

THE FALL ARMYWORM: ADVANCING THREAT TO GLOBAL FOOD SECURITY

Panel Moderator: *Martin Kropff*

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Introduction

Margaret Catley-Carlson

Council of Advisors, World Food Prize

And now we're going to move to our last panel of the afternoon. I can see them assembled over there. Please come ahead. We've had a wide gamut of discussions this afternoon. The role of research in looking at problems of war and security and the problems of rescuing people in dreadful situations. What was the role of research in that area? We have looked, as we just did in this panel, we looked at the international research community itself and the role that gene banks in particular play, but also the research in trying to answer the questions of the immediate future. We've just had a really good look at new technologies and particularly the regulatory problems they create for all of us.

And now we're going to look at a totally different area, which is – Can we use research to fight together? How do we assemble an army of researchers to fight the real enemies? And you're going to have some real experts on the enemies this time. So we're going to move into talking about the fall armyworm, and somebody will tell us why it's called that. But we're going to have Martin Kropff as the moderator of this, and he's got a super panel. Where's Martin? Where are you? There you are. You're still there. Okay good.

He's got a super panel in no order of being super, just the order they're written down here. Pedro Sanchez, who was a 2002 laureate and I think the first soil scientist to be a World Food Prize laureate. And he has done a lot of work, obviously, on soil but a lot of work on tropical soils and agroforestry as well. We have Mandefro Nigussie. He's the Director General of the Ethiopian Institute of Agriculture, so do you have the fall armyworms yet? Yeah, you're going to tell us about those, okay. We have Eluid Kireger – Yes, hello, Eluid – the Director General and the Chief Executive Officer of Kenya Agricultural & Livestock Organization. And finally we have somebody without whom no World Food Prize week would be complete. Some people think that he is USAID. Others know that he's just really responsible for the good things that come out of USAID. Rob Bertram has been with those of us who care about agricultural issues and with this particular week for a very long time. He's a voice for sanity, and we know that he goes home and pushes in the right direction for the right causes.

So, Mr. Moderator, you've seen how tough the combination of the timekeeping and the transitioning angel (me) is, so I leave you to get some good conclusions out of this very interesting group. Okay, over to you Martin.

Panel Members

Rob Bertram	Chief Scientist, USAID – Bureau for Food Security
Dr. Eluid Kireger	Director General and Chief Executive Officer, Kenya Agricultural & Livestock Research Organization
Mandefro Nigussie	Director General, Ethiopian Institute of Agriculture
Pedro Sanchez	2002 World Food Prize Laureate

Pedro Sanchez

2002 World Food Prize Laureate

Margaret, always good to follow your lead. Last year I raised a warning here (they gave me only five minutes when I think I did it) about this new pest to Africa that is really classified in military terms as *a clear and present danger*. And I think we have more evidence now that this is the case. As anybody interested in food security in Africa... It doesn't matter what you are; I'm a soil scientist, but I really felt that the voice had to be heard – the issue has to be raised. And I think my team has been very successful.

So today we have now in a way a passing of the gavel also between the small scientific advisory board that we formed last year into now the CGIAR is developing a major consortium to fight the fall armyworm. So this is a transition which Martin Kropff co-leads with Nteranya Sanginga. So at this point I would like to ask Martin to come over here and tell us his story.

Panel Moderator

Martin Kropff

Director General, CIMMYT (International Maize and Wheat Improvement Center, Mexico)

Thank you so much, Pedro, and good initiative last year, because there is an issue – it's called the fall armyworm. We've heard you talking about security and armies and all these conflict situations. But then there's one reason in the future why we could get major conflicts – it's food security. We all know it. All these people, many people from Africa, they move to Europe all the time. We find it normal these days. And the fall armyworm, the name says it already – it's a small, tiny thing. But who has seen the fall armyworm live? Oh, 20% of the people. Good. Maybe not so good, maybe not so good, maybe not so good because you don't want to see it. But what I wanted to do is with just a few slides to make sure, for those who have not seen it in the field, so that you have a feel for what's going on, how this looks like.

