

The International Plant Diagnostic Network: Gateway to IPM Implementation and Enhanced Trade

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Summary

The IPM CRSP International Plant Diagnostic Network Global Theme Program is working actively in 14 countries in four regions, and cooperating with six additional countries in two regions. The major goals in the first year of the second phase of the project were to strengthen the network of plant science professionals involved in plant diagnostics initiated in Phase I; develop closer ties with the IPM CRSP Regional Programs (RPs) to support them in diagnostic efforts in priority areas; and improve our distance diagnostic/information management web portal. We met in Antigua, Guatemala in March 2010 to review the strengths and weaknesses of the program in Phase I and make plans for Phase II. We expanded the network by establishing the South Asia network including labs in India,

Nepal and Bangladesh. Additional labs were also added to the East and West Africa sites. During the year, we met with five of the six RPs to consolidate activities related to pest and disease diagnostics. Priorities for pest and disease diagnostics were established in the four major regions (South Asia, East and West Africa, and Latin American and the Caribbean (LAC)). Surveys of major pests and diseases of priority crops were initiated in conjunction with the RPs in East Africa (tomato, passion fruit and onion in Kenya, and tomato viruses in Uganda (joint with AFRI project)). The IPDN was instrumental in diagnosing new diseases and pests in several regions, including brinjal gall midge, bacterial canker, mango malformation disease and several viruses. Progress is being made on the development of Standard Operating Protocols (SOPs) and two are under evaluation. A 2-day diagnostics workshop was conducted in Indonesia at the request of the SE Asia RP. Two host country scientists from the East Africa RP were trained at Ohio State University in the 2-wk short course, "Pest and Disease Diagnostics for International Trade and Food Security."

Survey of professionals involved in plant disease and pest diagnostics

Latin America and the Caribbean: Few laboratories in the region have capacity for molecular diagnostics of bacteria and viruses. The recent outbreak of bacterial canker, caused by *Clavibacter michiganensis* subsp. *michiganensis*, in greenhouse tomatoes in Guatemala was complicated by the lack of experience in diagnosing this disease locally. There is a great need for training in bacterial disease diagnosis. The IPDN LAC is taking the lead in compiling results of capacity surveys

and preparing a publication, intended for *Plant Health Progress* or a similar journal.

East Africa: Taking cognizance of the fact that disease diagnosis and pest identification capacity is frequently inadequate in the East African region, a baseline and benchmarking workshop for crop health research was held in Kenya from 28th to 30th March 2010 with the theme “Pooling together to impact against pests”. The workshop drew participants from all KARI centers with scientists carrying out crop health research work in the three main areas of arthropod pests, plant pathology, and weed science. The participants were identified over a period of 3 months through email and telephone consultations initiated by the Crop Health Coordinator by requesting scientists to submit personal profiles on a pre-designed template. The workshop drew 55 crop health scientists from across all research centers of KARI, the premier agricultural research and technology development institution in the country. The workshop agenda had the following broad areas of discussion: 1) Identifying crop health research capacity, constraints and priorities; 2) Integration of crop health research in agricultural product value chains; 3) Networking based on crop health research capacity (expertise and facilities); and 4) Scientific information dissemination (publications, advisory bulletins, etc.). Individuals and their specialties were identified to improve diagnostic services to farmers. Priority setting for crop health research was initiated after lengthy discussions on the criteria to use. Contact persons were identified in each research center for further crop health priority setting.

West Africa: Diagnostic capacity surveys were completed in West Africa in Phase I, and results will be compiled in Year 2, in cooperation with the LAC IPDN.

South Asia: Professionals involved in plant disease and pest diagnostics in India were surveyed for infrastructural and human

capacity to perform critical functions. A preliminary survey on national laboratories (25) and professionals (56) involved in diagnostics of various crop maladies was done and a database was created.

Southeast Asia: Pest management professionals attending a joint IPM CRSP SE Asia/IPDN workshop, July 21-23, 2009, in Indonesia (see Training below) were surveyed for pest and disease diagnostic capacity at their institutions. Thirteen professionals from Indonesia, one from the Philippines, and one from Cambodia completed the surveys. Seven respondents were female and eight were male. Results of the survey are being analyzed and will be collated with those from other regions during Year 2.

