



REPORT OF THE 2ND PHYTOSANITARY CONFERENCE

Theme: “Phytosanitary Systems for Safe Trade and food Security”



4th to 8th June, 2018

KEPHIS Headquarters,

Oloolua Ridge-Karen, P.O. Box 49592, 00100, Nairobi, Kenya.

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List of Acronyms and abbreviations

AATF	African Agricultural Technology Foundation
ACL	Analytical Chemistry Laboratory
ACP	Asian Citrus Psyllid
ARET	Agricultural Research Extension Trust
ASDS	Agriculture Sector Development Strategy
AU	African Union
CAADP	Comprehensive Africa Agriculture Development Programme
CABI	Centre for Bio-Sciences International
CBA	Commercial Bank of Africa
CIMMYT	International Maize and Wheat Improvement Center
COMESA	Common Market for Eastern and Southern Africa
COPE	Centre of Phytosanitary Excellence
DARS	Department of Agricultural Research Services
EAC	East African Community
EAGA	East African Growers
EAPIC	East Africa Phytosanitary Information Committee
ECA	Electro-chemical activated
ECOWAS	Economic Community of West African States
EU	European Union
FCM	False Codling Moth
FPEAK	Fresh Produce Exporters Association of Kenya
FRIM	Forest Research Institute of Malawi
GCMSMS	Gas chromatography–mass spectrometry–mass spectrometry
GDP	Gross Domestic Product
GMOs	Genetically Modified Organisms
GMPS	General Manager Phytosanitary Services
GMQA	General Manager Quality Assurance
GRD	Groundnut Rosette Disease
HCD	Horticulture Crops Directorate
HLB	Huang long bing
HST	Horizon Scanning Tool
IAPSC	Inter-African Phytosanitary Council
ICT	Information And Communication Technology
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
ISPMs	International Standards for Phytosanitary Measures
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agriculture Livestock and Research Organisation
KCB	Kenya Commercial Bank
KEPHIS	Kenya Plant Health Inspectorate Service
LCMSMS	Liquid chromatography–mass spectrometry–mass spectrometry
LUANAR	Lilongwe University of Agriculture and Natural Resources
MCMV	Maize Chlorotic Mottle Virus
MLND	Maize Lethal Necrosis Disease
MRLs	Maximum Residue Limits

NBA	National Biosafety Authority
NGS	Next-Generation Sequencing
NPPO	National Plant Protection Organization
NPT	National Performance Trials
PCE	Phytosanitary Capacity Evaluation
PCPB	Pest Control Products Board
PIMS	Pest Information Management System
PPE	Personal Protective Equipment
PPPs	Plant Protection Products
PRA	Pest Risk Analysis
PRISE	Pest Risk Information Service
RECs	Regional Economic Communities
RNA	Ribonucleic acid
RSD	Ratoon Stunting Disease
SADC	Southern African Development Community
SCMV	Sugarcane Mosaic Virus
SDGs	Sustainable Development Goals
SPS	Sanitary and Phytosanitary
TBT	Technical Barriers To Trade
UAVs	Unmanned Aerial Vehicles
UoN	University of Nairobi
USAID	United States Agency for International Development
WPM	Wood Packaging Material
WTO	World Trade Organization
ZARI	Zambia Agriculture Research Institute

Executive Summary

Government of Kenya, USAID (Feed the Future Program), KEPHIS and COPE organized the 2nd Phytosanitary conference from June 4th to 8th 2018 at KEPHIS Headquarters, Nairobi, Kenya where plant health experts from the Eastern Africa region and COMESA countries shared their achievements, challenges and opportunities in application of phytosanitary (plant health) measures towards assuring market access, safe food and food security. The theme was “**Phytosanitary Systems for Safe Trade and food Security**”. The aim of the conference was to provide opportunities to discuss phytosanitary systems’ issues experienced by the different countries in the region. The main themes of the conference were:

- a. Pest Surveillance in Phytosanitary Systems
- b. Import Control and Quarantine Regulations in Phytosanitary Systems
- c. Pest Diagnostics in Phytosanitary Systems
- d. Export Control in Phytosanitary Systems
- e. Industry participation in Phytosanitary Systems
- f. Technologies and Innovation in Phytosanitary Systems
- g. Food safety issues in phytosanitary systems (MRLs, Heavy metals and Aflatoxins)
- h. Cross-cutting issues in phytosanitary systems (to include capacity building, legal requirements, communication in phytosanitary, GMOs, Biosafety, emerging phytosanitary issues e.g. new pests)

Participants to the workshop were drawn from various institutions which included but was not limited to National Plant Protection Organizations (NPPOs), government (Regulatory agencies, policy makers, extension agents), Private/Industry – Farmer, exporter organizations and others, International Plant Protection Convention (IPPC), Inter-African Phytosanitary Council (IAPSC), RECs (COMESA, EAC , SADC, ECOWAS), International Organizations and NGOs, Academic and Research Institutions and development partner agencies. In total, more than seventeen (17) countries and twenty five (25) institutions attended the conference and 46 papers were presented; there were 2 panel sessions on contemporary phytosanitary issues. A field visit to a flower farm was organized.

Side-by-side with the conference were training sessions between 5-8th June 2018, where 294 farmers, 25 seed sellers and 56 youth were trained on various issues affecting them. All the participants were drawn from different parts of the country. Also an exhibition was running hand in hand with these training and conference; it is estimated that over 300 persons visited the exhibition.

KEPHIS reaffirms its commitment to creating a conducive environment for the realization of stakeholders engagement in Agricultural development initiatives; their potential to contribute to the sector and indeed to the overall economic development, food safety, food security and nutrition.

Esther Kimani, PhD

Managing Director, KEPHIS

Introduction

Sanitary and Phytosanitary (SPS) measures are aimed at protecting people, animals and plants from diseases, pests or contaminants without hindering trade. The measures should be science based and in line with the SPS Agreement that seeks to ensure that such measures do not unjustifiably discriminate. Phytosanitary measures include any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests. International Standards for Phytosanitary Measures (ISPMs) guide countries in setting measures to prevent or limit the entry, establishment and spread of pests that may otherwise have serious impacts on plant resources and food security. ISPMs are developed through a consultative process where all International Plant Protection Convention (IPPC) contracting parties (countries) and other stakeholders worldwide are given a chance to provide their input.

In the last few years a number of pest, diseases and weeds have been identified as being of phytosanitary concern in Kenya and other countries in Africa. These include:

- **Fall Army Worm (*Spodoptera frugiperda*)** – that was introduced in Africa in 2016 and in Kenya in 2017 and has affected maize production in the country. In addition, it has major implications on the EU market access for herbs and vegetables (capsicum and aubergines) and cut flowers.
- ***Tuta absoluta*** – Introduced in Africa and seriously affecting tomato production. It has not been reported in some countries in Africa.
- **False Codling Moth (*Thaumatotibia (Cryptophlebia) leucotreta*)** – An endemic pest in Kenya which is affecting market access in Europe, especially for cut flowers but also some other horticultural products such as *Capsicum spp.*
- **Maize Lethal Necrosis Disease** – The disease was introduced in Kenya in 2011 where it severely affected food production and was spread to other countries. It has not been reported in some countries in Africa.
- **Fusarium Tropical race 4 (TR4)** –The disease has been reported in Mozambique, but is a risk to it's neighbouring countries as it has potential to devastate banana production as well as affecting exports in agricultural products.
- **Potato Cyst Nematode** - affects production of potato in Kenya.
- **White flies/*Bemisia spp*** - A pest and vector of plant viruses hence of concern to market access.
- **Larger Grain Borer** - A major storage pest and a threat to food security
- **Fruit fly (*Bactrocera dorsalis*)** - A serious threat to fruit production and market access.
- **Striga weed** - threatens livelihoods as it affects production of food crops and food security.
- **Parthenium weed** – invasive weed that affects pasture production and natural habitats.

Apart from pests being a challenge, a number of other issues have been identified as challenges in phytosanitary systems such as the impact of bio-control agents if they are not well regulated; limited capacity to conduct Pest Risk Analysis (PRA); lack of capacity to manage phytosanitary risks; lack of capacity in diagnostics and accreditation; limited capacity for surveillance; limited emergency response to pests and limited systems for traceability particularly in relation to pesticide residues and aflatoxin.

Session 1: Official opening [Chair session Dr. Esther Kimani, Managing Director KEPHIS]

Welcoming remarks, Dr Esther Kimani, Managing Director, KEPHIS

The KEPHIS Managing Director was pleased to be in the presence of guests from various countries and institutions. She recognized the presence of representatives from NPPOs in Africa, international bodies including CABI, policy makers, phytosanitary practitioners, KEPHIS staff and all guests present. The MD KEPHIS welcomed all the delegates to the 2nd phytosanitary conference and thanked them for making it on time to deliberate on pertinent phytosanitary matters. She urged all participants to use the opportunity to learn, share, network with each other as this could be the beginning for each one represented in the conference to change Africa in a positive way particularly as phytosanitary practitioners.



She outlined the objectives of the conference as being to provide an opportunity for National Plant Protection Organizations (NPPOs) in Africa to share achievements and challenges; To provide the NPPOs with an opportunity to create linkages and promote market access within Africa, and lastly to identify potential areas of cooperation on phytosanitary regulation at regional and international levels.

Dr. Esther Kimani pointed out the focus thematic areas of the conferences which included Pest Surveillance in Phytosanitary Systems, Import Control and Quarantine Regulations in Phytosanitary Systems, Pest Diagnostics in Phytosanitary Systems, Export Control in Phytosanitary Systems, Industry participation in Phytosanitary Systems, Technologies and Innovation in Phytosanitary Systems, Food safety issues in phytosanitary systems (MRLs, Heavy metals and Aflatoxins) and cross-cutting issues in phytosanitary systems including legal requirements, communication in phytosanitary, GMOs, Biosafety, emerging phytosanitary issues such as new pests.

In conclusion, she thanked all the partners especially the United States Agency for International Development (USAID) Feed the Future through FOODSCAP, the Centre of Phytosanitary Excellence (COPE) and the Centre for Bio-Sciences International (CABI) who made the conference a success. She also thanked KEPHIS staff who tirelessly worked hard to make the event possible.

Prof. Anne Muigai [Representing the Chairperson, KEPHIS Board of Directors]

During her remarks, Professor Muigai who represented the Chairperson of KEPHIS board of directors welcomed the over 100 delegates from close to seventeen (17) countries in attendance to the Second Phytosanitary Conference. She noted the presence of delegates from many African Countries such as

delegates from Burundi, Cameroon, Eritrea, Ghana, Malawi, Nigeria, Uganda, Zambia, Zimbabwe as well as the host country Kenya.

She confirmed that apart from Kenya's and many African countries economies being predominantly agricultural based contributing significantly to their Gross Domestic Product (GDP) and employment, the sector is also a major driver of both domestic and local trade hence important in providing incomes for



farmers and foreign exchange earnings for the continent. Giving Kenya as an example, she informed the participants that the Kenyan government through its economic blue print, Vision 2030, seeks to propel the country to achieving economic development at an average ten percent growth rate that will enhance the country's status to a middle income economy since Agriculture is centre stage and remains the main catalyst of growth for Kenya's economy and emphasized the need for sustained agricultural productivity in ensuring food security for the Kenya as well as creating income and wealth for large and small scale farmers.

Prof. Muigai commended the important role KEPHIS is playing in contributing to above-mentioned milestones met for the country despite the various challenges and the way KEPHIS continues to partner with other regulators and stakeholders in managing any challenges facing the agriculture sector. In meeting the new vision of "Healthy Plants, Safe Trade and Sustainable Agro-Environment for a Prosperous Kenya" KEPHIS has taken into consideration key Government of Kenya economic development priorities as well as relevant areas in the United Nations Sustainable Development Goals (SDGs), the African Union Comprehensive Africa Agriculture Development Programme (CAADP), African Union (AU) Agenda 2063 and other regional and international policy documents. Prof. Muigai on behalf of KEPHIS Board of Directors concluded by welcoming all the delegates to KEPHIS and thanked them for making time to the important international conference, wishing them well during deliberations in the weeklong conference.

Ms. Tina Dooley – Jones [Mission Director, Kenya and Eastern Africa, USAID]

Ms. Dooley – Jones of the USAID was pleased to be part of the important conference to discuss important issues in phytosanitary systems. She pointed out that phytosanitary issues are not only for Africa but for the whole world. She reminded the delegates that sanitary and phytosanitary (SPS) measures are important aspects in phytosanitary systems and that harmonization of the SPS measures is very critical for safe trade between



countries. She outlined some of the aspects of harmonization of SPS measures that the USAID has been coordinating in the African continent giving the example of capacity building to implement the SPS measures in the EAC region. She reiterated that despite the many challenges caused by pests and other phytosanitary concerns, the USAID recognizes the efforts by countries. She urged all the delegates to share knowledge as these efforts will help many people over the world.

Dr. Daniel Tuitoek, Representative of the Parliamentary Agriculture Committee

Dr. Tuitoek representing the chairman Parliamentary Committee on Agriculture appreciated the invitation to the significant phytosanitary conference. He was pleased to announce that the Parliamentary Committee on Agriculture is proud to collaborate with KEPHIS, the institution hosting the conference and which is also Kenya's National Plant Protection Organization. He acknowledged the role KEPHIS is playing in protecting Kenya's agriculture. He also noted KEPHIS commitment to strict quality assurance processes which has ensured that Kenyan flowers, fruits and vegetables continue to meet market requirements in key markets. The legislator confirmed that the last parliament ratified SPS Protocol for the East African Community and hoped that the parliamentary committee shall continue to harmonize regulations and standards putting up structures for their implementation to facilitate free trade in the African continent. Dr. Tuitoek noted the presence of representatives from NPPOs of African nations and challenged them to use the networks develop in the forum to ensure that phytosanitary measures are adhered to in order to facilitate trade.

The Parliamentary Committee representative confirmed that as legislators, they recognize that agriculture is the backbone of many economies, especially in developing countries; hence the importance of the deliberations of the phytosanitary conference cannot be over-emphasized. He noted with concern that Agriculture is at a cross roads in Kenya, with many challenges facing the sector. It is the backbone of Kenya's economy and urged all Kenyans to do all that can be done to counter and mitigate the challenges for the sake of Kenyan farmers who earn their livelihood from the sector. He concluded by assuring that as policy makers, they are ready to support and work with the phytosanitary system practitioners such as KEPHIS and other stakeholders in agriculture sector in approving the necessary laws and improvement on agricultural resources for the betterment of our nation.

Official opening - H.E. Hon. Jackson Mandago, Governor, Uasin Gishu County

The Honourable Governor for Uasin Gishu, H.E. Hon. Jackson Mandago welcomed all the delegates to the second phytosanitary conference, noting that many of the participants are young and hence having the hope for the future of the Continent. He termed that the presence and participation of interns and university students in the conference is very progressive particularly for the future. The Governor thanked the development partners (USAID, CABI) for the support and KEPHIS for organizing the conference.

The Governor was humbled to be part of the pertinent conference to discuss all matters of plant health. He stated that Uasin Gishu County is extremely proud to be associated with KEPHIS, the premier institution that deals with all matters of phytosanitary. The governor confirmed that the County has collaborated with KEPHIS in a number of areas, the most recent one being in the promotion of potato and avocado. Other collaborations with KEPHIS include building capacity to Uasin Gishu County staff and farmers in



matters phytosanitary in terms of pest management, nursery certification, training on seed certification and plant variety protection, production of crops for export, identifying market opportunities, and coming up with mitigation measures against the Fall Armyworm and the Maize Lethal Necrosis Disease which were affecting maize production in Uasin Gishu. With the devolution of agriculture to the counties in Kenya, stated the need to facilitate organizations such as KEPHIS to make the spirit of devolution a reality and the need for greater collaboration between the national and county governments as agriculture is still the main backbone of Kenya's economy and will remain so for many years to come. The Governor gave the example of Uasin Gishu County exploring the export of its agricultural products to overseas markets and thus making Eldoret Airport a major transit route for this produce. For this reason, the governor emphasized the need for more capacity building for farmers in the region for assurance of exports that meets the market requirements of key markets.

