic bringing it here, resistance in probiotics gene. It's at the same time saving the land races and also addressing specific demand from our brewers, the question in the most marginal areas of 80 which are requesting, Hey, I do really cropping and what you put probiotic variety, doesn't do it for me and the developing strategy, but having huge yield loss, probiotic variety. We're complicating the program that we had and making a lot of crosses between all the probiotic material that we can recover. We had shared some with our partners and the same some pipeline races. So we all also working in trying to rescue the language, bringing these program, shoot. We need the resistance into these men.

Tor Edwards:

All right, great. Thank you. I think that one of the things that we've seen from our previous three speakers is how complex it is for us to be working on these issues, and the level of collaboration that we need in order to bring these research based solutions to some of the agr development programming that we have.

Tor Edwards:

So next up we have a couple of our team from USAID are going to talk a little bit about a new design and activity that is coming through. We have Dr. Bertram, who is our chief scientist in USAID Bureau for Resilience and Food Security. He is serving as a key advisor on a range of technical and program issues, in order to advance global food security and nutrition. He is leading USAID evidence-based efforts to advance research technology and implementation and support of the U.S. Government's Global Hunger and Food Security Initiative. And presenting with him, is Dr. Records. She's the science advisor at USAID and the Bureau for Resilience and Food Security, where she manages U.S. University led plants, disease, crop improvement, and post harvest handling research program. She was selected as the scholar fellow for science communications prob program and a science policy fellow with the American fight up at the LA pathological society. She currently serves as the deputy lead of the resilience of the pretty research community of practice.

Dr. Bertram:

Thank you very much Tour. I'm going to start off everyone. Well, I think the best way to follow those three tremendous presentations was to share with you our intention to stand up a new Feed the Future Innovation Lab for current and emerging threats to crops. And I think right now in the context we're in COVID, locusts plagues, I think the whole world is attuned to the issue of emerging threats. Greater awareness perhaps than ever before, where the New Lab we'll be focusing on crops. As I mentioned, we won't be covering all emerging threats, but we do also have a new Animal Health Lab working on a major disease of cattle, in Africa. We have the Poultry Innovation Lab working on new Castle's disease and heat tolerance in genomics. So we have other programs addressing the emerging threats in animals. And we'll continue to monitor and think about the best ways to engage there as well.

Dr. Bertram:

So thinking about the challenge of current and emerging threats, as you can see, and we've just heard, there are a variety of threats. There are difficult to control, especially in environmentally safe and sound ways. And we've also, I think, seen highlighted this morning, the role of research in generating solutions. And I have to say having just heard these presentations, it's so impressive, the speed with which the community and these researchers have come together with partners to generate solutions. We also know that in food insecure regions where USAID works on food security through Feed the Future and Resilience, we see a greater vulnerability in part because agriculture is such an important part of the economy. So many people's incomes and livelihoods and food security depend on it directly. I think

we've also noted this morning, the importance of Global Research Networks that are linked together to produce to communities.

Dr. Bertram:

And really you could see the tremendous potential of South-south cooperation on all of our speakers. I think identified some opportunities there, but also the importance of this connection amongst researchers to be able to respond rapidly as to existing or emerging threats.

Dr. Bertram:

The other point I would like to make is this is an area where public investment is critical. For example, the type we do through the Feed the Future Innovation Labs, this is the opportunities for private investment to deal with many of these threats would be very limited. So this is another reason that it's so relevant and compelling to stand up a new research program in this area. Now, I just wanted to take advantage of a recent paper by Savory at all, just from last year that this just looked at four crops, primarily those that are also important in temperate regions, but you can see the tremendous value of lot crop losses from pests and diseases. Especially in rice, where it's, worth $4 billion, what this slide doesn't show in which the paper didn't deal with, where was the impact of crops like cassava or sorghum? The things we've heard talked about this morning, mango or papaya, excuse me.

Dr. Bertram:

So the many important tropical crops that are critical to food security in the regions where we're Feed the Future works are not included, but we know that the losses can be tremendous in several of our speakers. All of our speakers really alluded to the magnitude of those losses and the disruption that these pests caused. Now Feed the Future, many will know that this is the 10th year of Feed the Future. And in just in 10 years, we thought about what threats have emerged that we've had to deal with. Fall army worm, a tremendous problem in Africa and Asia. Now with the emergence of an exotic pest from the Americas that's and it's spread across those continents in just four or five years, we've heard all about. maize lethal necrosis. We flashed. I know we have people on the seminar this morning from Bangladesh. This was noticed for the first time in Asia. I believe I just read that it's also appeared in Africa now, this is a disease of wheat that had formerly been found only in the Americas, and now we have it in other parts of the world.