Expansion of the network in IPDN regions

Latin America and the Caribbean: The IPDN in this region is working closely with the IPM CRSP LAC regional program to identify potential member labs and to recruit scientists to participate in IPDN activities. Contacts were made with professionals in Ecuador and efforts are being made to fully integrate them to the IPDN network. Zamorano University in Honduras is very interested in access to DDIS technology, and several other labs outside the IPDN network, particularly in Mexico, have inquired about access to DDIS technology; these inquiries are being evaluated.

The LAC IPDN hosted a conference of IPDN and Virus Global Theme (IPVD) leaders in Antigua, Guatemala, March 16-21, 2010. The meeting was designed to update host country and US program leaders on progress and plans for Phase II of the IPDN and promote cooperation with the IPVD. The first phase of the IPDN (2006-2009) was reviewed, focusing on strengths and weaknesses of the programs in each of the three Phase I Regions (West and East Africa, and Central America). Plans for Phase II for developed based on the approved proposal and the Year 1 Work Plan.

East Africa - The following are additional laboratories to those identified during phase I:

i. Department of Plant and Microbial Science of Kenyatta University – has been instrumental in providing expertise in nematology. So far, ten (10) technicians and research project assistants have been trained in diagnostic nematology.

ii. Plant Quarantine Station (PQS) of the Kenya Plant Health Inspectorate Service (KEPHIS), the National Plant Protection Organization (NPPO) in Kenya. Collaborative linkages are being established with KARI in testing of a diagnostic protocol for cassava brown streak virus. KEPHIS has RT-PCR equipment that can be used to discriminate between CBSV and CBSUV in samples collected from some parts of Kenya. Conventional PCR does not provide the required resolution.

The Diagnostic Clinic at Makerere University in Uganda was expanded in the Makerere University Agric. Research Institute Kabanyolo (MAURIK) with support of Makerere University and the Africa Food Security

Initiative (AFSI) Associate Award, in collaboration with IPDN.

The following is an updated list of laboratories/institutions that are participating in the plant diagnostics under the IPDN project in East Africa. A laboratory has not been identified in Rwanda as yet. However, interactions with Mr. Senkesha Ntizo of ISAR are in progress for this purpose.

Discussions are underway to integrate some activities spearheaded by the Global Plant Clinic (GPC) initiative with those of the IPDN project. In Kenya, the GPC has identified four clusters, each with particular agricultural produce market-based points, through which ‘plant doctors’ extend their diagnostic and pest management knowledge to farmers. In the event that some cases cannot be dispensed at the market meeting points, samples and other referral situations can be handled in diagnostic laboratories with capacity that has been enhanced through the IPDN activities.

West Africa: Laboratories in Ahmadu Bello University (Zaria, Nigeria), the University of

Lab Name	Country	Lab leader Name	Email
Plant Pathology Section, KARI-NARL	Kenya	Dr. Zachary Kinyua	kinyuazm@gmail.com
Namalere Phytosanitary & Diagnostic Laboratory, MAAIF	Uganda	Mr. James Karyabakora	korajames2006@yahoo.com
Plant Diagnostic Clinic, Makerere University Agric. Research Institute Kabanyolo (MAURIK)	Uganda	Dr. Mildred Ochwo-Ssemakula	mknosseamakula@yahoo.com
Biotechnology laboratory, Faculty of Agriculture, Makerere University	Uganda	Dr. Richard Edema	redema@agric.mak.ac.ug
Plant Protection Section, ZARI	Zambia	Dr. Jack Chipili	jackchipili@yahoo.co.uk
Plant Protection Section, ARI (Tanzania)	Tanzania	Mr. Lebai Nsemwa	nsemwalth@yahoo.co.uk
Plant and Microbial Science Department, Kenyatta University	Kenya	Dr. George Kariuki	gmmkariuki@yahoo.com
Plant Quarantine Station, KEPHIS	Kenya	Mr. Abed Kagundu	akagundu@kephis.org

Ghana Lego (Accra, Ghana), and The Universite de Thies (Thies, Senegal) were added to the network. The diagnostics laboratory at the Institute D'Economie Rural (IER) in Sotuba, Mali, continues to develop with support of the IPM CRSP West Africa Regional Program. IPDN collaborates with the WA Regional Program in diagnostic activities in this laboratory.