In conclusion, The Governor urged all the delegates from Africa to double the efforts in research so as to facilitate trade within Africa and most importantly eradicate hunger in Africa. The Governor concluded by congratulating KEPHIS, the United States Agency for International Development (USAID), the Centre of Phytosanitary Excellence (COPE) and other partners for putting together the important conference. He however, proposed that perhaps the team could consider the next conference being held in Uasin Gishu County.

With the remarks, the Governor Uasin Gishu County declared the conference officially open.

Session 2: Pest Diagnostics in Phytosanitary Systems [Chair Session: Dr. Isaac Macharia – GMPS KEPHIS]

1. Key note address: Pest Diagnostics in Phytosanitary systems (Dr. Maina Mwangi, Kenyatta University)

The presentation highlighted the importance of pest diagnostics in phytosanitary systems as it is aimed at provision of timely and accurate plant pest diagnostics and professional expertise for an effective response. The presentation posed the question of effectiveness in current diagnostic systems in terms of timeliness, accuracy, likely response scenarios and expertise/professional capacity. The presenter outlined what has been done, what can be done to improve systems and what can be enhanced. The highlighted areas to be enhanced include: leveraging technology, improving infrastructure, human capacity development, community engagement, development of effective pest diagnostics “ecosystem” (institutions, policies, networking, resources) and “going public” through multiple channels.

2. Next generation sequencing as a tool in modern pest risk analysis: a case study of groundnuts (*Arachis hypogaea*) as a potential host of new viruses in Western Kenya (Bernard Mukoye, MMUST)

The presentation described the diverse environments where Groundnut (*Arachis hypogaea*, L.), is grown and which include the semi-arid and sub-tropical regions. It was reported that poor yields of 500-800kg/ha are attributed to poor agronomic practices, pests and diseases. The major disease reported in Kenya is Groundnut rosette disease (GRD). The next generation sequencing tool was used to map out and confirm varied and severe symptoms observed in the fields in addition to those caused by Groundnut rosette disease. The results showed that there are additional viruses affecting groundnuts in western Kenya; this highlights the importance of starting a germplasm clean-up program of the plant material used as seed for this crop.

3. Distribution, Genetic Diversity and Viral recombination of Maize Lethal Necrosis disease causing Viruses in Kenya (Francis Mwatuni, CIMMYT-Kenya)

The presentation discussed the impact of Maize Lethal Necrosis disease on food security in Kenya and the results of the nationwide survey conducted in 2015/2016 which indicated that MLN incidence was 35 to 90%, prevalence was 44 to 72% and symptoms severity ranged from 1.7 to 4.1 on a 1-5 severity scale. The study identified MCMV and SCMV to be the major viruses causing MLN in Kenya through Laboratory diagnosis and NGS sequencing. The Kenyan MCMV isolates sequences from this study showed 99.75% similarity to the isolate previously reported in Kenya (MF510247.1), Ethiopia (KP798454,) and Rwanda (KP851970.01). The genome sequences also had 99% identity with MCMV isolates from Eastern Africa countries; 99.02% identity with MCMV isolate from Yunnan, China (KF010583.1); and 96 to 97% identical to genome sequences of MCMV isolates from Kansas (X14736) and Nebraska (EU358605). The conclusion was that SCMV genomes are genetically highly diverse as demonstrated by sequence identity analysis,

phylogenetic analysis and viral recombination analysis. MLN is a complex challenge and must be effectively addressed through several strategies that are implemented simultaneously.

4. Bioinformatics for plant biosecurity as a tool in surveillance systems (Kiguongo A.P.K, KEPHIS)

The presentation discussed the importance of the introduction of next-generation sequencing (NGS) which is thought to have revolutionized sequencing of nucleic acids due to its efficiency, deeper resolution and affordability in terms of economic requirements and experimental procedures. The presenter confirmed that Plant diagnostic protocols based on next-generation sequencing has proved to be of fundamental importance in detection and identification of multiple known and emergent viruses and viroids in major crops, nuclear stocks, germplasm in gene banks and imported plants in which the disease symptoms are triggered by two or multiple viruses or unspecific. Bioinformatics is deemed key in the use RNA-seq for virus detection in a variety of crops and virus detection using NGS data, their adoption and a framework for efficient biological characterization and risk assessment for previously known or new virus detected using NGS methodologies. The review concluded by discussing the need for virus network remote servers for enhanced plant biosecurity and virus surveillance systems for food security and sustainable trade.

Session 3: Pest Surveillance in Phytosanitary Systems [Session Chair: Chomba M. D., NPPO Zambia]

1. Key note address: Special session for CABI on Invasive species (Rodger Day, CABI Kenya)

The presentation introduced the many types of invasive species that have been introduced in many parts of the world and the impact they have caused. It outlined the various strategies and programmes CABI is working on Invasive and the targeted interventions. The interventions reported are targeted at prevention, early detection and eradication; control and restoration. CABI reported that the current strategies for managing invasives will focus on selected pests such as Fall armyworm, Parthenium weed and Tomato leaf miner to start initially in Ghana, Kenya, Pakistan and Zambia. The presenter outlined the programme components and the regional coordination in collaboration with partners. He presented the actions already done so far on Fall armyworm, parthenium weed and other invasives around the world using various approaches and improvement of various tools.

2. Pest Risk Analysis: Practices and Experiences in Uganda (Tumuboina E., NPPO Uganda)

The presentation outlined the Pest risk analysis (PRA) process and experiences in Uganda and how PRA has been widely used to make decision on importation of plants and plant products and also to regulate internal movement of plants and plant products likely to introduce pests in endangered areas where a new pest is not yet widely distributed. The presenter gave an outline of the Ministry of Agriculture in Uganda and how the commodities and actions are being handled by different departments. The presentation also described the PRA process, the legal framework, information sources and the challenges in Uganda. Giving examples of pests that have already been introduced, she emphasized the need for prevention and

rapid response to pests. In conclusion the presentation showed the need for improvement in terms of making PRA reports available, improving tools for conducting PRAs, capacity building and availing statistics for use in PRA during assessment.

3. Pest Risk Analysis in Burundi (Masabarakiza Lucien, NPPO Burundi)

This presentation described the importance of PRA as a tool, the PRA process in Burundi and the experiences in conducting PRAs. He informed the delegates that a team of pest risk analysts is normally tasked to undertake PRA; the PRA process includes three steps: Pest risk initiation for which the result is the potential quarantine pest list; Pest risk assessment that leads to proper quarantine pest list; Pest risk management. The presenter also described the gaps in pest risk analysis that Burundi faces.

4. Pest Risk Analysis in Malawi (Johny Masangwa, NPPO Malawi)

The presentation discussed the importance of Pest Risk Analysis in the phytosanitary system of Malawi and confirmed that the tasks are done by the NPPO in collaboration with other institutions such as Department of Agricultural Research Services (DARS), Agricultural Research Extension Trust (ARET), Forest Research Institute of Malawi (FRIM) and Lilongwe University of Agriculture and Natural Resources (LUANAR). The presentation further described the PRA process, the number of PRAs conducted so far in the last 12 months, the experiences in Malawi and how PRA can be improved. The presenter concluded by highlighting the importance of conducting regional PRAs considering the similarities in environments and conditions. However, he noted that the countries have different capacities in conducting PRAs.

5. New tools for pest risk analysis (Dr. MaryLucy Oronje, CABI-KENYA)

The presentation discussed the various programmes conducted by CABI on invasives. The particular tools reported by CABI included development of a Horizon Scanning Tool (HST) to support decision making by risk assessors, plant protection officers, quarantine officers, protected area managers and researchers to identify potential invasive species threats to a country, state or province. It's aimed at providing a quick and user-friendly means of accessing a large volume of relevant data for categorizing and prioritizing potential invasive species for the more focused / better adoption of preventative measures. Following from the Horizon Scanning Tool, CABI reported the development of an online pest risk analysis (PRA) decision support tool. The PRA Tool will focus on analysing risk associated with the unintended introduction and establishment of plant pests (any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products).

6. Improved phytosanitary system ensures the lifting of a vegetable export ban in Ghana (W. Hevi, CABI, GHANA)

The presentation discussed how phytosanitary compliance system failure in Ghana led to a decline in their vegetable production in 2016. It also reported that from 2012 to 2015 notification of interception in the EU on harmful organisms (*Thrips palmi*, *Thaumatotibia leucotreta*, *Bemisia tabaci* and Tephritidae) presence

on Ghana's vegetables increased leading to an EU import ban on 5 selected vegetables in 2015. The presentation pointed out the steps and measures that were put in place towards the recovery of the market. The EC ban on export of the 5 vegetables was eventually lifted from 1st January, 2018 and from the experience, it was deduced that public, private sector stakeholders and development partners need to work together to ensure systems compliant with international phytosanitary standards to boost trade.

7. Surveillance of maize lethal necrosis disease in Zambia (Chomba, M. D, Zambia NPPO)

The presentation depicted the threat posed by increased grain and seed trading between Zambia and some of the neighboring countries such as DRC Congo and Tanzania on introduction of the MLN disease in Zambia since MCMV is seed borne. The study was aimed at establishment of the presence or absence of MCMV in Zambia and was conducted through a survey of small-scale and commercial farmers. The results showed that all the samples collected and tested were all negative for the viruses causing MLN. The negative status of MCMV implied that MLN is not yet present in Zambia. Zambia Agriculture Research Institute (ZARI) together with other Government agencies such as extension service and all stakeholders in the maize value chain were urged continue to implement measures that are effective in preventing the introduction of MLN in the country.

Panel Session 1: Missed opportunities on trade due to non-compliance to phytosanitary issues [Session Chairperson: Prof. John Nderitu, UoN]

This session was chaired by Prof. John Nderitu of the University of Nairobi with panelists from selected government and industry representatives. The topic was meant to open a discussion on phytosanitary non-compliance and its repercussions which include loss of market, changes in requirements and conditions as well as destruction or shipping back of consignments at the exporters' expense. Since non-compliance also leads to the introduction of pests and diseases in the importing country, it was necessary to discuss possible measures that need to be put in place by both public and private sectors in order to ensure that trade opportunities are not lost. Key points raised during the discussion were;

- There is need for strong private-public partnerships that will even pave way for self-regulation in the long term;
- There is need for training of all actors in the value chain by NPPOs to ensure that information gap is no longer an excuse;
- Setting of databases by all relevant institutions on market and other requirements is important for ease of information access;
- Systems need to be put in place to ensure efficiency and accuracy in the value chain. Systems such as the e-certification need be tested during peak periods in order to be sure they work;
- Funding of the agricultural sector by nation governments needs to be enhanced in order to mitigate emerging pests and diseases. Governments must support the business and not the other way round;
- Regional integration of NPPOs is necessary in order to put together efforts in dealing with issues that face the region as a whole.

Session 4: Import Control and Quarantine Regulations [Session chair: Francis Mwatuni, CIMMYT]

1. Key note address on Import control and quarantine regulations (Dr. Washington Otieno, CABI)

The presentation pointed out the importance of pest risk analyses in informing the decisions by a country to regulate imports of plants, plant products should by considering regulated articles in the context of pest risk in the context of the International Plant Protection Convention (IPPC). The presenter emphasized that the objective of a phytosanitary import regulatory system is to prevent the introduction of quarantine pests with imported commodities and other regulated articles. The presentation outlined the various aspects to be considered in phytosanitary regulation as: Transparency in import conditions, Risk based decisions, Regulatory actions backed by enforced laws, Regularly updated phytosanitary regulations, Involvement of more boarder agencies than NPPO, Proactive approach, Innovations that improve efficiency and Multi-stakeholder engagement

2. Tackling Maize Lethal Necrosis (MLN), a major epidemic in Eastern with better phytosanitary intervention measures (Suresh L. M, CIMMYT, Kenya)

The presentation described the MLN as a devastating disease in East Africa and the measures that CIMMYT have put in place in an effort to manage the spread of MLN to other areas and thus reduce impact on food security. Some of the measures reported include;

- Establishment of a centralized MLN Screening Facility at Naivasha Kenya in 2013 as a rapid response to the epidemic;
- Optimization of Protocols for artificial inoculation of maize germplasm against MLN, for the individual viruses. The phytosanitary protocols are used in the facility for ensuring safe movement of maize germplasm is in place to meet internationally established phytosanitary standards for the safe screening of germplasm for MLN;
- MLN phenotyping services are also offered to the national agricultural research institutions or NARS (without any charge) and for seed companies (on a cost recovery basis);
- Five first-generation MLN-tolerant (CIMMYT-derived) hybrids have been identified and released in Kenya (H12ML & H13ML), Tanzania (HB607) and Uganda (UH5354 and UH5358);
- six second generation MLN-tolerant/resistant hybrids have been released in Kenya in 2017 and 10 MLN tolerant hybrids are under National Performance Trials (NPTs) in Kenya, Tanzania and Uganda.

The presentation concluded by confirming that various phytosanitary intervention measures that are followed in tracking, monitoring and managing the devastating disease such as MLN is the key for good crop production and food security.

3. Appropriate Surveillance and diagnostic tools in prevention of spread of MLN to Southern Africa (Francis Mwatuni, CIMMYT Kenya)

The presentation pointed out the several strategies in the management and in preventing further spread of the MLN disease to southern Africa countries where Maize is a staple food and the seed maize industry is vibrant. It reported on the strategies that have been used to prevent the spread of MLN, especially Maize Chlorotic Mottle Virus (MCMV), from the MLN-endemic countries in eastern Africa to non-endemic countries in sub-Saharan

Africa and Support the commercial seed sector in the MLN-endemic countries in producing MCMV-free commercial seed and promote the use of clean hybrid seed by the farmers. The presentation reported that surveillance reports have indicated the MLN disease still persists in the region and the disease has a potential of spreading to southern Africa. The strategies developed by CIMMYT include MLN tool box – an electronic tool used by surveillance teams, MLN phytosanitary COP and trainings on surveillance and diagnostics as well as training of out-growers, seed production technicians and lab analysts among others. The conclusion was that there is need for development of emergency preparedness plan.

4. The guidelines for conducting sea container cleanliness survey and inspection (Fredrick Koome, KEPHIS)

The presentation outlined the background on the International Plant Protection Convention (IPPC) endorsed sea container complementary action plan aimed at reducing the pest risk associated with sea containers. Listed were examples of pests that have been intercepted in/on sea containers hence depicting sea containers as being risky. The general guidelines were pointed out including the systematic inspection steps and the required equipment. The conclusion pointed out that the guidelines will help the NPPOs to assess the level of phytosanitary risk posed by sea containers.

5. Implementation of track and trace System for enhanced control and regulation of imported consignments with phytosanitary concern (Josiah Syanda, KEPHIS)

The presentation is based on a basic research conducted at point of entry in Mombasa to enhance the control and regulation of imported consignments. It was reported that the responsibility of the National Plant Protection Organization such as KEPHIS at the point of entry is to ensure minimization of risks associated with imported commodities. It had been realized that there was low level of detection of consignments of phytosanitary concern at Mombasa sea port and contributing factors were pointed out. The research identified critical control points where interventions would be targetted in the import process. The conclusion was that:

- there is a direct relationship between availability of consignment information and levels of detecting consignments of phytosanitary concerns;
- Availability of consignment information to NPPO can help in improvement of inspection system;
- Availability and access to consignment information can help NPPO to seal revenue leakages.

The recommendations were that NPPO should have a method of obtaining import consignment information before its arrival, interagency collaboration for key government agencies (The primary import data owners) and where there are systems in place, system integration is recommended to reduce human interventions.