Dr. Bertram:

And then fusarium will tropical race for began in Mozambique is now in South America and Colombia and banana growing areas. And it's a devastating disease that not only affects Cavendish, but many, many varieties of bananas and plantains that are critical to food security. So in all of these cases, we've responded one way or another often through South-south partnerships, often through working with the inter agency, with our partners in USDA, to rapidly tap into the expertise that exists both in USDA and in American universities.

Dr. Bertram:

So it's again, just to point the speed with which the research community has stepped up, and we're excited in the New Lab to think about continuing these efforts. Finally, Tour, mentioned at the outset of our session today, the role of the global food security act, which made really what was feed the future, the law of the land first under president Obama, and then reauthorized under president Trump. There are three act aspects of that, that I have the research strategy developed under the global food security act that are particularly important to point out. One is advancing productivity frontier. The second though is reducing risk, which is a huge aspect of the focus here. And the third is the human outcomes in nutrition, economic opportunity, and gender equity.

Dr. Bertram:

And, we've seen this morning for example, on nutrition, food safety issues that are associated with poorly controlled. Whether it's aflatoxin contamination or the use of pesticides in an unenlightened way. All three of the objectives of the research strategy are critical. Or also just the fact that you are limiting the availability of an important food, like papaya affects the Vitamin A status of people who depend on papaya as an important source of Vitamin A in their diet.

Dr. Bertram:

And finally, just to note that we will be working with our sister agencies in Feed the Future and the inter agency working group. One of the explicit aspects of the law is that, we seek to develop our investments in research under the Global Food Security Act. In ways that leverage and draw on and learn from the important experience of other agencies like USDA, the NSF, NIH, extra. Many, many important partners in that space. So now I'd like to stop and turn it to my colleague Angela Records. And she'll say more about the design of the Lab.

Dr. Angela R.:

Thank you, Rob. Yeah. So I'm just going to drill down a little bit on our intention to fund a research activity in this space. So, as we heard from the previous presenters, the scientific and development communities have learned a lot about crop passing pathogens over the years and made great strides toward mitigating those that plague agriculture in the countries where we work and around the world really it's a global problem, but important questions remain and pests and pathogens will continue to evolve and expand their geography. So we propose to use research as one of our key approaches to addressing current and emerging threats to craft. Importantly, this approach responds to the Global Food Security Research Strategy, which Rob just described. It gives us an opportunity to build on lessons that we have learned, through our own programming, like the IPM Innovation Lab, as well as other efforts.

Dr. Angela R.:

And our approach opens the door to a consultative design process that incorporates those learnings and considers the current pace of emerging threats and the challenges of existing issues. So generally our research investments abide by core operating principles. GFS research is perfect, purpose-driven it generates and sustains global public goods. And leveraging data to accelerate research impacts. GFS research activities are continuously monitoring and evaluating progress, thereby learning and adapting as appropriate. Global Food Security Research, promotes empowerment and equitable participation in science and strengthened agricultural innovation systems. Importantly, GFS research efforts are oriented toward supporting scaling. Fast, ensure that technologies reach end users.

Dr. Angela R.:

We can't take on these efforts without extensive partnerships. A number of partners come together to implement the Global Food Security Research Strategy. This slide just takes a closer look at our innovation partners, the Feed the Future Innovation Labs, which I'll talk about in just a moment. And activities at the CGIAR international agricultural research centers make up the bulk of our research portfolio. We also have various investments that fall into the other category, including support for discrete research activities through public private partnership. Investments in capacity development and training programs, engagements in efforts to ensure that efficient systems are in place to get clean, improved seeds at farmers. And other types of activities. And the USAID missions in our partner countries have their own budgets and goals, and they also support research. So the Feed the Future Innovation Labs are U.S. University led research programs that collectively address a range of research themes, sustainable intensification, animal health, crop improvement, for example. And the Innovation Labs themselves have an array of partners. And many of our Innovation Labs hold sub award competitions to identify additional partners, to focus on particular research questions and work streams.