So it doesn't look nice. This is an affected maize plant – big holes in it, terrible. It's an insect native to the tropical, subtropical regions of the Americas. So it comes basically from Florida, its origin, and first reported in Africa in January 2016. And since then it spread tremendously fast. People say that it goes at 100 kilometers per day. It's a moth. It doesn't look nice. But a major program like Striga – at least it looks nice, but it doesn't look nice as well. So migrating in great capacity leading to rapid spread. And they, like many of the African people, they like maize the most. Maize is the preferred crop. When there's no maize, they go through sorghum, and step

by step through all the crops, but they focus mainly on maize. And as DG of CIMMYT, the International Institute for Maize and Wheat, of course, we are really worried about what's going on.

So this picture gives an indication. So it was already in North America coming from Florida. It's been down to the South, South America, a big issue, long time—30 years. And since 2016, Africa. And it came into India. And yesterday I got the slide from FAO, the most recent one. Here you see 2016—these are the red countries in Africa, 17 is orange, 18 is green. So India is also being infected right now, so it's going to go to Bangladesh, Nepal and maybe to the North. And even in Europe they are afraid. So it's a serious issue.

And then for the smallholder farmer—how can they help protect the food security and livelihoods of those smallholder farmers in Africa? Because I've seen in the fields what's happening, and basically it's really, really serious. And the problem is, there's not a single tool. Sometimes there is a single tool and you solve the problem. Like resistance varieties or so, completely resistant and there you go.

So what we need is to go for integrated pest management, so trying to make plants as resistant as we can—traditional, conventional but also through transgenics, BT—that's what you guys have been doing in the United States and in Brazil, etc. Then we have biological control—biological control naturally but also biological control by inundation. I've seen examples in a recent tour in Brazil. And then we have cultural control, for example, by conservation agriculture and also growing mixed crops, and like in Africa and border crops, you can also do a lot, and habitat management in general.

So this is a sort of toolbox. And the problem is that the type of tools and the size of the tools and the combination of the tools has to be different in different places. And that's when you need knowledge, that's when you need science, and that's when you need cooperation internationally—and that's why you need a consortium. So we formed it. Now recently, this new consortium with many parties that CIMMYT and IITA, we coordinated, but that means basically that all the parties bring in their expertise, their knowledge, sometimes on biological control, sometimes on chemicals; also the companies are in here.

So this is going to be a joint effort, and two weeks from now we will have the first Fall Armyworm R4D International Conference. It will be in Addis. Thanks also to USAID for supporting it, and many of the other parties. This is the first meeting that we try to bring all the parties together—in the first place, sharing a vision. Because right now all these research institutions, they go one by one to donors and trying to do their own thing. They have to have a shared agenda; then second, leverage the expertise. So biological control people, bring them together with the other ones. And the purpose, proposing plans to identify gaps. So where is the evidence? We want to have science-based, evidence-based solutions—not dreams; it's no dreaming thing. We have to solve the problem based on science. And then to develop, validate and deploy ITM technologies.

So it's going to be a major challenge. We already developed a fall armyworm in Africa, science-based. What do we know about it? What do we know about the solutions? But a lot of science is necessary, and that's why we have this panel, to see also what our experts from Ethiopia and Kenya indicate but also experts from the United States. So in that sense, I think, I hope that these pictures... You see the plant there; you see how devastating it is. Let's keep the picture there so that you keep in mind why we are doing this. But the FAO has estimated right now

that the effect is 30% – 30% of the maize in Africa is infected, and they estimate the yield loss now already across Africa at 10%. Do they have good data? Not yet, but it's a serious issue, and that's why we discuss it here. Thank you.

So let's go basically to Africa, because I just mentioned the FAO data, global, but these people, they just came in two hours ago from Africa, and they know exactly how it is in their country. So maybe, Eluid, could you explain the situation of the fall armyworm in Kenya and in Africa in general as well, if you don't agree with what I just said?

Eluid Yeah, thank you very much. As you have been informed, the fall armyworm is native to the Americas, and it was first reported in Africa in Nigeria in January of 2016; and it spread very, very fast. By November it had spread to six other countries – Niger, Benin, Togo, Cameroon, Ghana and Sao Tome. By February 2017 it was reported in Southern African countries. By April 2017 it was reported in Kenya and 8 South African countries – Ethiopia, Burundi, Tanzania, Swaziland, Congo, Rwanda, Uganda. And in three years it has spread 38 out of 54 African countries. In Kenya it has been reported in 43 out of 47 counties.