6. Post-Release monitoring of quarantine seaweed (*Kappaphycus alvarezii*) in Coast region of Kenya (Thomas Kosiom, KEPHIS)

The presentation highlighted the outcome of monitoring of *Kappaphycus alvarezii*, commonly known as cottonii; this is red tropical seaweed native to Philippines which has been reported to be invasive in other

areas. The seaweed is reported to be highly demanded for its k-carrageenan which is processed into gels used as thickeners, stabilisers, emulsifiers in food. *Kappaphycus alvarezii*, was introduced in Kenya in 2009 under vigorous dossier review by experts and strict quarantine conditions. It was released for commercialization in 2015 after monitoring results were evaluated and accepted. Post-release monitoring was then carried out to assess growth behaviour of the seaweed, determine the invasive capabilities of the seaweed and find out the impact of cottonii seaweed to fishing community since it was commercialized in 2015. Results showed that in 2016, over 99% of seaweed farmers abandoned cottonii seaweed due to high rate of ice ice disease, high marine herbivory and market-related price fluctuations. Three years of post-release monitoring results showed that *K. alvarezii* has not posed any threat to marine ecosystem and not detected beyond all the production sites. It was recommended that since invasiveness can result with the change of environmental conditions or seaweed adaptation, further monitoring is required to fully confirm cottonii under Kenyan coast condition. Early detection of invasiveness and emergence response measures are required in case invasiveness is detected. There is also need to build capacity on seaweed monitoring due to the nature of the marine environment, and different seaweed species in the ecosystem.

Session 5: Export Control in Phytosanitary Systems [Session Chair: Abed Mathagu – AATF]

1. Key note address: Role of Industry self-regulation in phytosanitary compliance (Andrew Edewa, PhD)

The presentation highlighted the fact that self-regulation has been applied successfully in the EU and United States and that it is an incorporation of official controls into the current production systems. It is implemented by the private sector with frequent audits and certification by the NPPO. It also calls for identification and registration of producers, mapping out of production sites, developing pest management strategies, training on pest management, investing for effective pest control, implementation of protocols and establishment of conformity assessment systems.

2. Quality of mangoes exported from Kenya and strategies for compliance to international market requirements (Augustine Kivi, KEPHIS)

The presentation outlined the outcome of a survey that was conducted in Makueni county to find out the quality of mangoes exported from Kenya three years after the EU ban. The findings were that 25% of farms in Makueni were found to have fruit fly while at the point of exit only 3% of samples were found to be infested with mango seed weevil and 0.1% with fruit flies. From these findings, it was clear that post-harvest grading and quality control was able to reduce fruit flies and mango weevil to a level that could guarantee pest free mangoes from Kenya. The establishment of a mango export certification protocol which incorporates proper pest management at farm level, proper sorting & grading at pack-house level and intervention by KEPHIS would guarantee pest free mangoes for export from Kenya hence compliance to international market requirements.

3. Efficacy of selected bio-pesticides, polythene mulch and sticky traps in controlling *Liriomyza* (diptera: agromizidae) infestation on basil (Alfayo Ombuya, KEPHIS)

The presentation highlighted the results of a study that was carried out with an objective of evaluating the efficacy of selected bio-pesticides, polythene mulch and sticky traps in controlling *Liriomyza* spp infestation on basil which is one of the fresh products exported by Kenya to the European Union. From the study, integrated application of neem, spinosad, polythene mulch and yellow sticky traps recorded the lowest number of leaflets damaged and number of *Liriomyza* spp larvae damaging leaves. Results showed that this IPM tool can be adopted as an option in addressing phytosanitary incompliance, food safety, pesticide resistance and environmental concerns that occur with the use of conventional chemical pesticides in basil production.

4. Effect of phosphine fumigant on false codling moth larvae in capsicum (George Momanyi, KEPHIS)

The presentation outlined the preliminary results of post-harvest treatment of Capsicum fruits using phosphine against FCM moth. Phosphine generated from aluminum phosphide is a fumigant for insect pests of grain and other stored products in Kenya. The current registration of the product covers stored grain and tobacco pests by fumigation of raw agricultural commodities, processed foods and animal feeds. The findings of a study aimed at determining the potential for extension of the scope of registration in Kenya to include fresh capsicums were presented indicating that Aluminium phosphide has shown potential as an effective FCM fumigant of fresh capsicum fruits. However, there were observations that the shelf life of the capsicums is compromised as a result of the treatment. Therefore, more data needs to be generated for refinement of a number of test parameters to achieve complete mortality of a large number of test insects. Further investigation is needed to optimize and validate the treatment protocols.

Plenary 1

A question on whether the public sector would be willing to undertake the venture of private inspection came up citing the fact that NPPOs do cost recovery from the services they offer – The answer was that the rules would still remain public but only being implemented by the private sector with an arrangement between the two sectors to have a system whereby costs can be paid for either through associations or directly to the inspectors. There will also be regular audits by the NPPOs.

A question on whether private inspections should be called self-regulation or partnership was raised and the answer was that partnership is broader than just inspections therefore self-regulation was an appropriate terminology.

As for the use of phosphine to kill larvae already within the Capsicum, a question of whether the quality of the capsicum was being compromised came up citing the fact that customers would not be happy to buy a capsicum only to find dead larvae inside. The answer was that this treatment was a proposal just to ensure that the zero tolerance was met bearing in mind that the good agricultural practices are applied in the field

hence only small percentages of the produce have the larvae within therefore the quality would not be at stake. The 72 hours required for the phosphine treatment to work was thought to be a long time but in comparison with the 23 days cold treatment, it was being proposed as a better option.

A question on why not use methyl bromide which has better efficacy other than proposing phosphine which requires 72 hours came up but the answer was that since most EU countries do not accept the use of methyl bromide then phosphine would be a better(safer) option.

A question on the dosage of bio-pesticides used in basil herb came up and the answer was that since there is no recommended dosage of neem in basil by the pests control produce board, the dosage adopted in this case was 20mls of neem per liter and 5mls of spinosad per liter but it was made clear that further research needs to be done to establish the right doses of neem and spinosad on basil.

A question on whether the white mango scale was a pest of concern in Kenya as it is in Ethiopia was raised and the answer was that in Kenya though the white mango scale is present, it is not a big threat like the fruit fly.

A question on whether the mango ban to the EU was permanent or it was going to be lifted at some point came up and the answer was that KEPHIS had done a self-ban due to the many interceptions that had been realized in the past and the protocol being developed was aimed at ensuring that the exportation of mangoes to the EU was resumed.

Session 6: Industry participation on Phytosanitary Systems [Session chair: Hosea Machuki, FPEAK]

1. Status of Asian citrus psyllid on citrus and curry leaf production areas in Kenya (Thomas Kosiom, KEPHIS)

This presentation outlined a study that was carried out to determine its spread in Kenya, the effectiveness of pest eradication measures used and to establish its behavior in different seasons. The Asian citrus psyllid (ACP), *Diaphorinacitri*, is one of the two vectors spreading “huanglongbing” (HLB), a devastating greening disease of citrus trees. It was found that the pest is present in Kenya and still spreading despite the eradication measures that were applied and that its population was high during flush seasons. From these findings, it is therefore recommended that further study be done to establish whether the citrus trees have been infected with the pathogen responsible for greening disease, that citrus farmers be sensitized on the presence and management of the pest and also research be done on its natural enemies.

2. Management of crown gall disease in the production of flower cuttings in Kenya (Magdalene Wanza, Kenyatta University)

The presenter described Crown gall as being caused by *Agrobacterium tumefaciens* and which is the most widely distributed bacterial disease of plants in the world. It remains a major challenge in East Africa since limited research has been done on effectiveness of various management strategies and chemicals are

largely avoided due to health and environmental concerns. In conclusion, it was stated that better management strategies with less pesticides use are needed hence the on-going research on Electro-chemical activated water, commonly abbreviated as ECA water which is harmless to the environment.

3. International Standards for Phytosanitary Measures (ISPM) No. 15 – Regulation of wood packaging material in international trade (Hellen Mwarey, KEPHIS)

The presenter described the standard as a standard that outlines phytosanitary measures that reduce the risk of introduction and spread of quarantine pests associated with the movement in international trade of wood packaging material made from raw wood. An empirical analysis of how the regulation affects the economy of a group of countries in Africa was carried out by Elissaios Papyrakis and Luca Tasciotti. The presentation outlined the observations that were made with the following weaknesses being highlighted;

- ✓ Import inspections - ISPM 15 compliance at the import level is lacking and many non-agricultural related consignments comprising with Wood Packing are rarely targeted for inspection;
- ✓ Former WPM treatment facilities may still stamp the WPM;
- ✓ Lack of Clarity on the duration of WPM treatments;
- ✓ Audits of the WPM treatment facilities done twice a year in form of an informal chat-The inspection procedures should be formalized;
- ✓ Lack of inspection manuals.

Analysis showed that investment to support ISPM 15 had no negative impact on the ability of the four countries to trade. Three countries saw exports increase as a result. The costs for a WPM treatment facility to meet the standard are high. However, the costs of not meeting the standard are higher in terms of loss of exports, income, and the risk of pests. Treatment facilities are profitable for countries with enough production and export volume. It is recommended that NPPOs promote the awareness of ISPM 15, develop a check list to audit WPM treatment facilities and regulate WPM repairing facilities as well as assigning unique codes to each facility.

4. Assessment of pests incidence, pesticide use and application practices on tomato production in Bungoma county Kenya (Michael Barasa, Kenyatta University)

This presentation highlighted the results of a study that was carried out to determine the incidence of major pests of tomato as well as find out the pesticide use and application practices on tomato production in Bungoma County, Kenya. From the findings of the study it was concluded that arthropod pests are a constraint to tomato production the County and the majority of the farmers are unaware on the alternatives to synthetic chemicals in tomato production. It is therefore important to increase awareness on appropriate use of pesticides, food safety and importance of IPM to farmers as well as having more research on bio-pesticides done.

5. Distribution and management of the invasive Papaya mealy bug-*Paracoccusmarginatus* in Kenya (Koome Makathima, KEPHIS)

The presenter described the Papaya mealy bug (*Paracoccusmarginatus*) as a serious invasive pest affecting horticultural crops; highlighting the results of a survey carried out in the Kenyan coast region to determine its distribution, host range, severity and management options farmers were putting in place to control the invasive pest. The findings were that the pest is already present in six coastal region counties with farmers incurring a mean yield loss of 91% due to the pest. 7.2% of the farmers visited during the survey were employing a pest management strategy against the papaya mealy bug the host-range for this pest includes; Papaya, cassava, pepper, guava, mangoes and eggplants. Recommended management options include; monitoring and scouting, Pruning of the infested branches and burning them, removal and burning of crop residues, removal of weeds/alternative host plants, destruction of ant colonies, sanitation of farm equipment before moving it to uninfected crop, soaking planting materials in a pesticide before planting, use of high pressure water jets, timely application of recommended pesticides, limiting movement of suspected plant materials and use of bio-controls and natural pesticides.

6. New EU plant health Regulations (Morag Webb, COLEACP)

The presentation outlined the new regulations that were introduced in 2016 that is expected to come to effect in 2019. Highlighted major changes as:

- Target all pests of plants - one regulation covers all pests –quarantine and non-quarantine - categorised by risk assessment;
- Phytosanitary certificates for all living plant materials -List of exemptions of “low risk” commodities to be issued in an implementing act;
- High risk commodities-specific measures on imports and movement of high risk commodities. Listing under development by EU select committee;
- Temporary Measures Against New Trade – where there is little experience and pest risks unknown.

It was shown that the implications for African countries are that there will be Potential impact on important export crops, future low tolerance of non-compliances, CAs must ensure controls are applied at all times to guarantee exports meet requirements, private operators must invest to meet the rules and above all there is need to start preparing now. The question was - What can be done through FFM to help prepare for the new regulation? Lobbying for the ACP industry, Informing stakeholders, Targeted capacity building and Support national platforms/action plans.

7. Effect of quality of farm saved cowpea seed on bacterial blight and dry grain yield (Njonjo M.W., University of Nairobi)

The presentation noted that seed is the most important input since the subsequent practices after planting depend on the quality of seed planted. Cowpea farmers use seed from the informal seed system which are of unknown quality. The results of a study carried out to determine the effect of farm saved cowpea seed quality on the incidence and severity of bacterial blight and dry grain yield were outlined. The results of the study show that Quality of farm saved seed negatively affected establishment of the cowpea evidenced by the reduced seedling emergence, increase of rotten seeds and reduced plant stand. The grain yield and dry matter yield was negatively influenced by the quality of farm saved seeds. In conclusion it was observed

that it is advisable for farmers to use certified cowpea seed to achieve optimum seedling emergence and plant stand, low incidence of bacterial blight of cowpea and high dry grain and matter yield.

8. Effect of time after incorporation of lablab green manure on establishment of common beans (Oliver O., University of Nairobi)

The presenter introduced the presentation by noting that green manure contributes to soil nutrient pool through mineralization of decaying biomass thereby promoting soil fertility and in turn improves crop production. However, un-decomposed plants residues have been reported to reduce crop establishment and increase incidences of pests and diseases. He described the aim of the study was to determine the appropriate time for green manure incorporation before planting. Incorporation of lablab green manure at planting reduced emergence, yield and stimulated the population of root rot pathogens while reducing population of saprophytic fungi which could be antagonistic to root rot fungi. The results showed that increasing the time after incorporation of green manures before planting would allow proper decomposition and reduction in root rot incidence but increase grain yield.

9. Moroccan watermelon mosaic virus is responsible for symptoms associated with Papaya ringspot disease in Kenya (Naomi Mumo, JKUAT)

The presentation highlighted that there is no information on PRSV isolates in Kenya, and its genetic diversity is unknown. Knowing PRSV isolates and their genetic diversity would help in establishing virus origin and dispersion in the search of effective PRSV disease management. She presented the results of a study carried out to find out the real identity of the virus associated with Kenyan ringspot disease in papaya. The results showed that the symptoms associated with PRSV are probably caused by MWMV which is widespread in Kenya except in the coastal region. The conclusion was that appropriate management strategies need to be devised and directed towards preventing further spread of this new virus.

10. Phytosanitary challenges facing potato farmers in UasinGishu and Elgeyo-Marakwet counties (Jane Boit, KEPHIS)

The presentation pointed out the importance of potato in Kenya as being the second most important food crop after maize and a major food staple among potato growing communities. The main phytosanitary challenges in the potato production were given as low availability of certified seed hence use of farm saved seed and diseases such as bacterial wilt spread easily. Increased bacterial wilt occurrences can be explained by the lack of appropriate management practices as research on this subject has been very low.

Plenary 2

A question as to why biological controls are not yet being used by Kenyan farmers despite the availability came up and the answer was that most farmers get information on pesticides from stockists who do not stock the biological controls due to their short shelf life, in this case they only will promote what they have in stock. The farmers will also prefer to use the fast acting chemicals instead of the slow acting biological controls.

A question on whether there are chances of re-infestation after wood treatment and whether the standard gives room for re-treatment came up, the answer was that any wood packaging materials must be

debarked as a rule and therefore chances of re-infestation are minimal since pests lay eggs only on the bark. After treatment the material can be used for three months without re-treating though there is need to do more research to establish the possibility of re-infestation and the length of treatment validity.

Why are biological controls not yet being used for the control of the papaya mealy bug? The answer was that we do not yet have any biological control registered by PCPB for the control of this pest but hoping that in future somebody can take it up and register a biological product for the control of this pest.

It was recommended that there is need to have a regional approach to treat invasive pests in order to be able to control the pest as a region since most of these pests are cross border.

There is need for African countries to do surveys and risk analysis and come up with official controls for the pests in preparation before the new EU regulations come to effect. NPPOs also need to have the skills, capacity and funding in order to do the surveys and risk analysis. African countries need to lobby through their national delegates to WTO in case they are not contended with the new EU regulations.

Session 7: Technologies and Innovation in Phytosanitary Systems [Session chair: E. Tumuboine, NPPO Uganda]

1. Key note address: Technologies and Innovation in phytosanitary systems (Prof. James Muthomi, University of Nairobi)

The key note address presented the main activities of a phytosanitary system and the importance of timely and accurate plant pest diagnostics for effective response. The presentation also described the conventional methods of carrying out the activities and the many available technologies for pest surveillance technologies, phytosanitary certification technologies, pest detection and diagnosis technologies such as Geospatial technology in pest monitoring and detection, Geospatial technology in pest monitoring, use of unmanned aerial vehicles (UAVs), Biosensors in plant pathogen detection, Spectroscopic and imaging techniques among others.