Development of the IPDN network in South Asia

A list of laboratories in India for inclusion in the IPDN was prepared. Tamil Nadu Agricultural University (TNAU) serves as the Hub Lab. Spoke labs in India include the following: ADAC&RI, Trichy, HC&RI, Periyakulam, ARS, Kovilpatti, KVK, Tindivanam, KVK, Krishnagiri (private institution located at Elumichangiri), TERI, New Delhi and BCRL, Bangalore (Private lab). A national (India) level network meeting of hub and spoke lab scientists was conducted on July 14, 2010. Spoke labs identified to date in Bangladesh and Nepal are BARI-HRC (Joydephur, Bangladesh) and NARC/IDE (Kathmandu, Nepal). IPDN and the IPM CRSP South Asia Regional Program support a pathologist/diagnostician at IDE.

Expansion of list of subject matter experts

This activity continues slowly in all regions as subject matter experts are identified and recruited to participate in IPDN. In East Africa (Kenya) sample profiles from selected scientists were displayed during the March 2010 planning meeting.

Access to data management materials for countries/labs with limited internet access

As of March 2010, there were 22 labs in the system and 48 registered users. At this point, adoption (sample submission) is not strong; encouraging sample submission will be a priority in Year 2.

The IPDN website (<http://www.intpdnddis.org/>) continues to be improved; support was provided to users; and additional clinic and lab accounts were set up. Specific activities during Year 1 were as follows: 1) Maintained the website up and running, and provided user support; 2) Attended (J. Xin) IPDN planning meeting in Guatemala to present DDIS/CIMS and answer questions from participants; 3) Modified DDIS Media Library to reflect the need from IPDN users; 4) Created an Excel Spreadsheet for IPDN users with slow Internet connection so that their data can be imported to the system. The form is now available for downloading at IPDN website; 5) Set-up new countries (Nigeria, Bangladesh, India, Nepal) in IPDN system; 6) Modified IPDN homepage to make it faster for initial display; and 7) Updated content and added new features for IPDN website.

A digital media library, GIS capability, and mapping will be incorporated in Phase II. System security, which is described in the "User Confidentiality Policy" within IPDN DDIS is a concern to most members of the IPDN. Samples may be "Private" or "Public"; in the former, only the submitter and the receiver know the origin of the sample. Country information can be blocked on referred samples. It is recognized that sample identification can be a complex issue that may limit adoption of DDIS.

Identification of priority crops, pests and pathogens to provide focus for IPDN efforts

Latin American and the Caribbean: Crop, disease and pest priorities were determined during a joint IPMCRSP LAC Regional Program/IPDN/IPVD meeting at FHIA, Honduras in May 2010. Solanaceous crops tomato, pepper and potato were identified as priorities for the IPDN project. These crops range in production type from low technology field (potato in Guatemalan highlands) to high technology greenhouses (tomato growers export

to the USA and other countries). The outbreak of bacterial canker in greenhouse tomato caused significant losses in Guatemala. In peppers, *Phytophthora cinnamomi* (basal rot) is the most important pathogen. In potatoes, the most important disease is bacterial wilt caused by *Ralstonia solanacearum*. *Candidatus Liberobacter* has also become this year an important threat to potato production.

Whitefly-transmitted begomoviruses are also a significant problem in vegetables. New races of the Fusarium wilt pathogen in melons are also of concern.

East Africa: The IPM CRSP East Africa Regional Program crop priorities are tomato, passion fruit and onion. During the March 28-30, 2010 priority-setting meeting in KARI, contact persons were identified in each KARI research centre represented in the workshop. This is a primary step towards ensuring that resources are directed to important crop health constraints.

Between July and September 2010, IPDN and the East Africa Regional Program jointly surveyed the three target crops in Kirinyaga and Murang'a in central Kenya. The full report is presented in the EA Regional Program annual report. Tomatoes appeared to have the widest variety of health-related problems, including fungal, bacterial, viral, and nematode infestations. Farmers were usually unable to identify even common diseases in their fields. Therefore, increasing the farmers' capacity to detect/diagnose diseases will be a focus of future work. It will also be important to determine the ease with which people providing services (extension and agro-input sales) are able to identify/diagnose plant disease conditions. Some diseases, in particular those caused by viruses, require the use of definitive analysis such as serology or nucleic acid analysis.