Now, the most preferred crop is the maize, although it has been seen in sorghum, rice and wheat. But of course we have been told it can attack up to 8 crop species.

Now, given the fact that maize is a staple crop in Africa and in Kenya 90% of the population depends on maize as food, its invasion has affected food security and especially when it infests seed-growing areas where we are doing basic seed, where we are doing certified seed. So it destroys the future of the maize sector.

Now, in terms of yield loss, approximately 30 million hectares of land has been affected in Africa with a potential loss of between 3 to 7 billion U.S. dollars in terms of crop loss. In Kenya, 250,000 hectares of land was affected in 2017 with a yield loss of about \$30 million U.S. dollars. This may not sound very high, but in economies struggling with food security it is really very devastating, and the [inaudible] if it does not a lot of concerted efforts by different actors to within the countries to come together and try to control the problem.

Martin You said 3 to 7 billion.

Eluid U.S. dollars, yes, equivalent.

Martin Africa as a whole.

Eluid Yes.

Martin Did you agree the 10% I mentioned? FAO indicates Africa as a whole, 10% yield loss now this year.

Eluid In 2017 they feel it was [inaudible] more devastating because it was the first time. It was the first time. So over time, there are a few measures, control measures that have been put in place. So even in Kenya in 2017 it affected 250,000 hectares. This year there is has affected 200,000 acres. But we attribute that mainly to the very

good weather. It was a bit cold. There was very good rain. But during the drought period it can be more devastating.

Martin Okay, thank you. Mandefro, how is it in Ethiopia?

Mandefro Thank you. In Ethiopia it was observed last year in 2017, and the first time we had the pest was in the southern part of Ethiopia. And within the same cropping season it was observed in three major maize-growing states – Oromia, Amhara and South. So with that pace, the loss is from 5 to 100%, depending on the localities. And for Ethiopia the estimate is \$490 million a year. There are also estimates by different scholars who reported about \$750 million a year.

So the impact is not just about the current production. It's about the future production. It's about the future market. It's about coastal production. It's about affecting education even. You know, the current production, the pest effects what is being in the field. How does it affect the future production? It affects the seeds of maize. You know, the seed enterprises, the seed companies, very limited and these are in specific areas. So everything we lost in terms of seed we are going to lose additional yields by next year. So it is affecting the future production and the future market in Europe, fall armyworm is [inaudible] in the world is [inaudible] a pest, which means it is affecting anything that was going to export as well.

So it affects the market, and it also affects the environment, because in order to offset the problem of the pest, currently it's not the best option, but one of the options is insecticide. So insecticide use in a farming community where farmers are not educated is very difficult to use a proper chemical and to use a proper dose and a proper application using protective measures. So it affects the health of the farming community. It affects the environment. And one of the decisions of the government of Ethiopia was to have a campaign where the rural community really goes out and collects the larvae. So in order to do that, school children went for this campaign, and the family retained was students, so a lot of drop-outs from school. So it's affecting the future generation too. So it has a multidimensional effect, not just agriculture but in many things. And the loss is about challenging our food security or worsening our food insecurity situation.

When it affects one country, the effect doesn't remain within that country. It affects the entire region, because the region is interlinked. And it also affects the globe. Food security is not an issue of one country or one locality, it's a global issue. And it also affects the Sustainable Development Goals that we are targeting by 2030. If the food security situation is affected right now, in order to compensate that, in order to really invest in our research that was supposed to be invested in some other area is going to be challenged that way. So the effect is quite big. And food security in Africa in general and in Ethiopia is not just food – it's the national security, it is peace, it is the stability. So when food security is affected, the entire stability is affected.

Martin Okay, thank you. Very clear. Now, it came in now two years ago in Kenya and last year in your country. I think we first have to listen, if you don't mind, to our colleagues from Africa. So what are you doing already, and what are you planning to do?