2. Leveraging ICT tools and Earth Observation Satellite data for early warning of pest outbreaks: Extension and Pest Risk Information in Africa (MaryLucy, CABI, Kenya)

The presentation pointed out the fact that there is high demand for plant health information coupled with rising unexpected pest outbreaks and new invasion makes traditional agricultural extension approaches inefficient and at times redundant. It reported the need for innovative, efficient and timely ways of reaching the small scale farmers with relevant information. The presenter highlighted the current activities that CABI and its partners are doing in addressing the challenge through the plant health networks operated through the plant clinics. One such development is a Pest Risk Information Service (PRISE) that uses state-of-the-art crop and pest modelling techniques to provide Extension officers and plant doctors with advanced warning of a damaging outbreaks and appropriate advice on mitigation responses. Field observations and validations are targeting Fall Armyworm (*Spodoptera frugiperda*), bean fly (*Ophiomyia phaseoli*), whitefly (*Bemisia tabaci*), *Liriomyza* spp, cocoa mirids (*Sahlbergella singularis*) Tomato leafminer (*Tuta absoluta*), maize stalk borers (*Busseola fusca*) and stem

borers (*Chilo partellus*). Plant clinic networks as early warning information which is key in successful pest management.

3. Application of electronic phytosanitary certification (ePhyto) for enhanced phytosanitary compliance (Josiah Syanda, KEPHIS)

The presentation described the adoption of electronic phytosanitary certification known as ePhyto which has currently attracted global acceptance, as a means of mitigating against phytosanitary noncompliance risks. ePhyto is an electronic equivalent of the paper phytosanitary certificate. The presentation reported that the ePhyto has been viewed as a more secure and faster method of exchanging phytosanitary information between countries. In the current model, a paper certificate is issued by the exporting country but it is conveyed to the importing country through various methods of transport. Some of the methods were shown to expose the certificate to defacing, loss of integrity, alteration, delays among others. Adoption of the ePhyto by trading partners is seen as the future for ensuring safe trade and efficient movement of agricultural consignments.

4. Effect of Hot Water Treatment on Sugarcane Ratoon Stunting Disease, Cane Yield and Quality (Esther S. Philip, UoN)

The presentation reported the decline of sugarcane yield in Kenya due to many factors including pests and disease such as Ratoon Stunting Disease (RSD) caused by *Leifsonia xyli* subsp. *xyli*. This presentation showed the results of a study that was conducted to determine the effectiveness of hot water treatment in management of ratoon stunting disease and its effect on cane yield and cane quality. It was reported that Hot water treatment at 50°C and 52°C significantly reduced RSD and increased cane yield. Therefore the two temperatures are recommended for management of ratoon stunting disease of sugarcane.

5. Management of bacterial wilt (*Ralstonia solanacearum*) in tomato (*Solanum lycopersicum* L.) using resistant African eggplant (*Solanum* spp) rootstocks (T. Nikuze, KEPHIS)

Tomato is an economically important horticultural crop in Kenya and the production has been declining over time due to a wide range of pests. The presentation outlined the results of a study conducted to determine phenotypic reaction of African eggplant accessions to bacterial wilt infection with the aim of using them as rootstock for tomato for tomato production and as a source of genes breeding. The results found that *Solanum aethiopicum* and *Solanum anguivi* are good source of resistance genes. The resistance markers will help breeders to develop tomato varieties resistant to bacterial wilt (*Ralstonia solanacearum*).

6. Influence of Seed Source and Production Practices on Quality of Soybean (*Glycine max*) Seed (Ochran, M. K., UoN)

The presentation depicted how little involvement of seed dealers in handling soybean seed compared to seeds of other crops such as maize and vegetables has led to over 70% of the farmers recycling and using seed from informal sources whose quality is poor or unknown beside lacking knowledge on appropriate production practices. The study aimed at determining how seed source and production practices influenced

soybean seed quality. The results showed that production and post-harvest practices affect the quality of soybean seeds and that there is limited production of certified soybean seeds.

Session 8: Emerging issues such as Food safety issues in phytosanitary systems **[Session Chair: Simon Kibet – GMQA, KEPHIS]**

1. Role of KEPHIS in safe handling, transfer and use of GMOs (Margaret Wanjiku, KEPHIS)

The presentation is a report on the collaboration between KEPHIS and other institutions in safe handling, transfer and use of genetically modified organisms, the mandate of KEPHIS in the whole process and the various methods used in detection of GMOs. This is based on the recognition that all countries that are signatory to the Cartagena Protocol on Biosafety, require to put in place mechanisms to regulate GMOs. As a regulatory agency under the Biosafety Act, KEPHIS together with the lead Agency - National Biosafety Authority (NBA), regulates safe handling, transfer and use of plant genetic modified materials in Kenya. KEPHIS has been involved in the trials of GMOS since the 1990's when modified plants were first tried in the country. The institution also played a critical role within the National Biosafety Committee, Institutional Biosafety Committees and now the National Biosafety Authority as a regulatory agency.

2. Impact of Fusarium Wilt Disease on Banana Trade in Mozambique (Chiluba Mwape, CABI)

This presentation reported the outcome of a study conducted in Mozambique and whose objective was to determine the impact of Fusarium Wilt Disease on Banana Trade in Mozambique, since its first report in 2014. It is concluded that Fusarium Wilt Disease has a negative impact on banana trade in Mozambique therefore there is the need to review phytosanitary measures for Mozambique in order to contain the disease not to spread to other countries and also promote use of resistant varieties. In conclusion the following was recommended:

- Member States in the tripartite region (COMESA-EAC-SADC) must put up effective rapid alert systems;
- There is need to conduct a regional pest risk assessment;
- There is need to strengthen technical capacity in disease prevention and management.

3. Communicating emergency farmer friendly messages in response to Invasive Alien Species; The case of Fall armyworm in Africa (David Onyango, CABI-KENYA)

The presentation described the impact of fall armyworm since its introduction in Africa and Kenya. It was shown that farmers could not distinguish it from other caterpillars (African armyworm, Stalk/stem borers) and therefore needed awareness creation on the same. The presentation outlined how different communication channels impacted on farmer perceptions and adoption. He concluded by pointing out the key communication elements that are important in order to reach the target audience.

4. Phytosanitary capacity evaluation a case study for Kenya (Faith Ndunge, KEPHIS)

This presentation highlighted the outcome of the Phytosanitary Capacity Evaluation (PCE), a tool used for evaluating the phytosanitary capacity of a country with a view of improving capacity to undertake functions outlined in article IV of revised IPPC convention, 1997 as applied in Kenya. The conclusion was that,

although there are systems in place to implement phytosanitary regulations there are gaps such as: Inadequate regulatory framework; Some mandates for implementing phytosanitary activities are held by other organization's; Need for additional resources i.e. human resource, technical capacity; There is no weed science capacity in the NPPO. It was recommended there is need to review the tool to help in identifying gaps in the NPPO and the need to participate in IPPC related trainings to enhance capacity of NPPO.

5. Role of KEPHIS in mitigating impacts of emerging and re-emerging pests and diseases due to climate change (Alex Njugi, KEPHIS)

This presentation pointed out how climate change is rapidly emerging as a global critical development issue affecting many sectors in the world including agricultural productivity as well as pest emergence and re-emergence. It depicted the impact on pests, the economic impact as a result of emerging pests, a case of Kenya and the strategies employed by KEPHIS in mitigating such impacts. As a wayforward, the presenter showed that severe and widespread climate change impacts on agricultural productivity will require adaptation through;

- Complex systemic and transformational changes in food systems accompanied by a combination of improved trade policies and shifts in diets.
- The impacts of climate change on agricultural productivity, requires a paradigm shift.

Climate Smart Agriculture is a solution to problems of modern agriculture to meet demands of the increasing population.

6. *Escherichia coli* and Salmonella contamination of tomato marketed and consumed in Nairobi metropolis (Joseph Nguetti, UoN)

The presentation reported the results of a study conducted in Kenyan fresh produce markets to study the possibility of contamination of tomato by *E. coli* and *Salmonella* species. Although it has not been easy to establish the correlation between both agents during the study, exceptions were found where high presence of *E. coli* corresponded to high presence of *Salmonella* on the skin of tomato. The seasonal analysis has shown significant difference between dry period and wet. Dry weather creates competition for water between the environment (soil) and tomato plants and- this slows down the multiplication of the *E. coli* living inside the produce.

7. Exposure Assessment of the Kenyan population to Pesticide Residues through Vegetable Consumption (Peter Kamuti, KEPHIS)

The presentation pointed out how different pesticides applied to control insects and diseases on crops to increase production may constitute a possible risk to consumers due to pesticide residues on vegetables. Result of a study whose objective was to perform exposure assessment of Kenyan Population to Pesticide Residues through consumption of vegetables revealed that cooking reduced pesticide residue concentration by an average of 90% and that there is no public health concern on Kenyan population due to pesticide residues in vegetables.

8. First report of *Colletotrichum boninense* and *Pestalotiopsis microspora* infecting avocado fruits in Kenya (Stanley Kimaru, Kenyatta University)

The presentation reported that about 60% -100% of avocado fruit decay is associated with anthracnose in Kenya as shown by a study conducted in Kenya to determine the causal agent(s) of anthracnose and its genetic diversity. The results showed that both Hass and Fuerte varieties are susceptible to anthracnose disease and that *Colletotrichum gloeosporioides*, *Colletotrichum boninense* and *Pestalotiopsis microspora* were identified as causal agents of anthracnose of avocado in Kenya.

9. Pest Information Management System (E. Muchiri, EAPIC Coordinator)

The presentation outlined when East Africa Phytosanitary Information Committee (EAPIC) was formed, its roles and the objectives of its formation. It also described how Pest Information Management System (PIMS) is linked to EAPIC. PIMS is a web-based database for storing plant pest lists, surveillance data and for generating elements for PRA reports. It is a tool for the NPPOs to share critical information to satisfy international obligations. She explained that the tool assists countries to access reliable information on pests of economic importance thus reducing intra-regional trade barriers. The presenter outlined how PIMS has been developed over time and the next steps in its enhancement to ensure it serves its purpose. In the end, the presenter sought for national ownership by countries to avoid reliance on donor funding.

Panel Session 2: Food safety non-compliance [Session chairperson: Okisegere Ojepat]

This panel session was chaired by Mr. Okisegere Ojepat and the industry representatives were East African Growers (EAGA) Ltd, Vegpro Ltd and KEPHIS represented government as a regulator. The topic was meant to open a discussion on food safety non-compliance and its repercussions which include loss of market and changes in requirements. The growers presented what they do on day to day production cycles particularly in terms of ensuring food safety, food quality and meeting the market requirements. Food safety non-compliance is a barrier to trade, it was necessary to discuss the challenges and the possible measures that need to be put in place by both public and private sectors in order to ensure that trade opportunities are not lost. Key points highlighted during the discussion;

- There are challenges in ensuring that contract farmers only sell fresh produce from their farms. They tend to get more products from other farms
- There is limited communication flow between business operators and regulators hence the need for enhancement of public private partnerships for better coordination
- Traceability is key in food safety, however, in most companies, the systems are on paper and not being implemented
- There is need for growers to work hand in hand with regulators to ensure safe food is traded since globally food safety is of great concern
- Business operators were urged to invest in quality management systems and define roles adequately
- Standards in food safety do exist therefore there is the need to translate the standards into industry guidelines and further to company policies for better interpretation of the guidelines

- There is need for harmonization of training and awareness creation on food safety issues i.e the public and private sectors to have a common message on food safety

Session 9: Field Visit

During the phytosanitary conference, delegates visited a cut flower (Flamingo Horticulture) and bio-pesticide production (Dudutech) facilities in Naivasha. The objective of the visit was to appreciate the phytosanitary controls applied in production and export of cut flowers as well as the phytosanitary controls applied in production and export of bio-pesticides.

i) Flamingo Horticulture

Flamingo Horticulture is one of the largest exporters of cut flowers in Kenya with production facilities in Mount Kenya and Naivasha. The delegates visited Kingfisher farm in Naivasha which produces Roses, Spray Carnations and fresh vegetables. In the farm's Rose flowers production facilities, common pests that are of concern during production were familiarized with including the management approaches applied on them. In the pack house, delegates were taken through the quality control systems enabling detection of pests of concern. Both in production and processing, delegates were taken through the regulatory inspections carried out by KEPHIS in enhancing compliance to the various market requirements on phytosanitary compliance.



Delegates in a *Rosa spp* production site orientation



Various approaches applied in pest management



Processing and grading facility

ii) Dudutech Ltd

The delegates visited Dudutech facilities to appreciate the production and regulatory processes applied in the production of beneficials including Nematodes, Fungi, Insects and Predators applied in Integrated Pest Management. The company prides itself as “Africa’s leader in Integrated Pest Management”. The discussions featured quality monitoring undertaken by KEPHIS in maintaining the quality of the beneficials and in meeting phytosanitary requirements of importing countries.



Display of various bio-pesticide products by Dudutech Ltd

Session 10: Closing Session

Dr. Isaac Macharia, General Manager Phytosanitary Services (GMPS - KEPHIS)

The general manager Phytosanitary Services, KEPHIS appreciated all the delegates for their great effort during presentations and contributions during the conference. He thanked all the panelists for availing themselves even on short notice, the rapporteurs, the secretariat, organizers and all who participated to make the conference a success. The GMPS also appreciated the technical team which included CABI, KALRO, KEPHIS and other stakeholders that ensured the book of abstracts was ready in time for the conference. He also thanked all the guests who opened the conference.

Simon Kibet, General Manager, Quality Assurance (KEPHIS)

In his closing remarks the General Manager Quality Assurance KEPHIS thanked all delegates and guests for finding time to attend the conference. He termed the conference a very important meeting for Africa since African problems must be solved by Africans. He informed the delegates that Africa has similar pest problems.

Delegate from Nigeria

One delegate from Nigeria on behalf of all delegates thanked KEPHIS for the opportunity to learn. He confirmed that he personally had learnt a lot from the conference and urged all to take the advice from the MD KEPHIS to share what was learnt in the conference with others who could not attend. He promised to share too. The delegate urged all the delegates to collaborate and work together for purposes of improvement of plant health systems in Africa. He wished KEPHIS well even in the future planning of the next conference.

Managing Director KEPHIS, Dr. Esther Kimani

The MD KEPHIS in her closing remarks was grateful for all the delegates and guests having attended the 2nd phytosanitary conference. She thanked all the members who planned and organized the conference and made it successful, the institutions that attended and all visitors.

The MD hoped that participants had successful networking sessions throughout the conference noting that there is need to learn to share information to help every one in improvement of plant health systems in Africa. She informed the delegates that Africa has always been referred to as a dark continent but she urged all not to believe this but work hard and better to brighten Africa. The Managing Director KEPHIS confirmed that the conference was a great opportunity for Africa to be together and discuss ways in which to take Africa to the next level in terms of plant health.

Dr. Esther Kimani finally thanked all the institutions and partners especially the United States Agency for International Development (USAID) through FOODSCAP, Feed the Future, the Centre of Phytosanitary Excellence (COPE) and the Centre for Bio-Sciences International (CABI) who supported the conference. She also thanked all KEPHIS staff who tirelessly worked to make the event possible. The MD KEPHIS confirmed that there were

more than 110 delegates from 18 countries with 300 participants having visited the exhibition. She hoped that there will be more in the next conference and thereafter other countries can also plan the conference. She concluded by urging all to continue enhancing capacities in order to facilitate phytosanitary concerns.

All delegates were presented with certificates of participation.

Side Event Involving Exhibition, Farmers, Seed Sellers & Youth



FARMERS TRAINING

The farmers producing vegetables were drawn from Nairobi, Machakos, Nakuru and Muranga counties. A total of 281 participants attended the session cutting across the three days. The sessions were deliberated on the following:

Vegetable agronomy and challenges in export of vegetable, Gitonga Samuel, Ngong Veg Ltd

The farmers were taken through the entire agronomy process of French beans. This included the information on farm preparation, farm layout, weeding, irrigation, diseases and pests and harvesting. They also were introduced to marketing and export standards for French beans. Farmers were explained the importance of contractual farming.