Initial discussions with crop health research scientists in Kenya have shown that prioritization of pathogens and pests require

the development of appropriate and agreed criteria for the process. Without this tool, consensus can hardly be reached since there are strong professional/disciplinary biases among the scientists. The task is bound to be even tougher with the inclusion of other categories of stakeholders. As a starting point, the following criteria were suggested and pre-tested in a maize pest prioritization workshop in September 2010:

- the ease of identification of the problem (*very difficult...1; very easy...5*)
- the level of known damage or losses to maize yields (*very high.....1; very low...5*)
- the potential damage when no control measures are taken (*very high.....1; very low...5*)
- the availability of known control measures (*very poor availability.....1; easily available...5*)
- the affordability of known control measures (*highly unaffordable.....1; easily affordable.....5*)
- the ease of implementing known control measures (*very difficult to implement.....1; very easy to implement.....5*)

The total score for each pest (insect, pathogen or weeds) was determined on a scale of 1-5 to facilitate ranking (where 1 is most important and 5 is the least important). After robust discussions, the tool was well understood, although it can be revised to make it more effective. It is envisaged that this criterion-based tool will be developed further using particular crop cases for application across all countries where the IPDN and Regional Projects are operative.

West Africa: The target crops of the West Africa Regional Program are tomato, potato and cabbage. Diseases caused by fungi, bacteria, viruses and nematodes are common in tomato and potato, and incidence and severity varies by season. Pests are more important than diseases in cabbage.

South Asia: The South Asia Regional Program has identified tomato, eggplant, cucurbits and cabbage as priority crops. As in other regions, general categories of diseases and pests are known, but specifics as to virus and bacterial causal agents, in particular, are not well known.

Prioritization of diagnostic protocols, assays, etc.

Latin America and the Caribbean: Currently a commercial immunostrip assay is being widely used for bacterial canker diagnosis in LAC, but false positives are common; therefore, developing capacity for conducting confirmatory PCR assays is a priority. PCR assays for *Candidatus Liberibacter*, whitefly-transmitted geminiviruses, and *Phytophthora* spp. are also critical. Protocols for *Fusarium* detection in melons are also needed.

East Africa: Nucleic acid capture materials (FTA cards, Adsorption strips, RNA stable) were compared for tomato virus diagnostics in collaboration with the AFSI project in Uganda. Results will be available in Year 2. The best product(s) for DNA or RNA extraction from plant pathogens will be used for follow-up identification by PCR in select laboratories in Kenya and Uganda, depending on the pathogen. Permits are not required to move nucleic acids across borders.

West Africa: Nucleic acid sampling materials are also being used to sample tomato and potato for viruses and bacterial pathogens. It will be a priority to develop capacity in the IER lab in Sotuba for PCR diagnostics using nucleic acids collected throughout the region. The Biotech Laboratory at the University of Ghana Legon may also be used for this purpose.

South Asia: Key areas of focus for the South Asia RP include virus-vector interactions (Tospo, Begomo, Poty), fungal-nematode complexes in vegetables, population biology in sucking pests, and fruit flies in vegetable ecosystems. An identified need in South Asia is

training in bacteriology. Infrastructure development (for serological and molecular diagnostics) was undertaken in the TNAU diagnostic hub lab during this year.

Prioritization of pathogens or pests to be surveyed/mapped

Latin America and the Caribbean: Priorities for survey are being developed.

East Africa: A tomato virus survey was undertaken in Uganda in conjunction with the AFRI project.

West Africa: IPDN was instrumental in identifying new diseases in West Africa – mango malformation and a new disease of citrus (Ghana).

South Asia: Brinjal gall midge (*Asphondylia* sp) emerged as major pest in Coimbatore Dt; *Liriomyza* sp., *Spodoptera exigua* and Iris yellow spot virus were observed in onion for first time in Tamil Nadu; Little leaf in beetroot (phytoplasma) and Tobacco streak virus in cotton were recorded.

