Sweetpotato Cultivar Degeneration Under High and Low Sweetpotato Virus Disease Pressure Zones in Uganda

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Background

- Sweetpotato is vegetatively propagated, using vine tip cuttings from previous crop or volunteer plants
- Such practice may lead to systemic pathogen accumulation, thus cultivar degeneration
- Viruses are reported to contribute to cultivar decline in China, USA and SSA
- In Uganda, elite cultivars have been abandoned - whether this is due to virus is not known
- The study seeks to understand how cultivars decline so as to design appropriate seed systems in order to boost production

Materials and Methods

Source of planting materials

- Symptomless cuttings of sweetpotato Cvs. Dimbuka, NASPOT 1 and Ejumula, were grafted on indicator plant *I. setosa* and monitored for virus symptoms

•Symptomless scion were tested using NCM ELISA.

- Healthy scion were multiplied in pots under screen house and a portion initiated in vitro

Asymptomatic maintained

Symptomatic plant discarded

Multiplication of planting materials in screen house

In vitro multiplication of planting materials

Field trials

- Experimental sites: MUARIK and NaSARRI
- 4 Cultivars: Dimbuka, Ejumula, NASPOT1 and Beauregard were grown for 5 seasons (generations-G)
- 3 reps, 10 mound/variety in area of 1m x 10m and 30 cm high.
- 3 vines/mound, vines 30 cm long

Trials	Generation planted	Planting seasons	
		Kabanyolo	Serere
1	G1	2011A	2011A
2	G1,G2	2011B	2012A
3	G1,G2,G3	2012A	2012B
4	G1,G3,G4	2012B	2013A
5	G1,G4,G5	2013A	

Data collection and analysis

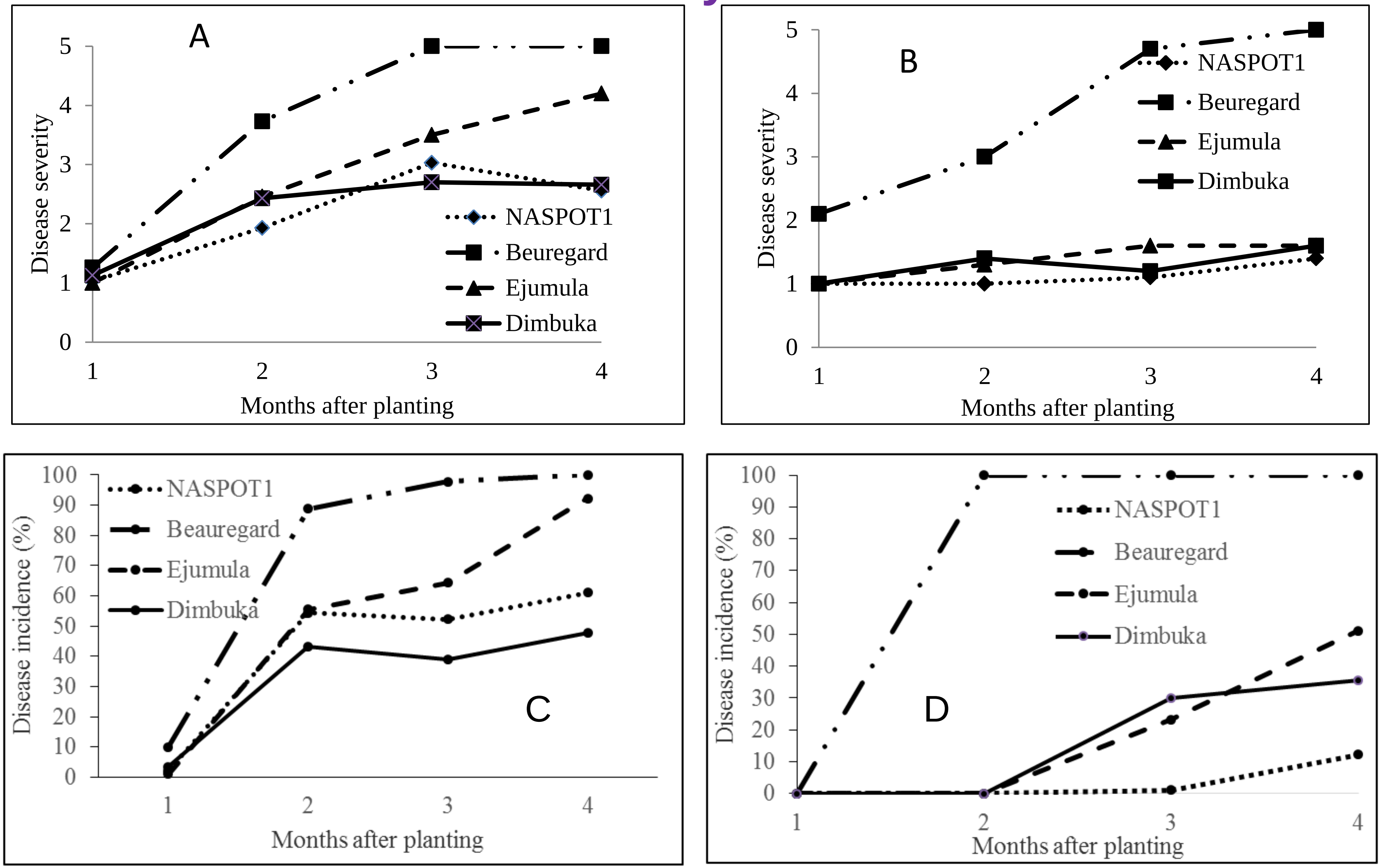
- Virus incidence and severity were monitored monthly for four mouths
- Leaf samples were collected in fifth month before harvesting for NCM ELISA
- At harvest, total root yield marketable root yield and total number of storage root and marketable storage root number were collected
- The data was subjected to ANOVA and the means separated using Fisher's protected least significant difference at 5% probability level