The facilitator further discussed with the farmers the challenges experienced during growth of French beans for export. Among the challenges identified were;

1. Rejection of produce if they do not meet the set quality standards

2. Poor disease and pests management leading to poor quality produce
3. Poor crop husbandry
4. Controlled checks on Maximum Residue levels
5. Lack of proper training and support to farmers
6. Unscrupulous dealers who indicate that produce has been rejected yet have no proof of rejected lots & variance of weights of produce at farm gate verses pack houses causing farmers to loose

Overall, the farmers were advised on good planning, record keeping, strict adherence to agronomical requirements so as to obtain good income. The quote *Garbage in, garbage out* was re-emphasized for investment in the process. They were advised to avoid quick solutions as they have been proven unsuccessful.

Use of traps in enhancing Phytosanitary controls

Mellabon Adembo & Geoffrey Ongoya Koppert Biologicals Ltd

The two sessions were offered separately by two facilitators from companies producing and importing traps for use in Kenya against pests of economic importance. The farmers were educated on available traps for control of thrips, whitefly and FCM; deliberations on dos and don'ts to ensure highest effectiveness of the traps was made.



Visit to the exhibition

The farmers visited the exhibition to see what was being exhibited.



KEPHIS exhibition stand

Promotion of orange fleshed sweet potatoes

Florence Munguti KEPHIS Plant Quarantine and Biosafety Services

A presentation was given on orange fleshed sweet potatoes. Further, a video promoting the crop was also provided. Farmers were provided information on how to handle the vines, where to collect the vines and the cost for their future purchase.

Role of KEPHIS in Phytosanitary and food regulation of vegetables

Eric Were KEPHIS JKIA

A presentation on the role of KEPHIS was made. This cut across the main roles in phytosanitary regulation, analytical chemistry laboratory services, seed certification and varietal protection. A description of the different roles was made with clear information on import and export procedures for plants and regulated articles.

Exhibition presentations- Three exhibitors were able to discuss the items of exhibition. Simlaw seeds and CBA companies demonstrated to the farmers their products while responding to questions raised during discussion.

Soil and water analysis

Mwaniki Onesmus KEPHIS ACL

The services offered by the analytical chemistry laboratory were promoted through the discussion. A clear indication on the various services offered and their tentative cost was made. Further, information on importance of soil and water analysis as key components for good farming was given.

Safe use of pesticides

Linda Maina KEPHIS ACL

The farmers were taken through a presentation on safe use of pesticides. Information on the important factors to consider when handling pesticides were made. Effects on lack of proper use of PPEs was greatly discussed during the presentation. An emphasis of need to have trained sprayers was made. Some farmers indicated use of the registered sprayers in their area.

Questions and answers

Farmers raised questions relating to the days training and their experiences from home which were responded to by KEPHIS officers as well as the facilitators in the team.

1. Certified nurseries to be placed on website for ease of access with updated information and contacts
2. US market for herbs may open as soon as all the prerequisite preparations are finalized. She urged the farmers to comply with all requirements to ensure the market is sustained. She indicated that regaining a market that has been closed was a very tough activity for the industry.
3. A consignment was held and then released with no details. Yet was perishable. Need to follow up to determine reason for holding consignment
4. Fragmentation on how the industry works. Needs more collaboration. Need to refer and borrow ideas from the FOODWISE model of Ireland
5. Sweet potato vines being sneaked at the borders. Especially the orange fleshed variety
6. Many nurseries are unregistered
7. Enhance nursery inspection and sensitization on regulation to promote clean planting material sourcing

FRUITS

Fruit agronomy

Judith Kilonzo and Eunice Musembi, Genetics Technologies Ltd

A presentation on fruit agronomy was made mainly through physical presentation on the process of growing fruit trees. The fruits discussed include banana, avocado, mango.

Discussion on the process of developing tissue culture bananas, grafting fruits was done and demonstrated. This was to make farmers appreciate the importance of sourcing seedlings from certified/registered facilities. This would reduce and/or eliminate chances of introducing and spreading pests and diseases.

Challenges in export of fruits

Alfayo Ombuya and Asenath Koech, KEPHIS

A presentation on challenges experienced during export of fruits was made. This mainly comprised pests and diseases. Deliberation on the various pests of mango and avocado were made in detail with feedback from farmers on their experiences as regards these pests. Integrated pest management procedures were discussed as solutions to the challenges faced by the farmers.

A presentation on the main roles of KEPHIS in phytosanitary regulation, analytical chemistry laboratory services, seed certification and varietal protection. A description of the different roles was made with clear information on import and export procedures for plants and regulated articles.

Role of KEPHIS in Agriculture

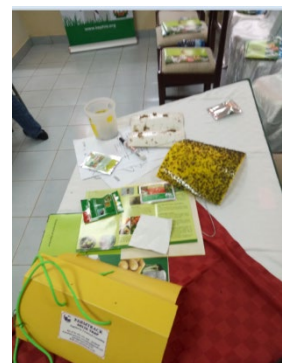
Dr. Esther Kimani- Managing Director KEPHIS

The Managing Director informed the team on importance of adhering to rules and regulations.. She emphasized that the information provided to them has been well synthesized and packaged for ease of their adoption. Integrity of the farmer determines the output they would get from farming. Buying certified seed, conducting soil and water analysis are key pillars to good yield. She emphasized need for farmers to follow the recommendations made to ensure access to markets. Further, the access to market can be done by KEPHIS but maintenance of the market is a collective responsibility whose greater weight lies with the farmer. All evidences of malpractice and non-compliance lie with the farmer. Compliance would mean less work to other players thus better working environment and outputs.

Use of traps in enhancing Phytosanitary controls

Geoffrey Leport- Kenya Biologicals Ltd and Farmtrack Consulting Ltd

The two sessions were offered separately by two facilitators from companies producing and importing traps for use in Kenya against pests of economic importance. The farmers were educated on available traps for control of fruit flies and FCM. Deliberations on dos and don'ts to ensure highest effectiveness of the traps was made.



Exhibition presentations

Farmtrack Consulting Ltd, Kenya Seed Ltd and Commercial Bank of Africa presented their products to participants while responding to questions raised during discussion.

Questions and answers All

Farmers raised questions relating to the days training and their experiences from home which were responded to by KEPHIS officers as well as the facilitators in the team.

HERBS

A number of presentations made focused mainly on good agronomy and health of herbs.

Growing Herbs and Challenges in export of Herbs

Arun K Singh, Evergreen Ltd

A presentation on herbs agronomy was made with basil being discussed from planting to export. Challenges of agronomy were discussed in detail. Farmers were able to present their challenges which were responded to by facilitator appropriately.

The biggest challenge indicated were variations in weights of harvest at farm-gate with that recorded by KEPHIS and HCD. The farmers were advised to congregate in groups to ensure their broker was trusted to deliver the correct amounts. This would further allow them to handle challenges as a team which are very tough when individually managed.

Role of KEPHIS in Phytosanitary and food regulation of vegetables **Mellon Kabole KEPHIS**

A presentation on the role of KEPHIS was made. This cut across the main roles in phytosanitary regulation, analytical chemistry laboratory services, seed certification and varietal protection. A description of the different roles was made with clear information on import and export procedures for plants and regulated articles.

Safe use of pesticides **Linda Maina KEPHIS ACL**

The farmers were taken through a presentation on safe use of pesticides. Information on the important factors to consider when handling pesticides were made. Effects on lack of proper use of PPEs was greatly discussed during the presentation.

Questions and answers All

Farmers raised questions relating to the days training and their experiences from home which were responded to by KEPHIS officers as well as the facilitators in the team.

The closing remarks were from a farmer and Dr. Isaac Macharia- General Manager, Phytosanitary Service- GMPS. He emphasized on importance of compliance for continued expansion of export product. Similarly, he informed the farmers on need to also do the due diligence to the products intended for local market. These will ensure the Kenyan people equally benefit from good farming practices.

The farmers from Herbs team agreed to form a whatsapp group for deliberation on issues affecting them, indication of any opportunities for capacity building. An agreement for a visit to Evergreen was made. KEPHIS will be informed to support the team during the visit.



YOUTH TRAINING



OBJECTIVES OF THE TRAINING

- To encourage youth involvement in diverse Agricultural value chains to ensure youth participation in enhancing food security and nutrition.

- To strengthen youth employment opportunities through agriculture
- To promote agricultural entrepreneurship among the youth
- To equip the youth with Agri -business skills

EXHIBITION TOUR

The youth training commenced by a tour to the exhibition where they were taken through various KEPHIS activities and services among them seed certification, phytosanitary services, the analytical chemistry laboratory activities, the plant quarantine and biosafety services as well as some of the products Kenya exports to other countries. There were also other institutions exhibiting among them Simlaw seed, CABI, KCB, CBA, Farmtrack consulting and COPE.

A presentation by Phyllis Githaiga on **Youth in Phytosanitary and Trade** revealed that Agriculture remains the back-bone of Kenya's economic growth directly contributing 24% of the annual GDP and another 27% indirect contribution (ASDS, 2010 – 2020). In particular the horticulture subsector (Fruits, vegetable and cut flowers) is the fastest growing employing directly and indirectly millions of persons (Approximately 4 million), majority of whom are women. The presentation took the youth through the following:

YOUTH IN AGRICULTURE

It was stated that-

- The Agriculture sector is yet to fully exploit the potential of the youth who view it as unattractive career, a career of last resort as well as one of the drudgery and low monetary benefits.
- Phytosanitary trade is a more attractive area in agriculture of the youth.
- The youth must keep themselves informed abreast.



The areas addressed entailed: Phytosanitary and trade, Market access, WTO-SPS and WTO-TBT agreements, global systems for agri/food trade, phytosanitary challenges and continental and REC overview.

Discussions on youth in agriculture

Phytosanitary and Trade

It was noted that there is need for the youth to familiarize themselves with market access issues, economic trade blocks, existing arrangements for market access etc. in order to trade in the international market and access market. On Market access issues the youth learnt that International trade in plants and plant products is guided by the Sanitary and Phytosanitary agreement under the World Trade Organization (WTO) whereby Sanitary involves human and animal health while phytosanitary entails plant health issues. The Agreements provide guidelines for market access and sets out the basic rules for food safety and animal and plant health standards which must be based on science. Examples of SPS measures are:- Requiring products to come from pest/disease-free area, Inspection of products, Post-harvest handling Measures for Aflatoxin control, Specific treatment or processing of products and setting of allowable maximum levels of pesticide residues. Other agreements highlighted relevant to market access included Agreement on agriculture and technical barriers to trade (TBT). It was learnt that TBT covers any regulations which do not fall under SPS such as technical standards, testing and certification procedures.eg Food related (shape of food cartons; packaging, labelling, food quality standards).

Finally the youth were taken through the global system for Agri/food trade as well as phytosanitary challenges.

The Role of KEPHIS in Phytosanitary regulation, Regina Kabiru

Mentioned that the Kenya Plant Health Inspectorate service (KEPHIS) is the Kenya's NPPO established under State KEPHIS Act no. 54 of 2012. It commenced operations in 1997 and provides quality control services in agriculture inputs, plant variety protection and plant health. It also regulates agricultural sector through the application of Sanitary and Phytosanitary Measures.



She added that, in line with the IPPC treaty KEPHIS inspect growing plants and plant products in stores and on transit, inspect consignments of plants and plant produce moving into the international market after which it issues a phytosanitary certificate. It also looks at disinfection and disinfestation of consignments of plants and plant products such as wood packaging material. In addition, it undertakes pest surveillance and maintenance of pest free areas by conducting pest risk analysis to facilitate trade. In addition, she took the youth through the export and import requirements certification. She mentioned that export certification is conducted by KEPHIS and HCD and this comes after the physical inspections and laboratory tests in the production chain. Therefore, for one to be able to export he/she must be a registered exporter with KEPHIS which takes a procedure for one to be licensed i.e. they must meet certain production standards. She said that, after licensing inspections are conducted to ensure compliance that is; the consignment is free of quarantine pests and regulated non quarantine pests, to ensure effectiveness of phytosanitary measures such as fumigation, eradication and isolation during the previous stages which later result in the issuance of phytosanitary certificate or notification of non-compliance. She also noted that the produce should be free from: pests and pest damages, chemical residues and chemical damage, excessive moisture, any regulated article or foreign material, has no phytosanitary disorders, ensure that the produce is properly graded i.e. there is uniformity in size, color, shape, maturity, index, distinct packaging, clean, strong and clearly labeled. On plant import, she mentioned that the plant import permit is issued to the importer after contacting KEPHIS for the intention to import. KEPHIS would then issue the permit for imported plant material in accordance to Cap 324 which is a plant protection act. The conditions stated on the document were noted to be different for various plant species depending on phytosanitary risks.

Pesticide residue analysis, James Woto

Presented on pesticide residue analysis; mentioned that sampling is done in accordance to codex CAC/GL 33-1999, EU commission directive 2002/63/EC of 11th July 2002 and SANTE 11813/2017. He added that it is done to ensure: safe food which results to a healthy population, maximum profits and also helps in making smart decisions. However, during sampling there are various risks that may be encountered which can be associated with: personnel who may be unskilled or may not put on the right protective, sample being contaminated or non-representative and farmer who may lack proper sampling procedures. He cautioned the youth that it is important to come up with a sampling plan that should contain the type of crop and area to be sampled, analyses to be tested, number of trained samplers and the laboratory performing the analysis as this would help in assembling the necessary tools for sampling such as; sampling bag, Pair

of gloves, sampling tags, Cool box, sampling records, marker pens, sampling procedure and sampling frame. In addition, he taught them about how to prepare a sample in the laboratory which begins by mixing the primary samples and dividing them into quarters after which the amount to be tested would be taken as per codex CAC/GL 33- 1999 guidelines. He noted that, “it is important to take 3 laboratory sample incase of repeats or disputes i.e one for certified lab, one for reference laboratory and another kept by company whose commodity was taken.”

On storage and transport of laboratory samples he stressed that the laboratory sample must be taken into each sealed sampling bag and uniquely labelled. The identification should include: name and nature of the sample, date and time of sampling, name of sampler, and identity to which samples were taken. Sampling record is also recorded and delivered with each sample. However, marker pens and labels that contain ink should be avoided in case fumigant pesticides are to be tested as they might give false positive results during analysis with electron capture detector.

Nonetheless, the laboratory performing pesticide residue analysis must have: Validated analytical methods, accredited with ISO 17025 in case of official controls, have a procedure for sampling and be able to analyse at least 150 pesticides within its scope out of which 70% should be commonly used or registered pesticides.

He reported that the current practises for pesticide residues are: GCMSMS and LCMSMS which are based on fragmentation of parent molecule. Therefore, the analysing laboratory should have GCMSMS and LCMSMS equipment. The customer should however be availed with all the raw data or witness analysis being done and the report made simple to interpret. This must be signed at the contract before analysis begins.

Food Safety Export Requirements for New agribusiness entities, Bernard Okonda

Defined agribusiness to be agriculture strictly conducted on commercial principles i.e. farming for business (Kilimo Biashara). It was revealed that the agribusiness system is comprised of the:

- Input sector which entails feed stuffs, seeds, seedlings, pesticides, soil, irrigation water, fertilizers, farm



machinery, and the environment/weather).

- Production sector which involves (horticulture, tea, coffee, beef, dairy, sheep, pig, poultry fish etc.
- Processing or the manufacturing sector entails: juice, fertilizer, butter, ghee, animal feeds, vegetable oils sugar, tea, flour, seed, leather, lime etc.

Challenges involved in the agribusiness system were also highlighted key among them being- Middlemen, weather/climatic changes, postharvest loses, poor quality inputs, pests and failure to comply with the market requirements.

The youth were urged to invest in agribusiness since it has many opportunities such as; growing population market, viable partnerships with cooperatives/associations, available human

-resource, favorable government policies, vast irrigation potential, value addition including processing, branding and quality, certification and accreditation as well farm level quality.

They were also urged to venture in:

- Forming own Sacco's/cooperatives which are easy to purchase inputs and access markets without exploitation of middlemen.
- Spend on modern innovative farming methods of production such as (green houses, different forms of water, collect/harvest water and store it in (dams, ponds, tanks) for use during dry seasons.
- Horticulture i.e. fruits, vegetables and flower production (capsicum, tomatoes, avocado, mango, passion fruits and flowers).
- Dairy farming
- Processing of juice, butter, ghee and yoghurt.
- Pig, rabbit and chicken keeping

He insisted on **food safety** to ensure that food does not cause harm to the consumers as well hygiene and sanitation during **production, handling, transportation, storage, processing and packaging.**

They were taken through food safety hazards which might cause harm to the consumer either by causing illness or injury. The hazards are:

- Biological hazards-bacteria, viruses, fungi and parasites.
- Chemical hazards-pesticide residues, heavy metals, polish, antibiotics, lubricants, additives and mycotoxins.