Dr. Angela R.:

There are currently 21 Feed the Future Innovation Labs. And as Rob pointed out earlier Feed the Future is a whole of government initiative. This slide just shows the collective of agencies that participate in our Feed the Future inter agency working group on research. (silence) And our timeline process for putting together a New Innovation Lab on current and emerging threats to crops begins with consultations, including webinars like this one, focus groups and other discussions. We're developing a white paper that will lay out some of the context and thinking behind the proposed Innovation Lab. We hope to complete that by late November, at which time we plan to hope to release a solicitation toward a proposed award date of June, 2021

Dr. Angela R.:

And a design team here at USAID is working on these various elements. You all know Rob Bertram, our chief scientists, Julie March's leading the team. She's an ecologist and the chief of our production systems division in the center for ag growth. I'm a plant pathologist. Carol Levin leads on knowledge management and coordination of our Innovation Lab portfolio. She is an entomologist. Mark DOP is an

entomologist. Who's working with us on detail from the USDA animal and plant health inspection service. And then Chavonne Whitening is a AAA science and technology policy fellow. She's also an entomologist and she's taken on a number of important tasks related to this design, including as the lead writer for the white paper with input from work. So that is all I have Tour, I....

Tor Edwards:

Mark. So, that is all I have Tor. We can check with Rob to see if he has anything to add but otherwise I'll pass the microphone back to you. Rob, do you have anything left? Okay.

Dr. Bertram:

No. I think it'd be great to turn to the discussion. Thank you.

Tor Edwards:

Super. So we have about 20 minutes it looks like. We do have a lot of questions that have come up. Some of them can hopefully go fairly quickly. So, I'm going to ask the specific ones. Dr. Mooney I have a couple that were very specific for you and then hopefully toward the end, we'll be able to have ones that are opened up to all of you, specific also to Rob and Angela to talk about how the new activity may address them. Dr. Mooney, we had the question from Patrice Thomas. When your project gets a hold of these different threats, how do you connect to the experts in order to get solutions?

Dr Muni:

They can send me an email. I can respond to them. There are also several scientists work in different topic areas. So they can directly communicate with them to get that information. Did I answer that?

Tor Edwards:

I hope so. I would say as well. Maybe with these new designs that are coming out, there might be some opportunities to identify emergent threats from the field, so that they can swing into action on that. But we'll see how that all comes out. Another question for you Dr. Mooney, classical bio-control is and should be regulated by national authorities but regulatory systems are often weak and can end up hindering the use of bio-control. What can be done to address this?

Dr Muni:

I feel a little harsh code of conduct for introducing any natural enemies from outside the country. So they can follow that code of conduct of the [airfare war 00:02:27]in involving back classical biological control. Of course the national quarantine officials would be aware of that. But in the case of Ethiopia where we have been working on biological control of platinum. We have been involving the national regulatory officials as well as following the USAD and the USDA regulations. In India of course they have very good regulatory system in place so we have been following that system. So each country has to

develop its own. If it doesn't have it, they can communicate with the international organizations like [airfare war 01:12:11]to get the code of conduct.

Tor Edwards:

Okay, great. Thank you. I have two questions for you that kind of, I think, speak to the same issue. So, let me... One is what is the risk that biological controls attack useful crops, one full to pass that they were intended to control. And then the other is, will the bio-control agents survive once the target organisms disappear? How long do they remain active in the field?

Dr Muni:

The balance and control organizations are selected based on their host specificity. They are very specific to the host, so they won't attack others. If they do attack the other ones, they won't get the permission to be released in those countries. So. And also if the host population goes down the parasite of the predatory population also will go down. So the host won't reach zero level population. So if it was say about the 80% level, it will come down to 10 or 20% level. So both the pest and the parasite [inaudible 01:13:24] will operate at a very low level. Below the economic threshold level. That is what will happen in the country.

Tor Edwards:

Alright. Thank you, Dr. Mooney. Dr. Presona I have a couple of questions that are specifically for you.

Dr Prasanna:

Yes.

Tor Edwards:

Just weird echo but that's alright. Okay. So the first one is if MLN is caused by viral infection, is there any possibility for livestock infection?

Dr Prasanna:

No, there is no possibility. These are ready to for example maize flour takes more viruses to maize and the sugarcane mosaic virus has different hosts but these do not affect human or livestock.