Leaf purpling in Ejumula as one of virus symptoms

Dimbuka expressing SPVD symptoms

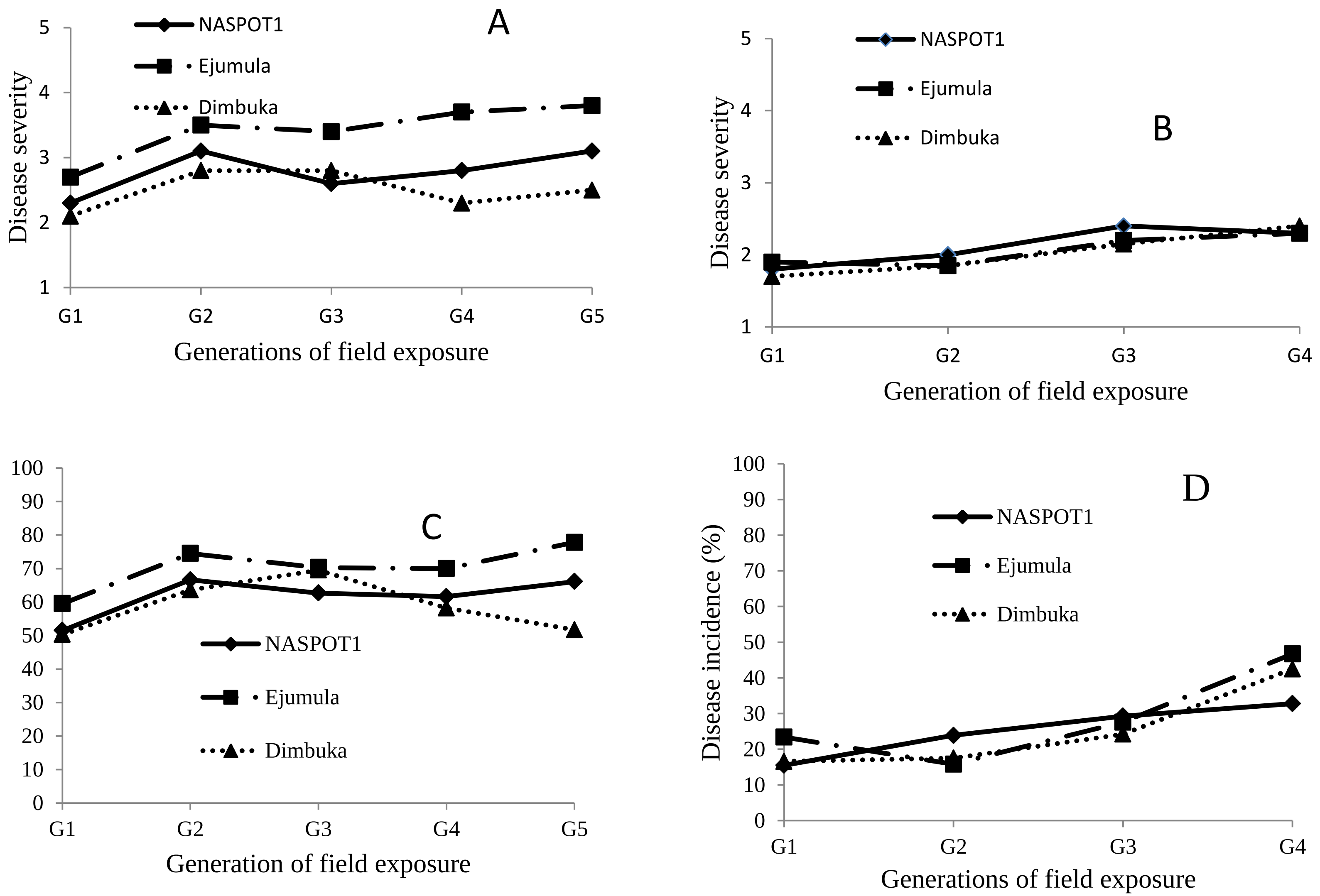
Root yield

Results: Rate of viral infection among sweetpotato cultivars under field conditions at Kabanyolo and Serere



A= disease severity at Kabanyolo, B= disease severity at Serere, C disease incidence at Kabanyolo, D= disease incidence at Serere

Rate of viral infection among different generations sweetpotato cultivars under two agro-ecologies



A = Disease severity among generations at MUARIK, B= Disease severity among generations at NaSARRI, C = Disease incidence among generations at MUARIK and D = Disease incidence among generations at Serere

Major viruses that infect sweetpotato grown in field condition