Eluid Now, in the Kenya situation when the pest was reported in Nigeria in 2017, the government formed a multi-institutional technical team, comprising of the national research organizations], regional organization, international organizations, the universities, so that they can provide technical information to the government in guiding the whole process of monitoring the pest.

Martin So in Nairobi meeting?

Eluid Yes, there have been several meetings. And when the fall armyworm was first noticed, before any action would be decided on what to be done, that caused a lot of devastation and there was a lot of panic. So farmers used all manner of chemicals that they would get, so there had to be a way of regulating what could be used in managing the fall armyworm. So multi-institutional team has been able to help in terms of testing the efficacy of insecticides that have been used elsewhere so that they can be used in the country, resource mobilization, passing of information so that the farmers can be able to..., training farmers to first identify the pest so that you can know the extent of the infestation. So that's most of the work that had been done by the government, and it's ongoing.

Martin So, but basically... I'm coming back to... After you, after you.

Mandero In Ethiopia the action taken by the government at large, the Ministry of Agriculture, research... When I say research, it's not just AIRalone, but we have CG Centers, we have universities and so. So the first thing we did was gathering information, because the fall armyworm was in this part of the globe for quite some time. And there are a number of information generated. So we had that review, and then formed a technical team who can propose intervention areas, produce a strategy document in the form of action plan.

So after that, the huge job done was advocacy work in the form of campaign, mobilizing the farmers and mobilizing the communities, the development agents and a subject matter specialist, who are supporting the farmers. So the campaign, information gathering, and then synthesizing extension material in the form of manual was some of the things that was done in one part. On the other side was chemical procurement, provision, and application was done in a very bulky quantity. So the pesticide, in addition to that research undertaken, I mean, took the assignment of screening this inorganic chemicals, bio-control measures like pheromones, biotech agents. In addition to that, we had also screened for one season the general types that are being produced to test whether there is a genetic variability in those germplasm or not. And there was also a platform that connects agricultural education, research and agricultural extension by having that big platform drawn from international, national and the local level. It was about preparing a strategic plan and an action plan. So this is not something that Ethiopia alone can fight against, but it requires the support of multiple actors. When I say multiple actors, it's not about research alone but is about financing the research, it's about promoting the product of research, and really having an integrated system than depending on just one measure. So those are some of the things that the government of Ethiopia has taken forward, and training; we have also provided for trainers for farmers, for development agents on the identified information and control measures.

Martin Thank you, and so a lot of [inaudible] play a big role and also scaling of FAO of course plays an important role. And thank you for allowing us to come with 200 people in two weeks from now to Addis to the meeting to sort out these issues. Now, we all heard that it was endemic to the United States, so we're all wondering—what happened here? How was it solved? And then we can maybe also go to Brazil with Pedro. You're from this place. You're from Florida, right?

Pedro Uh-huh.

Moderator That's where it comes from, so what did you guys do?

Pedro Well, actually no. Actually it comes from Central America. That's the best guess. And it came to Florida in the 1850s, so now we're talking about a bit over 160 years ago. It probably came with maize—as maize came from Mexico and Central America, it was probably there. Research... This, by the way, these are information from Dr. Greg Nuessly. He's in the audience around there. He is our chief etymologist at the University, so I'm just a spokesperson, but it still very, very interesting.

In the early 1900s at a time when probably our university and probably other ones in the South began working on this, they just tried to figure out the basic biology and how it developed, what are the host plants, many of them, the seasonal patterns, to look for weaknesses in how to attack it. In the beginning, the tools were just agronomy, early planting, crop rotations, something that the plants would grow before the fall armyworm really got to it. I mean, those were early days. We didn't know very much.

After World War II, a broad spectrum of synthetic fertilizers appeared and were used, but this is early, the silent spring type situation in which this insecticide had such a broad spectrum that it was killing everybody, the good insects and the bad ones and very much the silent spring type paradigm.

In the 1950s, natural enemies were identified, and they were mass produced and released, also what we now call the decision support systems, by monitoring and figuring out when was a critical injury level that would trigger a certain action by a certain state or county. Because this insect..., in the winter states and the warmer parts of the United States, South Florida and South Texas as well. And then when things get warm, the moths travel, a very large amount, 200 kilometers a day or so, and then they end up in Eastern Canada, in Minnesota, in all sorts of places, following the planting season as well. It's quite a nightmare. Also at that time a synthetic pheromones to follow up forecasting and migration were developed.