Tor Edwards:

Okay, thank you. What is the tolerance or resistance level of the lines that you've been developing and is reinfection feasible in the field?

Dr Prasanna:

We have a very robust system, not only testing our germplasm under artificial inoculation and rigorous assessment at the Naivasha facility. But we also have a satellite of centers, where we can do analysis of the same hybrid. Validate their responses from their natural conditions in MLN impacted countries. So these ensure that even if there is a slight variation, for instance, especially in sugarcane mosaic virus.

Dr Prasanna:

The host level still feels good. MCMB has very limited variation as we understand in Africa. But the sugarcane mosaic virus could have such a devastating terms of straints. So, even after rising there are new potty viruses that can cause infection. Our system of testing ensures that these varieties hold good and they are indeed holding good. So therefore there is no cost consumption that there could be a breakdown of this assistance because this assistance is mostly polygenic[inaudible 01:15:31].

Tor Edwards:

Okay, great. Thank you. And I believe actually that answers also what the other question was for you. So Dr. Priswa, I have just a couple for you specifically and then I'm going to ask the more general ones for everyone to address. Let's see. Can you comment on the pest... Oh no. Sorry. That one already was answered. Why did you select sorghum rather than maize. Is sorghum a staple food in Haiti.

Dr. Pressoir:

Thank you. So yes, ***Oregon is one of the three main cereals growing near Haiti[inaudible 01:16:14]was the place to Haiti during the colonial crime. And so we, we basically produce the 48, said a hundred thousand tons of rice and about 250,000 tons of maize, corn. So maize is the main cereal and also often maize is sort of are kind of associated. Maize is more of a spring crop, although it can be going into the second season but for them is basically the second season crop and often grown relay cropping with corn and pulses, including pigeon pea in association. So sorghum is a major crop. Now we did introduce and test. We work with summit a few years ago and we're now still promoting it's synthetic for maize and what's you used in the blood banks and tested by a number of partners, including ourselves. So there was this synthetic cement that we're promoting. We also have a rice breeding program. So we work in all three cereals and the number of not myself but people from my...

Tor Edwards:

Okay, great. Thank you. And so would you expect that the improved varieties that you're developing will perform well in other countries of relatively similar agriclimatic conditions?

Dr. Pressoir:

That's a very good question. And actually with the innovation lab for co-improvement, we're working on youth stability as one of our main focus and we're working with some Latin American country and it's such a lead in top from Costa Rica and we're going to be testing the variety of CA resistance with Central America especially in Costa Rica, soon. My guess is that these varieties are being produced with help

from National Research Agency kind of like [inaudible 01:18:12] so you are free to request these from these variety respecting local quarantine laws but we are happy to share [inaudible 01:18:23] and other places, especially as one of our main focus is on stability. We are especially happy if anyone is able to pencil all population, anywhere in the world. Please, be our guest.

Tor Edwards:

I hope everybody took note of that. So you can be requesting germplasm from them. So I'd like to now ask some of the more general questions and presenters. I suppose we'll leave it to you to jump in on it. Let's try to be as brief as we can because we have several of these larger questions and we only have about 10 minutes. The first one is that I suppose that with population growth, greater intensification of production systems and globalization of markets and trade, there is a natural vulnerability to wider spread of pests and diseases. To what extent is there a potential to strengthen regulatory systems to reduce spread between countries and regions?

Dr. Bertram:

Sure. Shall I take a stab at that? If, unless somebody else wants to come in? I think it really depends but the point is very well taken in as much as we have a globalized world now and we've seen it's a smaller world in many respects. So we've seen particularly exotic pests and diseases introduced from one region to another. We also had an example today of just a new threat evolving through a complex of two different viruses.

Dr. Bertram:

I think the issues around sanitary and phytosanitary is clearly an important aspect of trying to control a pest. In some cases, in a case in the Fusarium race 4 in banana. it's, it's really almost like an embargo. You have to almost quarantine an area because it needs so much not to have material transported from one region to another. So I don't think it's a one size fits all but we certainly work closely with the authorities that are involved in and our missions do as well. In sanitary and phytosanitary and trade issues related to that. So I think it's one more arrow in the quiver. I think probably the lab itself is really about research for problems which lacks solutions. But I think we also have to keep other solutions in view. It's not a silver bullet approach. Thank you.