- Out of 328 samples from MUARIK, 13.4% tested for SPFMV ; 17.7% for SPCSV and 49.7% for both

- Out of 268 samples from NaSARRI, 12% tested positive for SPFMV, 28% positive for SPCSV and 25% for both.

- Few samples mildly reacted positive for SPLV, SPMSV, C6 ,SPCMV and SPCaLV and were found in combination with SPFMV and SPCSV

Effects of natural virus infection on root yield of sweetpotato

In the field trials at MUARIK and NaSARRI, differences ($P \leq 0.05$) were detected in yield and number of storage root for all the cultivars, and generations.

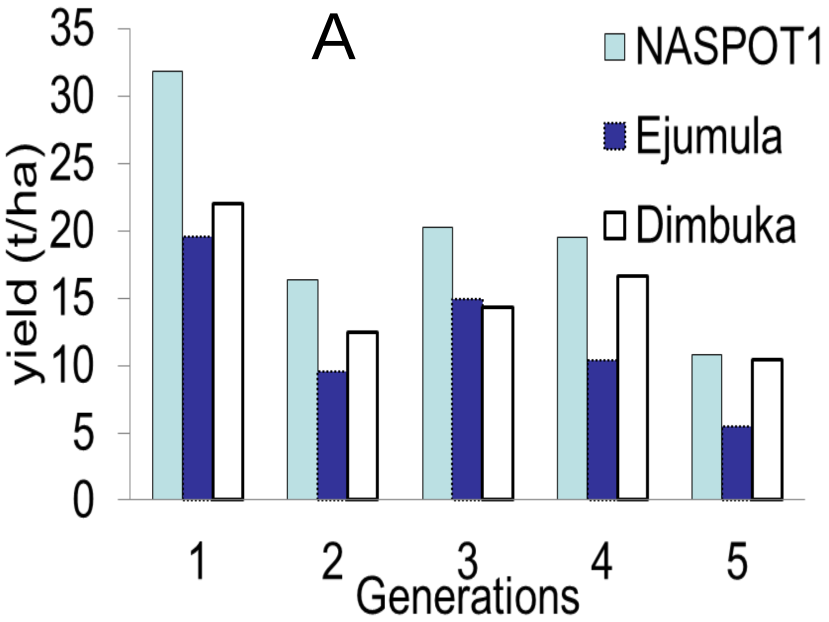
Beauregard degenerated within the 1st field trial in both location and was dropped out of the experiment.