In the '70s breeding collaboration, breeding maize, primarily, collaboration started with USDA, seed companies and CIMMYT. It's interesting that CIMMYT was dealing with this problem as well as with us. So basically developing cultivars, I guess mostly open pollinated varieties, with graded resistance.

In the 1980s again more of this broad resistance insecticides.

In the late 1990s Bt corn arrived and you get this tremendous resistance, so with the *Bacillus*, the bacteria inside the plants, anything that chewed it or sucked it died.

But finally the broad spectrum insecticides were phased out. So the silent spring thing just went away that way – thank goodness. The newer synthetic insecticides were narrow, sort of super targeted since the '70s. So things are reasonably under control.

And then 2012 the fall armyworm resistant Bt maize appeared in Puerto Rico, so there we go again. All the resistance and all the things developed by this great GMO – boom! So now there are other toxins besides the bacterium *thuringiensis* of Bt maize are now being added as other kinds. So now I would call them the BFs because there are three kinds of fungi now that are toxic to the armyworm that are now being bred by genetic modification, whether you like it or not. And this toxin's keep going.

Right now part of the recommendations and my belief is you have to follow the rules. The rules are in Florida and the Midwest is you cannot have more than 10, depending on the state, 10 to 15% of your maize area with Bt corn or any of these resistant varieties. So you have enough space there with susceptible varieties and so on, so breeders can look for susceptible plants and heterozygosity, which means just have a lot of variety, genetic varietal tolerance in the plant itself.

Question – Is it controlled now after over a hundred years of research? I guess the answer is yes, sort of. It's just "sort of" in the sense that it's no longer having great outbreaks like people told us and showed photographs of basically an army of this larvae climbing over the fence, coming down and chewing all the corn. But you have to follow the rules, and we realize that this is what it is.

So to finalize, this is true integrated pest management, the IPM paradigm, dealing with resistant cultivars of the host plants. We're dealing with via control, natural enemies and narrow-spectrum insecticides that are more armed. So basically it's a combination of those three. No one is more important than the other one and so on, and I think if this continues to happen in Africa and now in India, it will be a long road ahead but one that can be at least controlled.

Martin Thanks, Pedro, and thanks for your in-depth study as well; because, well, it is important to look back at what happens. Now, the key is of course smallholder farmers in Africa living on less than \$2 a day, how can they afford it? In the first place, can we have Bt there? And in the second place, can they afford pesticides as well. So it's not a simple story, but it's contained here, but breaks through resistance as well.

Pedro Yes.

Martin Now one key question here is people say, "Oh, well, now you have to do these types of things for large-scale farming, but is it useful for small-scale farming?" And Rob knows sort of all about that – right?

Rob Well, I think you might be referring, Martin, to the fact that a large group of African scientists and decision-makers with colleagues from FAO and other organizations went to Brazil to see how Brazil manages its pests.

Before I go to that, thought, I would like to just say that it was just a year ago that our administrator, Mark Green, was in this room and made his call to action. And I know we're not going to have time to showcase everything today, but there has been a huge response across the public-private and NGO sectors. And I think he'd be very gratified. The other thing I think he's very gratified about is that the President last week signed the Global Food Security Act into law, five years, \$5 billion, building on the progress made thus far but also around the emerging threat issue. Remember, Norman Borlaug and the stem rust, and I mean that was a catalyst, the threat of that, along with the food price, to really reenergize the global community on these issues.

So with respect to Brazil, we were really grateful across the U.S. Government and FAO and CIMMYT and elsewhere, IITA, that our colleagues in Embrapa opened their doors. They shared all the different ways that they deal with this pest, many of which are relevant in Africa – scouting, monitoring, biocontrol, bio-pesticides and so forth. So I think there was great value there.

Now, if the question is partly with respect to the use of Bt technologies, I think one only has to look further south in Africa to see that in South Africa those are used and the armyworm is not causing the havoc there that it's causing elsewhere – and that it's not just by large farmers; smallholder farmers grow that as well. And I think we only have to look to cotton, to Bt cotton where there are literally millions of smallholder adopters of Bt crops, very successfully. So I don't think that that alone should be an issue.