Physical hazards- hair, jewelry, and sharp objects like staples and broken glasses in food.

They were advised to attain the following food safety export requirements for new agribusiness entities which are fit for dealers in fresh produce export market.

- a.) Valid HCD export license (specifying produce)
- b.) Quality manuals (Farm & Pack house) with key policies and procedures
- c.) Validated Sources of produce-contracts, PSI, PSII, PSIII
- d.) Competent technical team-Farm & pack house
- e.) Trained spray team
- f.) Calibrated spray equipment & spray team
- g.) Approved supplier of PPPs, list of registered PPPs for use
- h.) Proof of farm & collection/holding shed inspection
- i.) Proof of packing facilities (inspected)
- j.) Soil or irrigation water analysis report
- k.) Waste disposal mechanisms
- l.) Farm stores: PPP, PPE, spray equipment, fertilizer/seeds
- m.) Relevant records/schedules-planting, fertilizer applications, scouting, spray calibrations, spray operations, cleaning, harvesting, PCNs, GRNs
- n.) They were also advised to ensure they clear with the Electronic Certification System to acquire an audit recommendation report as well as pesticide residue analysis report for edible fresh produce to be exported.

Analytical Chemistry Laboratory and Food Safety

Githenya Wachira took the group through sampling and testing for agro-inputs quality where they discussed the role of KEPHIS in agriculture as stipulated by the KEPHIS Act no. 54 of 2012 among them being:

- To protect plants from pests, weeds and invasive species
- To contribute towards improved levels of agricultural productivity and
- To support compliance to market requirements among others.

It was noted that the Analytical Chemistry Laboratory and Food Safety which is ISO/IEC 17025:2005 accredited has been able to provide quality assurance services for agricultural inputs and produce environmental monitoring. It is globally recognized thus acceptance of tests, inspections and calibration data nationally and internationally.

The lab conducts analysis of the following:

- Soil fertility Testing and Crop Specific Fertilizer Recommendation
- Fertilizer and Manure Analysis_ Guaranteed analysis of (1°) NPK, 2° and or T. -Elements
- Irrigation Water Suitability Test
- Plant Tissue Analysis
- Metal Contaminants Analysis

-Proximate analysis of Food and Feed

-Pesticides residue analysis

-Mycotoxins analysis

These analyses are carried out to ensure National Food Security, Food Security, facilitation of trade as well as enabling soil sampling for fertility evaluation which assists in developing and implementing strategies for soil fertility replenish management.

They were also taken through representative soil sampling, irrigation water, water sampling requirements as well as fertilizer formulations and manures checked for quality conformity to guarantee label specifications as well the nutrient content.

Pesticide formulations are also analyzed for active ingredient to ensure conformity to label guarantees.

The presentation also discussed about foods and feeds which was about proximate analysis of feeds for conformance to guaranteed nutrient specifications which include crude oil, crude proteins, ash/mineral content, crude fiber and moisture.

Chemical and biological hazards of concern in food safety.

-Mycotoxins e.g. Aflatoxin contamination in cereals

-Pesticides Residues in fruits and vegetable

-Heavy Metals contaminants e.g. Arsenic in rice, cadmium in cocoa and its products

-Microbial contaminants e.g. *e. coli*

Laboratory Tour



The session by a tour to the analytical chemistry laboratory where the youth were taken through the laboratory activities by Robert Koigi



KEPHIS laboratory analyst Robert Koigi taking the youth through the Analytical Chemistry Laboratory

Conclusion and recommendations

Most youths asked for more training to be conducted since there is need of more information for them to venture into business. They also suggested that certificates be presented to them and this would be good since it would be a proof that the training was conducted and it would also add to the CV of the youth.

The number of youth to be invited should not be limited to a particular number since more youth especially those in the field of agriculture are more willing to participate in such forums.

Youth should also be supported for instance through donating green houses to them and providing information since most of them would be willing to venture in the Agribusiness sector however they lack capital and enough information.

KEPHIS should come up with more platforms of communication for instance, Instagram and encourage the youth to follow their page so that the mandate of KEPHIS can be promoted using such platforms.

SEED SELLER TRAINING

The aim of the training was to enhance sanitation in plants and seed. The seed seller's training was held to help the stockist can challenges of fake seeds in the market and to help them acquire knowledge on how to register as a seed seller and improve business interaction.

Stellamaris gave a welcoming remarks and asked members to introduce themselves. She later introduced Mr. Simon Maina, Head Seed Certification and Plant Variety Protection he welcomed and thanked them for attending the training.

Proceedings

Seed Certification and Seed Regulation,

Mr. Maina made the presentation on the above subject and retaliated that for improved business interaction is required between the stakeholders to iron out issues, and the seed seller to different and appreciate between a seed and a grain. The seed certification ensures quality of the seed in the market and seed before sale by the stockist undergoes a long process (7 years) and is very expensive thus critical care is needed when handling seed. The new varieties are tested (NPT) in various site, data is collected and analysed and varieties tested and passed the set criteria are released for sale.

Plant breeders are given the opportunity to protect their varieties by granting plant breeders right. Exploitation of the varieties is prohibited legally to be able to recover the money spent on breeding.

Protection enables the breeders to have faith in recovering the money spent in breeding work unlike on the other countries in East Africa. Seed is a packet technology it has genetic potential to generate the required plant crops. Technology has to give money/productivity, the farmer by this seeds to make a profit. It can be potential lethal and has the ability to carry diseases. America was discovered when potatoes were infected and great famine occurred in Europe such as individuals moved from Europe to other lands i.e. America.

Legally sanctioned system of seed multiplication gives assurance that the farmers get the right seeds as specified.

1. Registration of seed growers and seed crops: - includes field inspection so as to verify factors that cause irreversible damage to the genetic purity of the seed.
2. Seed processing and sampling:- lot examination to ensure that the seed is clean , treated with the chemicals and seed is sampled , taken to the laboratory for testing.- purity tests , germination and moisture content.
3. Labelling and sealing.
4. Post control – conducted to determine the genetic purity of a given seed lot of a released cultivated. The samples are drawn from the seed in the market.
5. Post certification survey – monitors quality of seed sold to farmers by stockist.
6. Validity of certification- for – for cereals, oil crops, pulses and fibre crops is 12 months from date of sampling. Herbage grass, roots crops, vegetable s and stimulant crops is 9 months.
7. Agents and sub – agents are advised not to sell seed that is past the certification validity period.
8. Process of registration as a seed stockist: lease / own premises – premise inspection
9. Offences and liabilities: KEPHIS offices should have access to premise to inspect hence co-operation between all stakeholders and KEPHIS is key so as to eliminate rot in the seed industry.

Seed storage , Handling and Certification.

Seed are living and inside each seed there's a living embryo hence breaking the embryo lowers the viability of a seed. Natural seed life span of the seed is influences by factors such as dormancy, seed physiology, permeability of the seed coat and storage environment.

Vigour- ability of a seed to withstand harsh environment i.e. salinity, compacted soils, also environment factors i.e. temperature, relative humidity.

Seed should be stored in a cool, dry place to elongate the life span of a seed. During storage, seeds decline in germination capacity and vigour. 10°C and below the pests and insects are low in number and inactive, at 29 -32°C the insects are active.

Stockist were encourages to order what they can sell to avoid the repackaging also to advised their customer on good storage and handling of seed to avoid contamination. Handling seeds gently when loading and unloading, to avoid seeds with broken containers and poorer labelled; always to issue receipts to their customers to safeguard themselves against fictions claims.

The stockist were also advised on the importance of verification of seeds sources and relevant documents authenticating the seed and always buy the seed from licenced stockist, ensure the seed have a valid lot number and variety receipts.

Questions

A question on packaging was raised on whether the companies could take back the large packet of (25kg) for repackaging into a smaller packet. Mr. Maina indicated that there is a possibility of that happening in liason with the merchants.

Another seed seller asked if it were possible to get the presentations they were asked to register their email address.

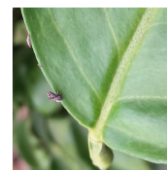
Another attended advocated for 1 kg packets for the small scale farmer who do not have the purchasing power.

Posters in display during the conference



ASIAN CITRUS PSYLLID (*DIAPHORINA CITRI*) STATUS IN CITRUS AND CURRY LEAF PRODUCTION AREAS OF KENYA

Thomas Kosiom and ¹Fredrick Koome, ²George Momanyi, ³Hellen Heya, ⁴Isaac Macharia, ⁵Esther Kimani
¹Kenya Plant Health Inspectorate Service, P.O Box 49592-00100, Nairobi, Kenya.



Abstract. The Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae), has been reported as an important pest of citrus worldwide because it is an efficient vector of "Candidatus Liberibacter" species that cause Huanglongbing (citrus greening disease). The psyllids have been reported to survive in different agro-ecological environment and is able to establish in lowlands. Surveillance for *D. citri* was carried out in citrus production areas in coast region of Kenya to establish its occurrence and spread. Farms were randomly selected and sampled plants were inspected for the presence of psyllids. Adult psyllids samples that were collected were identified using morphological identification keys. Survey results indicated that Asian citrus psyllids had been introduced and was spreading rapidly in Kenya. After its incursion in September 2016, the psyllids have rapidly spread and in December 2016, *D. citri* it was found on 7 farms out of the 13 surveyed in Kwale County more than 60km from where it was first detected. In June 2017, *D. citri* was detected in Mombasa, Taita Taveta and Kilifi Counties 24 farms out of 78 surveyed were infested. In a recent countrywide surveillance which was done in March 2018 indicated that *D. citri* was not detected in other parts of the country other than coast region.

Introduction

The Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae), is the most important pest of citrus worldwide because it is an efficient vector of "Candidatus Liberibacter" species that cause Huanglongbing (citrus greening disease). The psyllids are known to acquire the bacteria during feeding on infected plants and transmitting it to healthy plants during feeding. The psyllids have been reported to feed on all varieties of citrus and several close relatives of citrus. Apart from being an important vector of citrus greening, psyllids have also been reported to damage citrus directly by feeding on young leaves (flush). The Asian citrus psyllid (ACP) originated in Asia but it is now also found in parts of the Middle East, South and Central America, Mexico, and the Caribbean. The ACP was first reported in neighbouring country, Tanzania in 2015 in citrus production areas, the first case in Africa. In 2016 the psyllid was detected in Kenya following a detection survey conducted by ICIPE in collaboration with KEPHIS in September 2016 on citrus growing areas in Lunga Lunga where the pest was reported to have been observed on young shoots of citrus on two farms at Lunga Lunga Border.

Objective

1. To determine the occurrence and spread of Asian Citrus Psyllid (ACP) in Kenya
2. To establish the behaviour of the pest under different agro-ecological zones

Materials and methods



Fig 1. collection of psyllids from citrus orchards

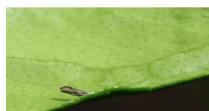


Fig 2. ACP on a citrus leaf



Fig 3. collection of psyllids from citrus orchards

County	Locations
Kwale	Lunga Lunga, Dzombo, Matuga, Msambweni, Shimba Hills
Taita Taveta	Taveta
Kilifi	Mwarakaya, Kaloleni, Kikambala, Chonyi
Mombasa	Likoni, Shimo la Tewa

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Table 1: Status of psyllid in the curry leaf production areas surveyed

Location	No. of farmers	Host	Citrus psyllid	Other pests
Matuga	20	Citrus	7 Farms	Bactrocera invadens, Leafhoppers, Scales, mealy bugs, Citrus whitefly, Dialeurodes citri, leafminers,
Msambweni	12	Citrus	3 Farms	Leaf hopper, Dysdercus spp., mealybug
Lunga Lunga	19	Citrus	7 Farms	Leafhoppers, scales
Likoni	2	Curry leaf, citrus	None	Leafhoppers, Leafhoppers,
Kilifi South	16	Citrus	5 Farms	Leafhoppers, Trirhithrum spp., Bactrocera curcubitae,
Kaloleni	7	Citrus	1 Farm	Dacus bivittatus,
Taveta	2	Citrus	1 Farm	Bactrocera curcubitae, Leafhoppers, Leafhoppers



Fig 4: World distribution of Asian Citrus Psyllid



Fig 5: ACP in coast Kenya

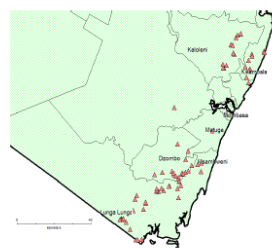


Fig 6: Map showing surveyed areas

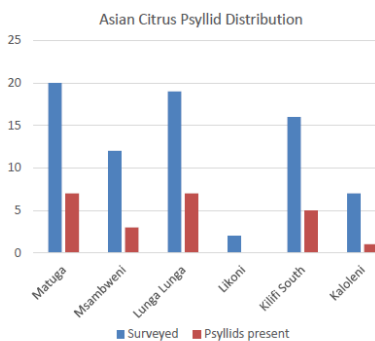


Fig 7: Distribution of Asian Citrus Psyllid

Conclusion

- ❖ The Asian Citrus Psyllid has spread from its where it was first detected to others parts of the country hence the need to establish potential introduction pathways.
- ❖ The pest was first detected in September 2016 on two farms at Lunga Lunga, bordering Tanzania and by March 2018 it was detected on 24 farms within four counties: Kwale, Taita Taveta, Kilifi and Mombasa.
- ❖ High population was recorded in June 2017 during wet season when citrus trees were flushing compared to the dry season in March 2018.

Way forward

- There is need to determine if the Asian psyllids identified in Kenya carry the pathogen responsible for citrus greening disease
- There need to establish whether the Asian psyllids has also spread greening disease to citrus trees where it have been identified.
- There is need to sensitize citrus farmers on the occurrence of ACP and management
- There is need to establish genetic diversity of the Asian citrus psyllid reported in Kenya





DISTRIBUTION OF *Bemisia tabaci* AND OTHER WHITEFLY SPECIES IN MAJOR HORTICULTURAL PRODUCTION AREAS IN KENYA

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Abstract. Whiteflies have been reported as important pests in many horticultural crops. Their importance as a virus vector of a wide range of viruses has led to interest in understanding their distribution. A survey was undertaken to determine the distribution of *Bemisia tabaci* in major horticultural areas in Kenya. A total of 26 districts representing 17 counties were surveyed during the survey and whitefly samples were collected from different crops across all the growing stages. Field were randomly selected and whiteflies were observed along fixed transects where different host plant were inspected for the pest and whitefly samples collected using an aspirator into ethanol. Collected samples were submitted to the laboratory for identification at the Plant Quarantine and Biosecurity Station, Muguga where identification were done using morphological identification using whitefly keys. Samples were referred to national Museum and ICIPE for confirmation. Five whitefly species were identified from samples that were collected *B. tabaci*, *Aleurodicus dispersus*, *Trialeurodes vaporariorum*, *Aleurocanthus woglumi*, *Aleurodicus spp.*. Out of the collected samples, 62.4% were *Bemisia tabaci*, 25.9%, *T. vaporariorum*, 9.8% *Aleurodicus species*, 1.6% *A. dispersus* and 0.1% *A. woglumi*. *B. tabaci* and *T. vaporariorum* were observed on tomato, cassava, sweetpotato and cucurbits among other while the rest had a low host range. *B. tabaci* and *T. vaporariorum* were collected in almost all the districts surveyed indicating that the two whitefly species are widely distributed in most of the production areas.

