Are begomoviruses a threat to sweetpotato production in Sub-Saharan Africa?

- Begomoviruses have progressively been reported to be infecting sweetpotatoes throughout the world.
- Despite showing few symptoms, limited studies have reported them to have a varying but significant impact on root quality and yield.
- A cultivar with moderate resistance to Sweet potato feathery mottle virus (SPFMV) and/or Sweet potato chlorotic stunt virus (SPCSV) had a yield reduction of 47% from of single infection of a begomovirus, in contrast to a SPVD susceptible cultivar, which was hardly affected by it.

SASHA Sweetpotato Action for Security and Health in Africa

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Fig 1. Symptom expression due to single infection on variety 'Ejumula' by Sweet potato leaf curl virus (SPLCV) showing rugosity (Credit: B. Wanjala)

What was the problem?

Virus infections cause significant sweetpotato yield loses of in Sub-Saharan Africa (SSA). Currently, more than 30 viruses are known to infect sweetpotato and more are being discovered with the improvement in diagnostic methods. *Sweet potato chlorotic stunt virus (SPCSV) - a crinivirus and Sweet potato feathery mottle virus (SPFMV) – a poty virus*, have been considered the most widespread and devastating among all the viruses affecting the crop. Sweetpotato virus disease (SPVD) occurs when SPFMV and SPCSV occur in combination and has been reported widely in SSA, causing up to 90% yield loss. However, another group of viruses, the begomoviruses, are increasingly being recognized as commonly causing yield loss of up to 30%. The impact of single and mixed virus infections on the yield and quality of sweetpotato varieties have not been established in Kenya. Begomoviruses cause no or show mild symptoms (Fig. 1 & 2) and additional storage root yield data are needed to establish whether they cause appreciable yield loss. Understanding interactions of begomoviruses with SPVD viruses and their effect on root yield will aid in developing management strategies.

What objectives did we set?

To evaluate the effect of Kenyan isolates of begomovirus *Sweet potato leaf curl virus* (SPLCV), SPFMV, and SPCSV alone, and co-infections on sweetpotato root yield of two varieties with contrasting resistance to SPVD.

Where did we work?

Surveys to collect data and samples for begomovirus detection and Sanger sequencing[1] were conducted in five distinct sweetpotato growing regions of Kenya (Western, Nyanza, Central, Coast, and Eastern). Different sole and

Fig 2. Symptom expression due to single infection on variety 'Kakamega' by *Sweet potato leaf curl virus* (SPLCV) showing rugosity and vein thickening (Credit: B. Wanjala)

combination of virus infections were used as treatments: i.e. SPLCV, SPFMV, and SPCSV, alone and in possible dual combinations, which were graft inoculated in green houses at Kenya Plant Health Inspection Service-Plant Quarantine and Biosecurity Services (KEPHIS-PQS). Yield trials of the graft inoculated plants with SPLCV, SPFMV and SPCSV alone and in possible dual or triple combinations were conducted at KALRO Kiboko for two seasons to evaluate the impact on yield.

What did we achieve during SASHA Phase 2?

Begomoviruses occur in all sweetpotato growing regions in Kenya (Western, Nyanza, Eastern, Central and Coast). Results showed marked differences in the effect of SPLCV

[1] **Sanger sequencing** is a method of DNA sequencing based on selective incorporation of chain-terminating dideoxynucleotides by DNA polymerase during *in vitro* DNA replication.

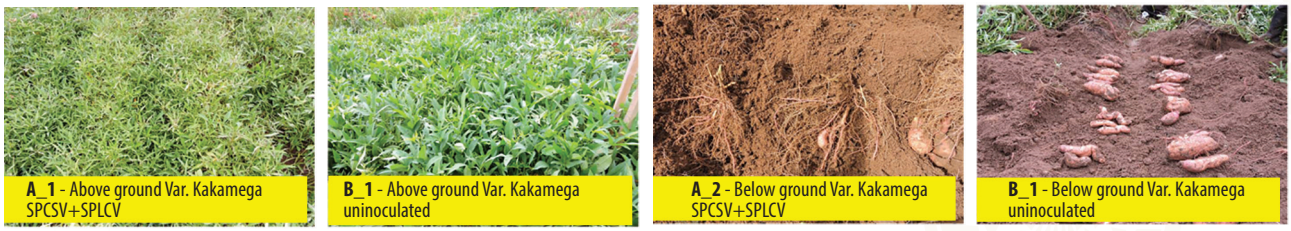

Fig 3. Effect of SPLCV+SPCSV on root formation for variety Kakamega; A_1 – vigorous above ground cover and A_2 – fibrous root formation and B_1 and B_2 – vigorous ground cover and B_2 – good root formation

infection on the two varieties despite only mild symptoms occurring in both varieties: 'Ejumula', which is susceptible to SPFMV and SPCSV, suffered no significant yield loss from SPLCV infection, whereas 'Kakamega', which is more resistant to SPFMV and SPCSV, suffered an average of 47% yield loss (Fig. 3 & 4).

Where there any key challenges or lessons learned?

- Results highlighted the variability in sensitivity to SPLCV between sweetpotato cultivars as well as a lack of correlation of SPLCV related symptoms with the impact on yield from the virus.
- The lack of correlation between resistance to the RNA viruses SPCSV and SPFMV and the DNA virus SPLCV.
- Resistance to SPVD and SPLCV (and likely other sweepoviruses) are not necessarily linked.
- Yield losses and symptoms caused by co-infections of SPLCV with SPFMV, SPCSV or both viruses were not significantly different, suggesting a lack of synergistic and limited additive effect of the different groups of viruses on yield losses

What's next?

- Begomoviruses can be symptomless in the field and we recommend testing using molecular tools in breeding and seed systems to confirm their presence.
- Further research is required to understand whether different virus isolates/species differ in their impact on sweetpotato root yield and if this is correlated to any particular characteristics other than symptoms.
- Explore whether the resistance of sweetpotato varieties to one isolate correlates with resistance to other isolates.
- Evaluate the extent of sweepovirus infections as well as the virus variability in farmers' fields in Kenya and other sweetpotato producing countries in Africa, and then conduct a risk assessment to assess potential economic losses and develop appropriate management strategies.

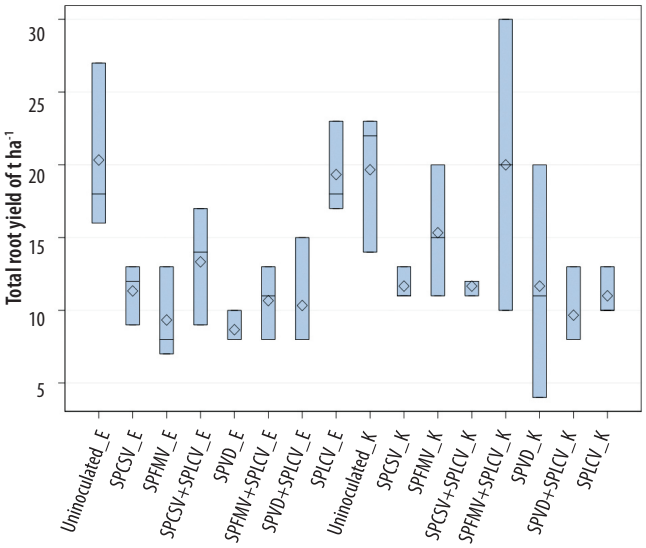

Fig 4. Box-plot root yield in tons per hectare for treatments inoculated with different viruses. All the treatments for Ejumula are abbreviated **E** and **K** for Kakamega

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