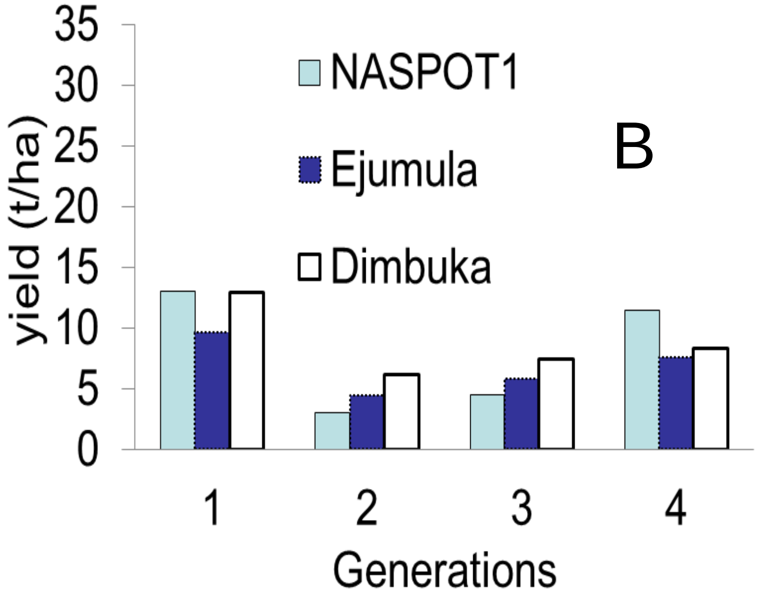
NASPOT1 had the greatest yield and number of roots followed by Dimbuka and least in ejumula.

Among the generations, G1 had greater yield than the subsequent generations. Ejumula, Dimbuka and Naspot1 had a sharp yield decline during G2 in both locations.

In G3 and G4 there was slight increase in yield for Dimbuka and NASPOT1 while Ejumula continued to decline at Kabanyolo but relatively stable at Serere

Yield performance of generations of sweetpotato cultivars in two agro-ecologies





Discussion

- High virus incidence in G2, G3 and G4 could be that the planting materials used were already infected with the virus despite the lack of symptom at the time the cuttings were taken for planting.

- Yield decline observed among sweetpotato generations could be a result from synergistic interactions of different viruses.

- Accumulation and perpetuation of single virus infection in planting material cannot be ruled out in its contribution to cultivar decline.

Conclusions and recommendations

- Virus indexed material once exposed to the field will quickly be infected with virus and susceptible varieties like Beauregard and Ejumula degenerate within one season of field exposure. Therefore need for constant supply of clean planting material

- Farmers should be encouraged to start with clean planting material of resistant varieties like Naspot and Dimbuka and should be grown away from existing sweetpotato field.

Contribution of SPFMV and SPCSV to sweetpotato cultivar decline in Uganda

- SPFMV and SPCSV are most prevalent virus in Uganda out of the six viruses so far reported and their co-infection leads to severe disease symptoms called SPVD and over 90% yield loss
- SPVD are easily recognizable by farmers and may be removed or at least not selected as planting material for the next crop.
- The impact of individual and combinations of mild viruses, which are usually symptomless, has not been well studied.
- some cultivars when singly infected with either SPFMV or SPCSV alone do not show symptom and farmers cannot select for purely virus free vines hence their continued use.
- In addition, no field study has so far been done in Uganda to determine the magnitude of single virus infection on yield of sweetpotatoes.
- Yet some elite cultivars have been abandon due to poor yield even in areas with low SPVD

Objectives

This study was design to determine:

1) effects of SPFMV and SPCSV on the yield of sweetpotato cultivars under two agro-ecologies

II) Recovery of sweetpotato cultivars from SPFMV in two agro ecologies

Generation and Multiplication of planting materials infected with viruses

30 cm length virus indexed sweetpotato cuttings of cultivars, dimbuka, ejumula, kabode, naspot1 and beauregard were planted in 15 pots each and grown for 2 weeks in a screen house at muarik.

Five plants per cultivar were graft inoculated with spfmv alone, spcsv alone or both spfmv+ spcsv.

One month after grafting, plants were tested using TAS ELISA (for SPCSV) or grafted on I.setosa and tested using DAS ELISA (for SPFMV).