The other thing that is attractive about a seed-based technology is that it is so scale neutral. I mean, if you're a large farmer or a small farmer, you still plant a seed – it's not something new and different – so I think that is an attractive aspect.

And then finally, the issue of relevance, it calls into question this issue of – well, who should decide? Shouldn't it be the countries themselves and the farmers in those countries that make these decisions rather than us guessing that, well, maybe that's not right for them. That seems to me to be a bit of an attitude that I don't fully understand. And I really think at the end of the day, with a lot of our R&D investments we're trying to just that – we're trying to give farmers choices. We're not telling them what to do.

Martin Farmers have to make their own choices, but information-based, evidence-based, and based on science. Now, let's go back to Africa. So given these experiences that we have here and your words, because we've been to Brazil. I was lucky to be there as well with 20 African leaders. Also one of your commissioners was there. It was a very nice exposition also by Embrapa. They explained everything they did. But hearing this type of things, what kind of... We need to do science, we need to do the research, and it takes time. What kind of things do you see that you can start implementing already pretty quickly right now? Kenya first?

Eluid Yes. A lot of work has been done of course in Brazil like you mentioned. And I think the first thing, because the infestation is already there, instead of recycling the wheel as it were, we need to borrow the technologies that are already working. That can only happen if that information is available. That can only happen if we work as a team, because the pests have no boundaries – between farms, in between counties, in between countries. So we should be able to act together and share the information that has already worked. If that's in Uganda, you can share it with the Congo.

And then the other thing is then it is a very expensive venture controlling fall armyworm. Put in terms of research, it's a disseminating research, so it also requires a concerted effort in terms of resource mobilization jointly. Either you know, in fact in this situation maybe a pool made up from the different governments or the governments do a joint research organization so that they can be able to work together. Because it requires an integrated approach.

Martin So to really get something going, you need money.

Eluid Yes.

Martin And not only for the research but also for the implementation. By the way, look at the pictures. Now you see really what it looks like, to be honest, in that sense. Mandefro.

Mandefro Yes. In this area I think it's not about knowing the source of the technology or the solution. What matters is – can we get that solution on a sustainable basis is the point. Currently, I've said, we have started screening genotypes, and we also had permission from the former Monsanto to experiment the Bt maize, and we have two sites, Melkassa in the Center Rift Valley, and Bako in the core breeding center. We have confined field experiment where we have started already testing the Bt maize or corn. So we are going to build on that, and we are negotiating with a private sector seed company – how can we really support the smallholder farmers. You know, a private is after profit, so the smallholder farmers are subsidized by the public sector. Can we have a balance between these two? That's what we are negotiating. Other than that, the government revised the GMO policy, and we already released Bt cotton, two varieties, and now we are moving towards Bt maize. That shows the commitment of the government looking for a solution, regardless of the source, whether it's from private or public. Can we get that solution on a sustainable basis? You cited as an example South Africa, because in South Africa these companies are producing seed, but in Ethiopia they don't have that piece. Are they going to import every year the seed, or can they start establishing the seed production area in Ethiopia, is what matters.

Martin Thanks, very good. I have a question here for Rob and for Martin. We know now that the fall armyworm has reached India recently, and we also hear about increasing prevalence of maize crops in several states in India, including Karnataka, Andhra Pradesh, Telangana, Maharashtra, Odisha, etc.. So that's another problem – it's just jumped to another continent. What should we do, we as an international community in Asia in general to protect crops like maize – that continues to be so important. What should we do, Rob?

Rob Well, of course, India is a key partner in much of this work, and fortunately they have strong institutions, and I think they'll be able to mobilize relatively well. It'd be great if we had an Indian or South Asian colleague with us to give us that view. But I can guess that as it moves north and gets into more and more areas where maize has grown... And maize has taken off in South Asia, very much linked to the poultry industry, and it will become a more serious problem.