Introduction

Bemisia tabaci (Gennadius) (Homoptera: Aleyrodidae) (tobacco whitefly) is an important pest of many agricultural crops worldwide and is widely distributed throughout the tropical and subtropical regions (Mckenzie et al., 2004). *B. tabaci* is of phyto-sanitary importance as it hampers trade in many horticultural crops. *B. tabaci* is very difficult to control because of its polyphagous nature with a host range of 600 plants species, ability to reproduce fast with many generations per year, and quickly develops resistance to most of the chemicals. Although the pest have been reported to cause direct damage, the most important damage that *B. tabaci* cause is by transmitting viruses. *B. tabaci* is known to vector at least 111 plant viruses in the genera Begomovirus (Geminiviridae), Crinivirus (Closteroviridae) and Carlvirus or Iponovirus (Polyviridae) some of which are of quarantine importance in Kenya and also to our trading partners (Jones 2003). Begomoviruses are the most numerous of the *B. tabaci* transmitted viruses and have been reported to cause crop yield losses of between 20% and 100% (Brown and Bird, 1992). *Bemisia tabaci* has several biotypes of which B biotype has been reported to pose a great risk in Europe where crop production is done in controlled environment throughout the year. Data on the distribution and genetic diversity of the *B. tabaci* in horticulture is lacking.

Objective

- To determine the distribution of *B. tabaci* and other whitefly in different horticultural production areas in Kenya.
- To establish the host preference within the production areas

Materials and methods



Fig 1. Collection of whiteflies



Fig 2. whiteflies

- Whiteflies were collected from different district
- Farmes were selected randomly in each district
- Samples were collected using an aspirator



Fig 3. whiteflies eggs

Province	Districts (1999 records)
Rift valley	Laikipia East, Kajiado, Naivasha, Gilgil,
Eastern	Embu, Mbeere, North, Meru, South, Imenti, North, Imenti South, Imenti Central, Tigania, Burii, Machakos, Makeni,
Central	Thika, Laikipia West, Kirinyaga, Kinangop, Nyeri, Nyandarua, Olkalou, Kiambu,
Coast	Kwale, Kilifi, Lamu, Taita Taveta,

References

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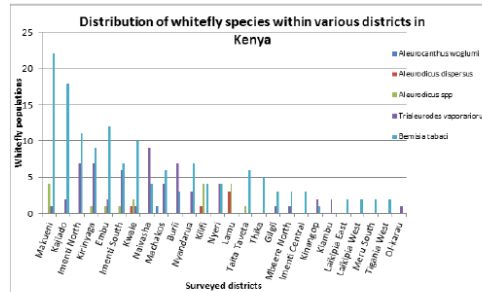


Fig.5. Whitefly population in different districts

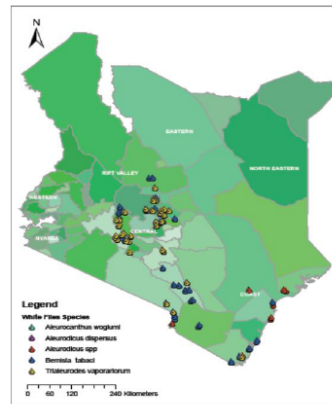


Fig.5. Map showing distribution of different species of whiteflies

Findings

- Five whitefly species (*B. bemisia*, *Aleurocanthus woglumi*, *Aleurodicus dispersus*, *Aleurodicus spp* and *Trialeurodes vaporariorum*) were identified
- B. bemisia* was observed in most of the areas surveyed.

Conclusion

- Most of the whitefly species identified from the survey had a wide distribution in most of the areas targeted.
- B. tabaci* recorded the highest number in terms of distribution as well as in host crop preference as compared to the other species.
- Other whitefly species were also identified from areas surveyed which include; *Aleurocanthus woglumi*, *Aleurodicus dispersus*, *Aleurodicus spp* and *Trialeurodes vaporariorum*.
- The results obtained indicated that tomato and cassava were the most preferred host plants by most of the whitefly species.

Way forward

- There is need to evaluate the occurrence of viruses transmitted by *B. tabaci*
- There is need for further studies to establish the efficiency of *B. tabaci* in transmission to viruses
- Since use of DNA barcoding has been demonstrated as an important tool in the identification of thrips species, there is need to evaluate the possibility of its efficiency in the identification of whiteflies
- There is need to establish genetic diversity of whiteflies in Kenya





STATUS OF COCONUT LETHAL YELLOWING DISEASE AND ITS VECTORS IN COCONUT PRODUCTION AREAS IN KENYA

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Abstract. Coconut lethal yellowing disease (CLYD) is a highly destructive, fast spreading disease of coconut. The disease is caused by a group of phytoplasmas. In Nigeria the disease has practically wiped off great majority of the palms in south-east part (98.5%) with, crownless coconut palms being a common sight in the affected areas. In the main coconut-growing areas of the Mozambique, the Zambezi province, LYCD disease caused almost complete loss of the crop in 1992. CLYD is well established in Tanzania where it has caused massive damage to coconut crop in the recent past. In Kenya, coconut palm is an economically important perennial crop that supports the livelihood of most farmers in the coastal belt of the county. KEPHIS undertook a surveillance in the coastal region to establish the status of lethal yellow disease of coconut in the coast region of Kenya. Wood shavings for molecular analysis were obtained by drilling the tree trunk using 10mm drill bit and samples collected into sterile bottles and dried using silica gel. The vector, *Diostrombus mkurungai*, whose occurrence in Kenya had not been reported, was found in the surveyed areas. Another vector of Cixiidae family was also collected. A number of coconut trees expressed symptoms of CLYD and others were dead stands. Coconut lethal yellowing phytoplasma was detected on 5 sites in Lunga Lunga, Kwale County. Specifically they were found in Vanga and Lunga Lunga, at the border with Tanzania.

Introduction

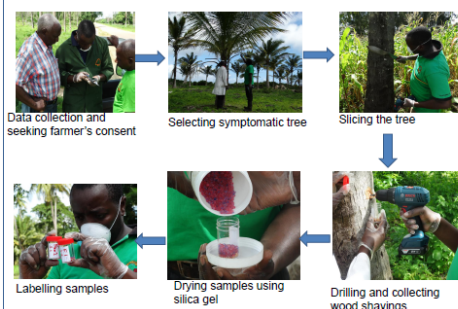
Coconut lethal yellowing disease (CLYD) is a highly destructive, fast spreading disease of coconut. KEPHIS Mombasa carried out a surveillance in the coastal region to establish the status of lethal yellow disease of coconut in the coast region of Kenya in February and March 2018. The surveyed include: Kwale, Mombasa, Tana River, Kilifi and Lamu counties in coast region. This disease has been reported along the coast line in the neighbouring country, Tanzania where it has killed millions of coconut trees and hence adversely affected the livelihoods of many communities. The communities along the coast both in Kenya and Tanzania share common interaction aspects such as trade, language and religion hence high likelihood of germplasm exchange. During the surveillance, a total of 44 farms were visited where symptoms similar to that of CLYD were observed on coconut plants in 76% of the farms surveyed. Further, a total of 35 wood shavings samples obtained from drilling the trunk of symptomatic palm tree were collected in sterilized vials containing silica gel and submitted to KEPHIS Molecular Laboratory for molecular analysis. A total of 7 insect samples that were frequently observed on palm plants were also collected in 96% ethanol for morphological identification and analysis for presence of CLYD. In affected farms, it was noted that most trees had died while others were showing symptoms of the CLYD. The farmers attributed the huge losses of coconut trees to prolonged drought that hit the country in the recent past. Since these symptoms expressed by other diseases such as foliar decay of coconut, the Molecular Lab analysis and sequencing was important in determining the actual cause of the symptoms observed or dead of coconut trees. The most abundance insect collected from the field was identified as *Diostrombus mkurungai*, a known vector of CLYD in Africa. This is the first report of *D. mkurungai* in Kenya. One other insect was only identified up to family level, Cixiidae, which comprises species that are known to transmit CYLD and other coconut diseases.

Objective

To detect the presence of coconut lethal yellowing disease in coast major coconut production areas in Kenya

To establish if vectors responsible for the transmission of the pathogen are present

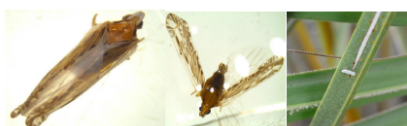
Methods



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Phytoplasma analysis



Vector of Cixiidae family

Findings

- ✓ *Diostrombus mkurungai*, was found distributed in the coconut production areas
- ✓ An insect belonging to Cixiidae family, which comprises species that are known to transmit CYLD was found in Kwale, Kilifi and Lamu
- ✓ Most trees were over 40 years
- ✓ Most farms had coconut tree stands
- ✓ Coconut lethal yellowing phytoplasma was detected on 5 sites in Lunga Lunga, Kwale County. Specifically they were found in Vanga and Lunga Lunga border



Diostrombus mkurungai

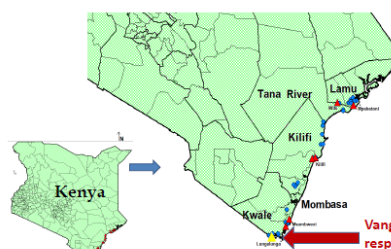


Fig 4: Blue refers to sites where wood shavings were taken while the red refers to sites where insects similar to vectors were collected



Symptomatic coconut tree

Vanga and Lunga Lunga are sites where the phytoplasma responsible for CLYD was detected

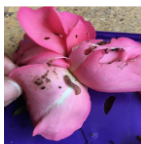
Conclusion

- ◆ Phytoplasmas responsible for coconut lethal yellowing disease was detected on five sites in Lunga Lunga and Vanga areas of Kwale County, next to the Tanzania border.
- ◆ Two vectors; *Diostrombus mkurungai* and insect belonging to Cixiidae family which comprises species that are known to transmit CYLD were detected in most of the surveyed areas.
- ◆ Although many coconut trees showed symptoms of CLYD, only a few of the coconut tested positive to CYLD in the surveyed sites
- ◆ CLYD vectors were most observed on African palm plants which are the dominant coconut trees in the coastal region.

Way forward

- There is need for further studies to establish the efficiency of *Diostrombus mkurungai* to transmit CLYD in Kenya.
- There is need to confirm the status of CLYD in all coconut production sites in Kenya
- There need to study the occurrence of natural enemies which can be important in the for the management of CLYD vectors
- There is need to study the technologies for monitoring and trapping the vectors of CYLD





Importance of FCM (*Thaumatotibia leucotreta*) on the export of Kenyan Produce

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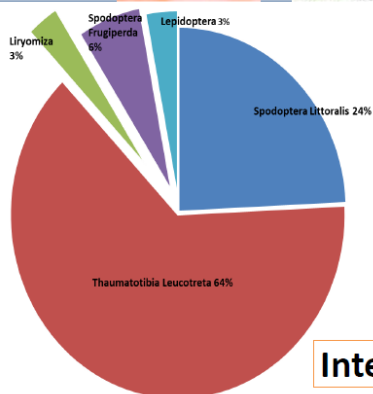
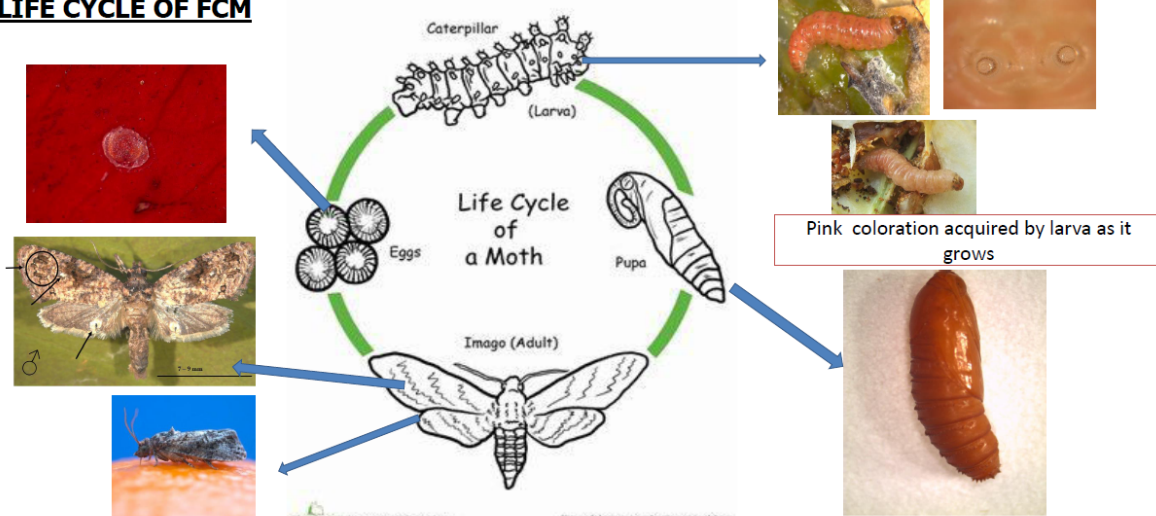


Introduction:

Kenya's economy is largely agriculture driven. Horticulture sub-sector is one of the top foreign exchange earners for the country generating approximately US \$ 1 billion annually. The horticulture sub-sector contributes about 1.6% to the national GDP with 1.1% being from the flower industry. Kenya is the leading exporter of rose cut flowers to the European Union (EU) with a market share of 38%. This sector is largely threatened by new emerging pests among them False codling Moth (FCM).

Taxonomy: Kingdom- Animalia, Phylum- Arthropoda, Class- insecta, Family- Tortricidae, Genus- Thaumatotibia

LIFE CYCLE OF FCM



Interceptions

Effect of FCM on Exports

- The export of chilies has reduced by more than 50% as from 1st Jan2018 (only 4 exporters doing it now)
- Increased cost of production of chilies (under shed-net or greenhouse)
- Increased interceptions/notifications of exported roses (Jan-April 2018 with 13 interceptions)
- Reduced balance of trade and balance of payment

Conclusion and way forward

- Kenyan can loose its market due to this pest
- All growers/exporters to ensure the produce is free from FCM



Minimizing Waste Through Value Addition and Preservation Of Fresh Mango Fruit In Kenya – Establishment of Mango Value Chain Innovation Platform

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Abstract. Mango is one of the key fruits produced in Kenya for domestic and export market. It is adapted to a wide range of agro-ecological zones and therefore produced in most regions in Kenya. Mango has great potential to improve livelihoods of the smallholder farmers in rural areas. This potential remains largely untapped. Unlocking this potential requires concerted efforts of all value chain actors including farmers/producers, transporters, processors, distributors and others. There are various challenges to productivity at the various stages of the mango supply chain. One of the key challenges in the mango value chain is high postharvest losses. It is estimated that up to 50% of the mango produced are lost along the supply chain. Minimizing post-harvest losses is crucial in ensuring food and nutrition security. The fruit and vegetable industry in Kenya play a vital role in reducing micronutrient deficiencies in the diet, generating income and creating job opportunities. In Kenya mango has been identified as having high potential. However, the mango industry experience 20-25% losses due to lack of storage infrastructure, poor access to markets and inability to value add through processing. Many technologies for storage and value adding of many perishable products are unaffordable to smallholder farmers. A new Africa-Australia partnership between the universities of Ibadan, Nairobi and Sydney and drawing in the National Horticultural Research Institute in Ibadan, the Kenyan Agricultural Finance Corporation, Kenya Plant Health Inspectorate Service (KEPHIS), National Biosafety Authority, Lilongwe University of Agriculture and Natural Resources was developed at the AAUN/Australia Awards Symposium on November 16 2016 aimed at establishment of a pilot innovation platform in Kenya to create a collaborative solution to reduce postharvest losses of mangoes, through engaging stakeholders in an innovation platform. This initiative would empower farmers to better their lives and co-create solutions. Activities included meetings to map out the initial strategy for initiating the innovation platform on mango, engagement of stakeholders through workshops, administration of questionnaires and farm visits. Analysis of the mango value chain provided an overview and the kind of stakeholders to be invited to the workshops. Many stakeholders identified during the meetings from the two sites in Kenya and who are available and would commit to the establishment of a mango value chain. Constraints and opportunities and possible solutions were identified and a way forward discussed and agreed upon. The conclusion was that the establishment of an innovation platform will help enhancing mango productivity, reduce post harvest losses and hence improve income, food and nutrition security and improved livelihoods.