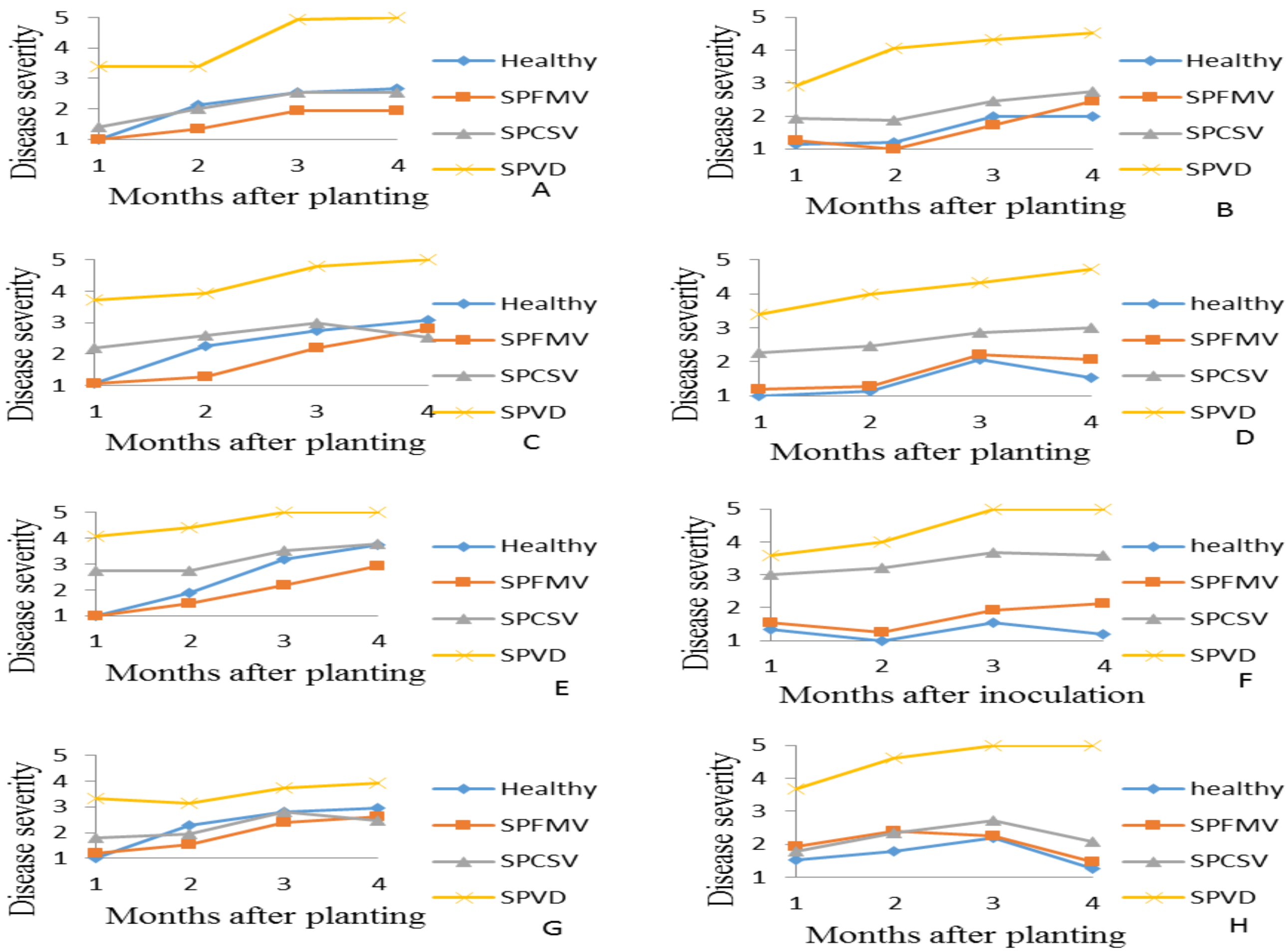
Infected plants were multiplied through 2 node repeated cuttings.

Field trials

Seasons	treatments	Cultivars tested
2012A	SPFMV Vs Healthy	Kabode, Naspot, Ejumula, Dimbuka and beauregard
2012B	SPFMV from screen house, SPFMV from the field in 2012A and healthy control	Kabode, Naspot, Ejumula, Dimbuka
2013A	SPFMV, SPCSV, SPFMV+SPCSV and healthy control	Kabode, Naspot, Ejumula, Dimbuka
2013B	SPFMV, SPCSV, SPFMV+SPCSV and healthy control	Kabode, Naspot, Ejumula, Dimbuka