I think India could be very helpful as it mobilizes and also collaborating both with its regional partners but also as part of this emerging research alliance in Africa. I think this idea of south/south learning, just as we again, the relevance of the Brazil situation where they've been dealing with this pest since the beginning is highly relevant in Asia as well. So I hope we can learn from what's gone on thus far and hopefully be ready partners with India and the other countries in Asia as they mobilize.

Martin I was just in India last week, so we discussed it with the Indian ICR. They have it... Because they have 25,000 PhDs in agriculture, in agriculture research in the universities in an ICR. But they need also this international link, and that's what we try to do as international organizations like CIMMYT, IITA and ISAPI and all these organizations. We try to bring knowledge from country to country. They are really interested in this, and of course the leader of our maize program, Prasanna, who is here, prepared these meetings and things, is from India as well. And directly he is now the advisor of the government as well, because they also have no experience in this whole thing. So they really want to build on the experience that we build in Africa. So in our meeting in Addis the fall armyworm doesn't need a visa, but when we travel from country to country, we need visa – right? So I hope that the Indians will get the visa also to attend that meeting. It's very important. We have to learn globally and also from your experiences here in the U.S.

Martin Okay. Our time is kind of short, but we can take a couple of questions, and if people want to ask questions, please.

Q Okay, my name is Patience Kuku, and I'm a farmer from Nigeria. I'm with the Global Farmer Network, attending the Roundtable that was held yesterday and today. So firsthand, being a corn farmer from Nigeria, growing both seed and grain, we were among the first farmers who experienced the fall armyworm. It's a devastating pest. We get the fall armyworm from one week after germination all through to the end of your production. So basically what the pest does is it eats your corn leaves, and it hides in the soil. So it's in the heart, right? So when you do a pesticide spray, it's very difficult to go in the heart of each corn and spray. So that's one thing – control is very difficult. And what it does is, it keeps eating the crop until... When the leaf is too hot, it waits, and then when you get the silk, it eats the silk, and then it opens up the cobs, and then you get fungus, so that it's a devastating crop to control. There's already existing technologies. Bt, I had the privilege of going to see a [inaudible] trial in South Africa. It's controlling armyworm perfectly. Kudos to Ethiopia where the government is backing the fight against Bt, but what's happening to other African countries? There's a solution. Embrace Bt and control it. So rather than have a long dialog of solutions... Spraying will be difficult for farmers in Africa. You still have the issue of when you spray the moth, so it flies from field to field, and it comes right back. So you get

several generations in one farming season. There's a solution. Let's not spend a lot of time on talking about it. There's a controlled Bt crop will solve the problem immediately for African farmers. African governments need to all back the technology and accept it. [inaudible] is already available for smallholder farmers, and so I would encourage that we... action.

Martin Thank you. I think this is a very important for you all to here that the research organizations in East Africa at least, they are working on this. We've already worked on Bt maize for a long time – right? But what we have to say is, well, in Brazil we learned that the first Bt was broken in three years, and now they have Bt varieties that are already there for ten years or something. So, but only Bt is not the solution as well, so we need an integrated approach.

Q Yeah, so South Africa has the refuge. So the farmer gets a bag in a bag. So you get the Bt corn and the conventional corn, and you plant a refuge, and it's enforced by law. So I think that we are really not looking for research. There's a solution – let's take the solution and hit the ground running.

Martin Okay. Very good point.

Pedro Our [inaudible] policeman is coming over now to arrest us. We want to thank everybody in the panel and the audience and we are at your service ma'am.

Maggie What I'm going to suggest is that there are other people who want to ask questions. I suggest they come up here, because this is such a good panel I don't blame you for wanting to ask questions. The people that have the questions come up and simply have a dialogue and conversation. I think, there must be so many things people want to know. This has been an exceptional panel and we've had the great benefit of having expertise from many angle of vision. Most importantly people that are living with it on the ground and experiencing it. Farmers that.., I know I've been there and I know I have a view and it's strong. So, and it's really very good to have this backed up by academic expertise, by the long expertise working in the international system. It's hard to go through four or five panels in the afternoon, but you've ended us up on a good note, a sober note. My goodness those pictures are dreadful, a sober note, but a note of knowledge, determination, and the idea that we might be able to go somewhere. Thank you very much, all of you, for this.

[End of recording]