Introduction

Food and nutrition security and poverty alleviation are major issues in Kenya. The fruit and vegetable industry in Kenya play a vital role in reducing micronutrient deficiencies in the diet, generating income and creating job opportunities, particularly for women. Post-harvest losses of fruit and vegetables contribute significantly to lack of food and nutrition. Minimizing post-harvest losses is crucial in ensuring food and nutrition security. In Kenya, horticulture industry is growing at an annual rate of 15-20% and provides 8% GDP (MOA, 2010) and mango has been identified as having high potential. Mango production has had an annual growth rate of 26% annually since 2005. Approximately 98% of the total mangoes produced in Kenya are locally consumed whereas 2% goes to export. About 20-40% of produced mango go to waste due to poor post-harvest handling (KARI, 2004; Gor et al., 2012), lack of storage infrastructure, poor access to markets and inability to value add through processing, and this affects farmers income in the sector. An initiative to create a collaborative solution for reduction of postharvest losses of mango, through engaging stakeholders in an innovation platform is envisaged. This would empower farmers to better their lives and co-create solutions. The overall outcome would be the delivery of low cost technologies to facilitate product to market and to process raw materials into value added products. Improving competitiveness of the mango value chain is vital to poverty alleviation and will transform subsistence production to market oriented production.

Objective

To establish pilot innovation platforms to create collaborative solutions to reduce postharvest losses of mangoes in Kenya

Expected Outcome

Consensus on the creation of IP for Mango, establishment of low cost technologies to facilitate products to market and to process raw materials into value added products and Improvement of competitiveness of the mango value chain in order to alleviate contribute to food and nutrition.

Methods



Fig 1. Visit to mango farms



Fig 2. Stakeholder meetings



Fig 3. Map of Kenya showing the two sites – Elgeyo Marakwet & Makueni

- Stakeholder meetings to map out the regions for establishment of IP, identification of potential stakeholders and creation of stakeholder analysis
- IP facilitators engagement with stakeholders from private sector, farmer communities, researchers, policy makers, and extensionists, through workshops/focus group discussion
- Administration of questionnaires to gather more information (post harvest losses, pests infesting mangoes, post harvest value addition) from the value chain players
- Farm visits to get firsthand information from the farmers and visual assessment

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Results

Constraints faced by the stakeholders along the mango value chain, opportunities and possible solutions were identified and a way forward discussed and agreed upon.

Constraints

- High post harvest losses
- Lack of storage & processing facilities
- Pest damage and Poor pest management
- Drought (no water source for irrigation)
- Lack of awareness in market requirements
- No organized marketing channels
- Lack of market intelligence/information by farmers, leading to huge losses

Opportunities

- Existence of technical assistance from research
- Regulation & extension services supporting farmers
- Input suppliers are available

Proposed solutions

- Construction of storage & processing facilities
- Marketing and price control through formation of farmer cooperatives/groups
- Harvesting & storage of Water for irrigation (drilling of boreholes)
- Value addition (drying or juice processing) for nutrient supply during time when mango fruits are out of season for nutrition security

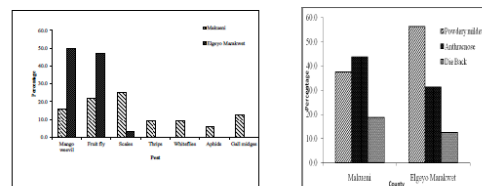


Fig 4. Major pests affecting mango production in the two sites

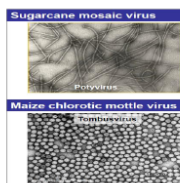
Conclusion

An innovation platform is the framework which brings stakeholders along the value chain together for continuous interaction lessons learning through action research to ensure that technology generation, dissemination and adoption takes place on targeted commodities or systems for the economic benefit of stakeholders. Creation of a multistakeholder platform has lately been promoted as a way to engender agricultural development in Sub Saharan Africa (SSA) (Adekunle and Fatunbi, 2012).

- Mango growers in the two mango production sites in Kenya are aware of the opportunities available, know the constraints and have identified solutions they believe can enhance mango productivity, reduce post harvest losses and hence improve income, food and nutrition security and standards of living
- With the existence of all the opportunities and platform players, there is great potential to establish an innovation platform in these sites

Way forward

- Stakeholders unanimously agreed to the establishment of a mango and Tomato value chains innovation platforms
- Players in the value chains are available and according to the stakeholders, would be committed to be part of the innovation platform
- The next steps – establishment of innovation platforms in the mango value chain and facilitation of the interaction among the stakeholders through contact meetings and other communication channels on a regular basis

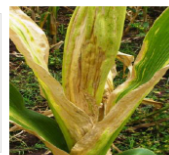


Prevalence of Maize *chlorotic mottle virus* (MCMV) in major maize seed production areas in Kenya and its status in local and imported seed

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Maize is the most important cereal crop in Sub-Saharan Africa (SSA) and an important staple food crop for more than 1.2 billion people. In Kenya, maize is the main staple food where over 90% of Kenyans rely on maize. Pest and disease are key constraints in maize production. In September 2011, A serious disease outbreak, later diagnosed as maize lethal necrosis (MLN), was reported on maize with yield losses of upto 126,000 metric tonnes. The disease is as a result of co-infection of maize with *Maize chlorotic mottle virus* (MCMV) and *Sugarcane mosaic virus* (SCMV). The disease is seed borne despite being transmitted by thrips, leafhoppers and beetle. A study was carried out in 12 counties to determine the prevalence of MLND in major maize seed production areas in Kenya in 2015. Surveillance was conducted in the maize growing regions and the incidence of the disease determined. This was done using the inspection protocol used during seed maize inspection. Symptomatic samples were collected and analyzed using RT-PCR and ELISA for the presence of the MLND causing viruses. A high incidence of MCMV was found in symptomatic samples collected during the survey. A total of 29 varieties were sampled and analyzed for the viral. A least 71% of the samples analyzed were found to have MCMV whereas. The survey results indicate that MCMV is widely distributed within the maize growing regions and most of the maize varieties are susceptible to infection with the virus. MLN incidence was significantly high within the counties and among varieties. MCMV infection was found to be high in locally produced seeds than the imports. Therefore, there is need to establish the role of seeds in disease transmission.

Introduction

Maize is a significant food crop in Africa and it accounts for more than 50% of low-income household expenditures in East and Central. Consumption of maize world wide stands at over 116 million tons in which Africa alone consumes 30% of which 21% is consumed in SSA. Maize lethal necrosis (MLN) disease in Kenya has been confirmed to pose great challenge resulting in heavy yield losses and a decline in maize production. The causal agents of the disease is *Maize chlorotic mottle virus* (MCMV) and any potyvirus such as *Maize dwarf mosaic virus* (MDMV), *Wheat streak mosaic virus* (WSMV) or *Sugarcane mosaic virus* (SCMV) (Niblett and Claffin, 1978). *Sugarcane mosaic virus* is known to affect cereals in Kenya with minimal damage (Louie, 1980) however in combination with MCMV the viruses are rated amongst the most important maize infecting viruses in the world (Lubberstedt *et al.*, 2006). There is also need to determine the status of the seed maize as far as MLN disease is concerned as part of management and monitoring of the disease. Surveillance in the seed maize farms would help to determine the prevalence of the disease in maize seed production areas.

Objective

To determine prevalence of Maize *chlorotic mottle virus* (MCMV) in major maize seed production areas in Kenya.

Materials and methods

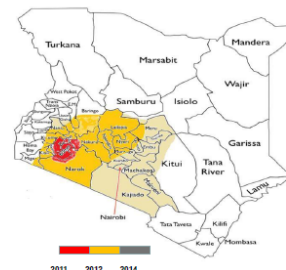


Fig 1 Symptoms of MLN in the field

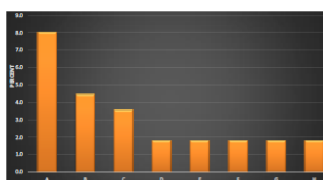
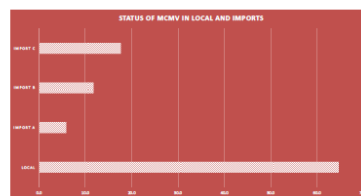
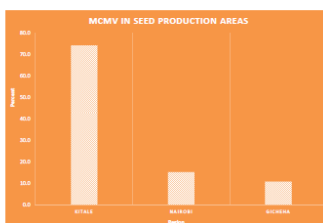
- Surveillance was carried out in 3 major seed production regions namely Taita Taveta, Kitale and Nairobi region comprising a total 12 counties
- Survey targeted crops that have attained knee height to mature green stage
- Survey started at a random position in the field in the row next to the male parents. 20 plants were counted then one row was omitted and then proceeded to count next 20 plants in the third row and again in the fifth row.
- Maize plants visually assessed for MLND symptoms with collected samples taken to laboratory for analysis using both ELISA and PCR.
- Seeds lots from imported seed and local were collected pre-germinated nucleic acid isolated and analysed using real time PCR.

Region	County
Nairobi	Kajiado, Meru, Tharaka Nithi, Murang'a, Machakos, Makueni, Embu
Kitale	Uasin Gishu, West pokot, Transzoia
Taita Taveta	Loitokitok and Taveta ,

Distribution and spread of MNL 2014



Results



Wangai, A.W., Redinbaugh, M.G., Kinyua, Z.M., Mahuku, G., Sheets, K., and Jeffers, D. 2012. First report of *Maize chlorotic mottle virus* and *maize lethal necrosis* in Kenya. *Plant Disease* 96: 1582.

- Symptomatic samples collected and analyzed using RT-PCR and ELISA for the presence of the MCMV causing viruses in the season 2014/2015
- Incidence of MCMV was found in symptomatic samples collected during the survey 2014/2015
- A total of 29 varieties sampled belonging to different merchants and analyzed for the presence of MCMV.
- A least 71% of the samples analyzed were found to have MCMV
- All the varieties collected had MCMV infection
- Most of the seed lots analyzed from local were found to have MCMV
- Some imports were also found to have MCMV infection

Conclusion

- There was incidences of MCMV in most of the seed production areas in the year 2014
- Most of the varieties are susceptible to infection by MCMV
- In the subsequent year 2015/2016 the same survey was conducted in the same regions and the survey indicated low incidences of MCMV, most samples tested negative (Data not shown).
- Locally produced seed were found to have high infection of MCMV since they were not being tested before processing

Way forward

- There is need for continuous monitoring of the disease incidence
- There is need to establish the rate disease transmission through seed
- KEPHIS implemented an agreed upon intervention of 1% MLND infection tolerance.
- Seed crops rejected at more than 1% infection and rouging at less than 1% MLND infection.
- All seeds regardless of infection/approval was sampled for MLND tests at PQBS. MLND tests continue to date for all seed at all processing factories.
- No seed sales/movement until tests for MLND are ready.

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Wangai, A.W., Redinbaugh, M.G., Kinyua, Z.M., Mahuku, G., Sheets, K., and Jeffers, D. 2012. First report of *Maize chlorotic mottle virus* and *maize lethal necrosis* in Kenya. *Plant Disease* 96: 1582.





DISTRIBUTION AND MANAGEMENT OF THE INVASIVE PAPAYA MEALYBUG, *PARACoccus MARGINATUS*, IN KENYA



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Abstract. The papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae), a serious invasive pest affecting horticultural crops, was first reported in Kenya in 2016 at Kwale, Mombasa, and Kilifi Counties of the coastal region. A series of studies were conducted to establish its identification, distribution host range and management at the coastal region. The papaya mealybug was found to infest papaya (*Carica papaya*), cassava (*Manihot esculenta*), chili pepper (*Capsicum annuum*), guava (*Psidium guajava*), mango (*Mangifera indica*), and eggplant (*Solanum melongena*) in these studies. In the first study, an average yield loss of 91% on papaya crop was reported in the affected farms. Due to robust pest management strategies that were put in place by KEPHIS, subsequent studies have shown significant reduction on yield losses- with some farms reporting zero losses on papaya crop. The pest has also not spread beyond the coast region where it was first observed.

Introduction

The papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae) is a new destructive and invasive mealybug infesting papaw, cassava, mangoes. It was identified in Mombasa County in May 2016 and has since then rapidly spread to other counties in the coastal region including Kwale and Kilifi. The pest cause severe damage on papaw where seriously affected plant is severely defoliated and eventually dies. Papaya mealybug is a polyphagous pest that damages many tropical crops in different families including economically important tropical fruits and ornamentals. The papaya mealybug, *P. marginatus*, is a native of Central America and spread to the Caribbean region and South America in the 1990s. Since then, this pest has accidentally been introduced to some islands in the Pacific region and some countries in Africa and Asia. The pest was first observed on the African continent in Ghana in 2010 from where it spread to Benin, Nigeria, Togo, and Gabon. It was discovered in Tanzania in April 2015 around Dar es Salaam and Zanzibar, and in May 2016, the pest was observed in Mombasa causing severe damage and death of papaw plants. Since then the pest has spread to other counties in the coast region. Plant infested by papaya mealybug shows chlorosis, plant stunting, leaf deformation, early leaf and fruit drop, a heavy build-up of honeydew, and death. Heavy infestations are capable of rendering fruit inedible due to the build-up of thick white wax and infected part is hard and bitter. The papaya mealybug appear as white fluffy spots on the undersides of leaves, branches, and fruit, often accompanied by an unsightly black, sticky substance coating these surfaces. The affected fruits are misshapen, discoloured, and shrivelled fruits. The mealybugs are dispersed in short distances by walking, and by wind and animals over longer distance. The main means of dispersal overlong distance is transportation of infested fresh plant material. Several control measures have been developed elsewhere in the world for papaya mealybug which included chemical control, white mineral oils, and biological control.

Objective

- To determine the occurrence and distribution of papaya mealybug.
- To establish the host range of papaya mealybug.
- To establish feasible management practices for control of papaya mealybug.

Methods

Papaya mealybug surveillance was carried out on three paw paw production counties in coast region, namely Kwale, and Mombasa Counties. A questionnaire was administered during the survey where information on farmers detail, location of farm (GPS readings), altitude, scouting for mealybug, samples collected, stage of production, symptom of the disease, pest management practices, and alternative hosts of papaya mealybug and number of trees on the farm was recorded. Forty seven farms were visited.



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Infested cassava underside of leaf



Infested brinjal



Infested mango fruit



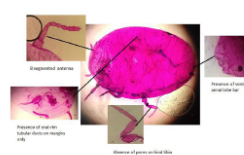
Infested papaw plant



Papaw orchard succumbs to pest



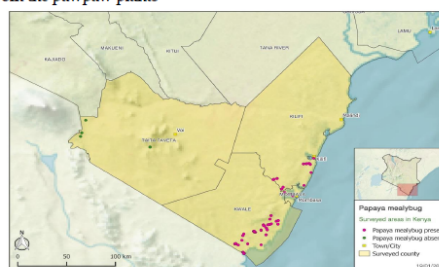
Infested jatropha



Identification of PMB

Findings

- Papaya mealybug had spread from initial detection area in Mombasa to two other counties namely: Kwale and Kilifi
- Papaya mealybug was found infesting on papaw, cassava, brinjals, mangoes, chilli, eggplant
- Papaw and cassava were severely infested and affected by the mealybug
- Different pesticides used by farmers proved ineffective against the invasive pest
- Some farmers were successful in the management of papaya mealybug via high water pressure technology that washed the pest from the papaw plants



County	No. of Farms	No. of samples collected from the farm	No. of farms managing the pest	Mean acreage (ha) per farm per county	Mean Percentage of infested plants per farm per county	Mean Percentage of yield loss per farm per county
Kwale	46	6	0	2.5	100%	92.5%
Kilifi	14	2	1	15	100%	72.5%
Mombasa	3	4	1	0.5		100%
Taita Taveta	6	0	0	2.0	0%	0%
Total	69	55	6			

Table of infestation level and yield loss

Conclusion

- Papaya mealybug was reported in Kenya in Mombasa county and has since spread to several counties in the country.
- Papaya mealybug has serious affected papaya production in the coastal with most other large produced of papaya recording 100% yield loss.
- The pest is affected by rains as there was reduced damage after the rain.
- The pest attack all stages of the papaw plants as was found to be capable of attacking a variety of plant species including cassava, mango, guava, brinjals etc

Way forward

- There need for further studies to establish the occurrence natural enemies for the control of papaya mealybug;
- There is need to establish effective pesticides against the papaya mealybug;
- There is also need to restrict the mealybug to coast as eradication measures are sought.