- The trials were set up in split plot randomised complete block design
- Each treatment was planted in five mounds per plot each mound at spacing of 1mX1m
- Each plot was surrounded by mounds of New kawogo
- Data were collected on disease severity, total root yield marketable root yield and total number of storage root and marketable storage root number

Results: Disease progress among sweet potato cultivars due to SPFMV, SPCSV and their co-infection under field condition in two agro ecologies



A & B= Kabode at MUARIK & NaSARRI, C & D= Naspot 1 at MUARIK & NASARI, E & F= ejumula at MUARIK & NaSARRI, G & H = Dimbuka at MUARIK & NaSARRI

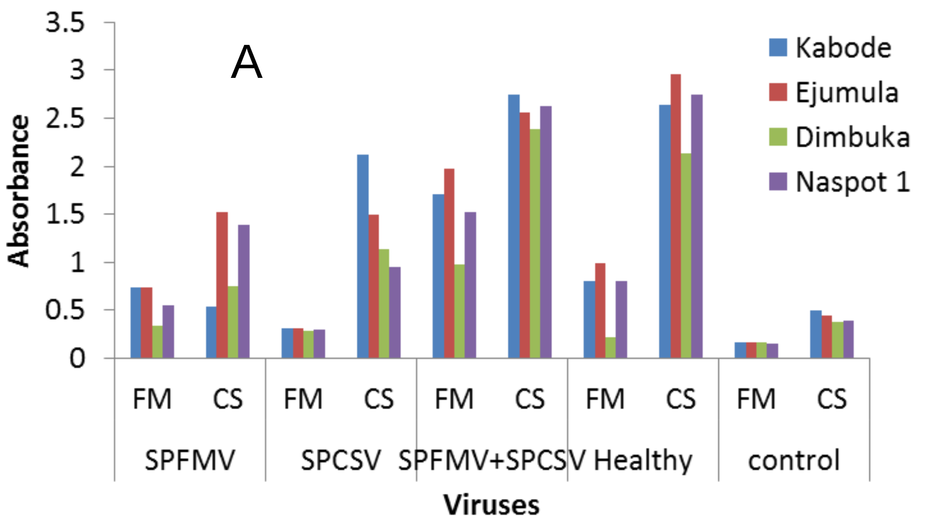
The disease severities plotted are the means of disease severity in the 2013A and 2013B field trial

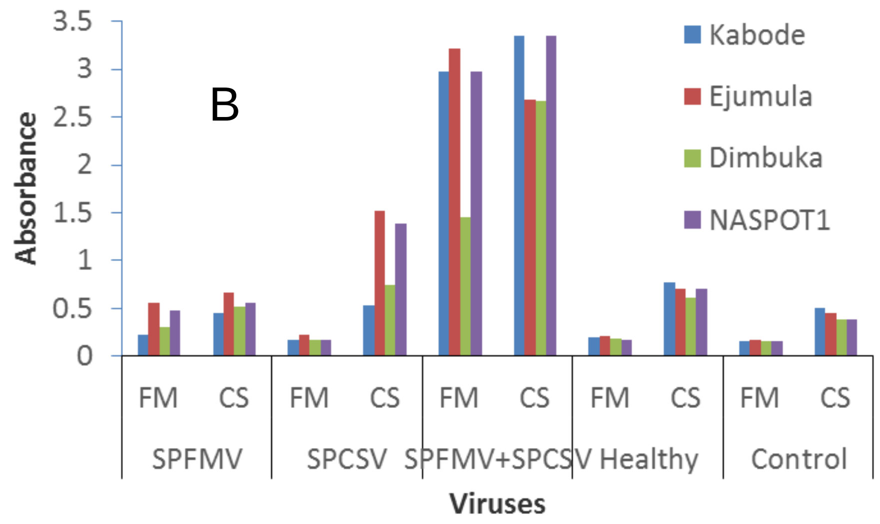
Recovery of Sweetpotato cultivars from SPFMV and reinfection by other viruses

cultivar	Virus tatus	Saluation	Number of plant samples	Positive samples at Kabanyolo		Positive samples at serere	
				SPFMV	SPCSV	SPFMV	SPCSV
NASPOT 1	H		30	46.7	93.3	0	20
	FMs		30	33.3	60	20	6.6
	FMf		15	60	80	0	26.7
Dimbuka	H		30	13.3	93.3	0	3.3
	FMs		30	20	40	26.7	0
	FMf		15	66.7	86.7	6	6.7
Ejumula	H		30	86.7	100	0	13.3
	FMs		30	46.7	80	53.3	20
	FMf		15	100	100	13.3	26.7
Kabode	H		30	40	100	0	16.7
	FMs		30	26.7	86.7	6	10
	FMf		15	26.7	100	0	0
Beauregard	H		15	100	100	100	100
	FMs		15	100	100	100	100