Dr Prasanna:

Yeah. Yeah. Just to quickly add to Rob's comment. There is a tremendous need for strengthening the capacity, the diagnostic capacity as well as the quaraintesity of the national partners. That's what we have learned in the last 10 years, to book MLN as [inaudible 01:21:51] it's not only the regulatory agencies in the lab level but also at the border level in interceptions of contaminated commodities. So I think in general, there are countries in sub Saharan Africa which need that support. We have done very little so far and there is a lot that needs to be done in terms of strengthening the local capacity of institutions in undertaking diagnostics for the presently emerging, as well as the future possible threats.

We need to have a compendium of such a devastating transformed [recapidence 01:22:31] and there is no what we call a prediction capacity right now or analytical capacity in many countries. So we need to strengthen that under the new innovation lab.

Dr Muni:

So, this is Mooney.

Tor Edwards:

Go ahead Dr. Mooney.

Dr Muni:

In the IBM innovation lab, we work on specific areas of the specific subject areas with the respective countries. Like for example, in the quarantine aspects of the parthenium in biological control, we work with Ethiopia, Kenya and Uganda quarantine regulatory officials and in Nepal, we worked with the PQPMC for introducing some of the regulatory activities. We also work in developing the human and capacity building in the regulatory areas in the respective countries that we work.

Tor Edwards:

That's a good thing to add to notice. The new innovation lab is coming on but we do already have a lot of this structures in place that we are currently working on them. Thank you Dr. Mooney. I have a really quick question that I'm going to read that I have written answer to and then I'm going to go ahead and turn things over to Rob and Angela to talk about. There are several different questions that are specific about the new design. So I'm going to turn it over to them. The question really quickly is measuring the counterfactual caution money saves the mitigation or control of pest and pathogen, is a really big challenge. Do we have any standard protocols or lessons for making these estimates. And we do have a response that Dr. George Norton, who is a professor of economics at Virginia tech. He does impact assessments of IPM technologies implemented in different countries. You may want to contact him for the standards established for such assessment.

Tor Edwards:

So with that Rob and Angela, I guess if you want to open up your mics, I can go ahead and let me read some of the questions that folks are asking about the new activity. And then you can add, arrange how you want, what order you want to answer them in. Are there specific countries or regions that the new lab should focus on? How will the HAG research agenda work with public and private extension sector partners? Will the innovation lab consider a similar lab for current and emerging threats to livestock? Will biotechnology be supported as an approach to develop durable strategies? And then there's just a whole bunch of current thinking about the new design, which cross geographic focus partners focused on prediction or response, et cetera.

Dr. Angela R.:

This is Angela. I'm happy to jump in on some of these and then pass it over to Rob. So there are some rules about how much we can discuss in advance of the solicitation but I can say that our intention for this innovation lab tech design is to be minimally prescriptive in terms of what the best research questions and technologies are, which crops, which geographic focus there will be some parameters. But again, we really want to see, what our partners in the scientific and development community offer as suggestions. And so, that would be kind of the basic answer to that question is that we don't anticipate being overly prescriptive in our solicitation. And I'll pass it to Rob to answer the question about livestock and a couple of other these. Rob?

Dr. Bertram:

Thanks, Angela. Well, first on livestock, we very much take the point that current and emerging threats are not limited to crops. And of course, as I mentioned earlier, we are addressing livestock threats but I can tell you that there's a lot of interest in this right now. And it goes beyond just the threats to the livestock sector but also the whole issue of one health as we're suffering from a global pandemic. The issue of zoonotic diseases is huge. So James, I think we need to, we will stay engaged on this and keep everyone informed as our thinking advances. And I think it would be a great subject for another Agora links seminar. I think there's a question on biotechnology too. Our approach on this, Diana, is that we take a science based evidence based approach on any of the solutions that would be developed. Also the scalability, the potential to address and we know that a range of scientific tools could be leveraged by our partners in the new innovation lab. So I believe that's really going to be... It will be open to all solutions. And I think Orain, as Angela just said, we're going to be looking for ideas and on new and innovative research approaches to solving major problems from our partners. So I think we can't say definitively right now, what will be there but we are open. Thank you.

Tor Edwards:

Alright, everybody. I think, I think we're getting right up to six o'clock. So I would like to thank all of you for your engagement today and for joining us on this as opposed to just seeing more as we learn about the new innovation layout. Thank you and have a great night.