Support for identification/reports of new diseases and pests

Latin America and the Caribbean: Bacterial canker was identified for the first time in greenhouse tomatoes in Guatemala.

West Africa: IPDN was instrumental in identifying new diseases in West Africa – mango malformation and a new disease of citrus (Ghana). In both cases, samples were submitted to DDIS/CIMS and IPDN assisted in identification as well as follow up assistance for laboratory confirmation. Other first identifications were Sweet potato leaf curl virus (SPLCV) (begomovirus) and African cassava mosaic virus (ACMV-Nigerian strain) (begomovirus) Sikasso, Mali, discovered in conjunction with the IPM CRSP West Africa Regional Program (Dr. Robert Gilbertson).

Prioritization for at least five pathogen or pest targets for SOP development

Latin America and the Caribbean: Priorities are *Ralstonia solanacearum*, *Clavibacter michiganensis* subsp. *michiganensis*, *Phytophthora* identification and species differentiation, Whitefly-transmitted geminiviruses, Fusarium wilt in melon.

East Africa: Among the pathogen/pest targets identified during Phase I, the SOP for banana bunchy top disease (BBTD) and banana xanthomonas wilt (BXW) are the most advanced in terms of completion and sharing for potential pre-testing. The BBTD procedure has been availed to Dr. Douglas Miano, a virologist based at KARI's Biotechnology Centre, in order to determine its suitability in surveys, sampling and analysis for the disease in Kenya. The draft SOP is availed separately. The BXW SOP (available separately) has been used to showcase the steps taken in the development of SOPs during pest discussion forums. The latest of such forums was the 6th EAPIC workshop held at Jacaranda Hotel in Nairobi, Kenya from June 9- 11, 2010. The idea of SOPs is highly appreciated in confirmatory processes, particularly those that involve trade in high-value commodities.

South Asia: A mealybug SOP is under development. Other priorities are being developed.

Write up of IPM recommendations

East Africa: A poster on tomato diseases was developed for the East Africa Regional Project. A crop health bulletin is currently in its first draft version in KARI. The bulletin will cover critical pest/pathogen diagnostic and identification aspects for the benefit of farmers, agricultural extension staff and researchers. Publication is expected by the end of 2010.

South Asia: Posters on the pests and diseases of onion, okra, tomato, papaya and brinjal were

prepared for training farmers and extension functionaries.

Training pathologists and entomologists in targeted methodologies or pathogen or pest identification

At the request of the IPM CRSP Southeast Asia Regional Program, IPDN assisted in organization and presentation of a 2-day diagnostics training workshop, July 21-23, 2009 at Bogor Agricultural University in Bogor, Indonesia. Dr. Fulya Baysal-Gurel, plant pathologist and postdoctoral associate in Dr. Sally Miller's lab at OSU, conducted training in serology and PCR, bacterial diagnostics, and fungal diagnostics.

Training key host country scientists in classical and modern diagnostics

Latin America and the Caribbean: Ms. Isabel Arias, Agroexpertos, Guatemala, attended in June 2010 a workshop held in Costa Rica for *Phytophthora* diagnostics and identification techniques. The Workshop was part of a USAID Horticulture CRSP project.

East Africa: Ms. Miriam Otipa and Dr. Monica Waiganjo attended the OSU short course, "Pest and Disease Diagnosis for International Trade and Food Security," August 23-September 3, 2010 in Wooster, OH.

- Farmers' seminar organized by Department of Agriculture, Trichy
- Agri-Expo on 21.01.10 – 24.01.10
- Agri-Expo on 24.9.10-26.9.10
- State-level farmers training program organized by NABARD and IFFCO on Feb 15-17, 2010 and 28.9.10
- Mealybug Awareness and management programs on 17.08.10
- Onion IPM Seminar by Private agency M/s. Bayer Crop Science Limited M/s. Indofil Chemicals Limited on 06.11.2009 and 7.3.10

- Twelve monthly zonal workshops organized by Department of Agriculture

Farm Advisory Service

- Diagnostic field visits undertaken by IPM-CRSP scientists: 33
- Plant protection advisory service through telephone: 245
- Farmers visit to Institute for pest management query: 168