H= healthy control, FMs= cutting inoculated with SPFMV and obtained from screenhouse; FMf= cutting inoculated with SPFMV and obtained from field in the 2012A

Accumulation of SPFMV and SPCSV in different sweetpotato cultivars grown in two agroecologies

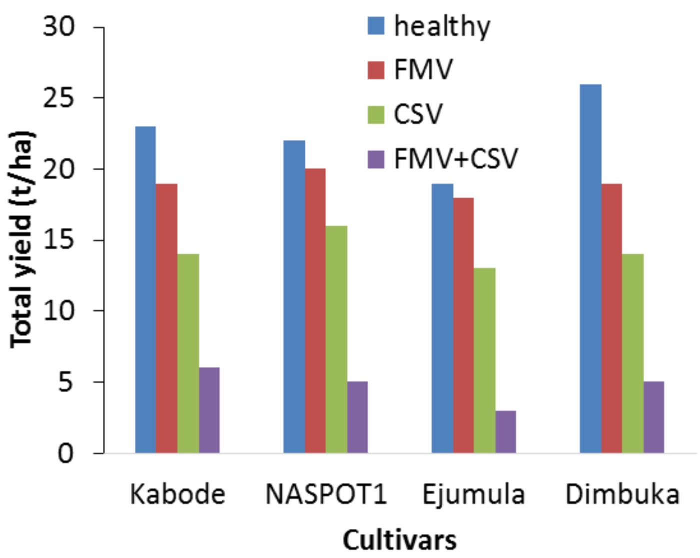


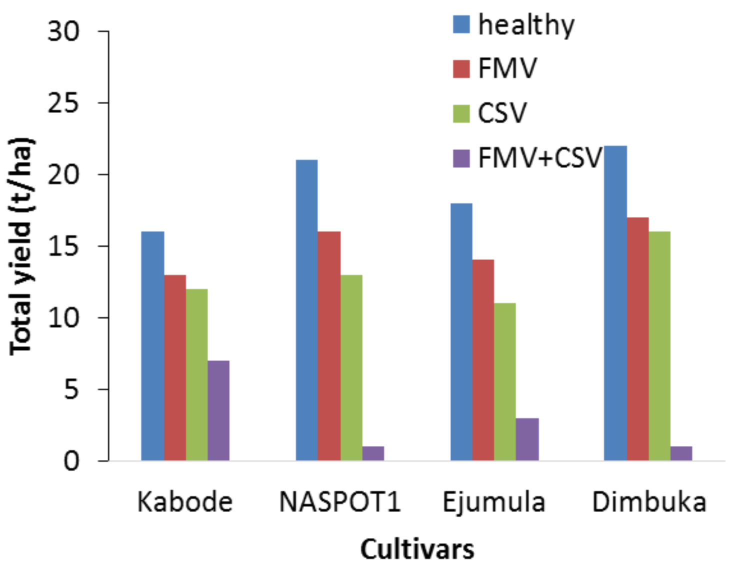


A= accumulation of viruses at MUARIK, B= Accumulation of viruses at NaSARRI

Effects of SPFMV, SPCSV and combination of SPFMV + SPCSV on the yield of sweetpotato cultivars under two agro-ecologies

- Virus indexed material had more yield than the virus infected ones but did not differ from the SPFMV infected ones
- SPCSV significantly reduced the yield of all sweetpotato cultivars in both location
- SPFMV+ SPCSV also significantly reduced the yield of all cultivars in both location





Conclusions

- This study has demonstrated that single virus infection or co-infection are indeed responsible for sweetpotato decline which varies with agro-ecologies in Uganda.
- SPFMV though does not affect the yield in MUARIK, it posed greater risk of SPVD due to high rate of spread of SPCSV in the region
- Recovery from SPFMV was greater at NaSARRI than MUARIK
- SPCSV alone is a serious threat to sweetpotato production in the central region and other regions where the whitefly population is high but also in low disease pressure areas through vegetative propagation of infected plants.

Acknowledgement