Sweetpotato cultivar degeneration under high and low sweetpotato virus disease pressure zones in Uganda

By

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Back ground

- Sweetpotato is the 3rd most important root crop in the world
- Uganda is the 3rd world and 2nd Africa producer of sweetpotato
- Various uses: food security, income, animal feed
- Requires few inputs and performs well in marginal soil

Food

Processed to biscuits

Source of income

Animal feed

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 South Africa
- In Uganda, elite cultivars have been abandoned - whether this is due to virus is not clear
- 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 Enjumula, 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

•Cultivars Dimbuka, Ejumula, NASPOT1 and Beauregard were grown for four season

•1st field trial only virus tested free sweetpotato cultivars (generation 1, G1)

•2nd field trial consisted of G1 + G2

•3rd field trial consisted of G1+G2+G3

•4th field trial consisted of G1+G3+G4

• All the experiment were laid in CRBD with three plots

• Generation of each cultivar was replicated in 10 mounds each in area of 1 m^2 and 30 cm high.

•Each mound was planted with 3 vines of about 30 cm long

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

Marketable roots

Non Marketable roots

Viral infection of sweetpotato roots under natural field condition

- Roots (30) of each cultivars from each location were randomly selected after harvesting the first season trial

- Roots were planted in plastic pots in screen house at MUARIK.

- The number of roots that sprouted and the number that showed virus symptoms were recorded.

- Symptomless sprouts were grafted on *I. setosa* to confirm whether they are virus free.

- This experiment was repeated with samples from the third season trial. 40 roots of each cultivars were obtained from symptomless sweetpotato mound prior to harvesting.

- Roots were planted and monitored for virus symptoms as already described. Symptomless sprouts were also grafted to *I. setosa*.

Results: Virus incidence and severity under natural field infection at MUARIK and NaSARRI experimental trials

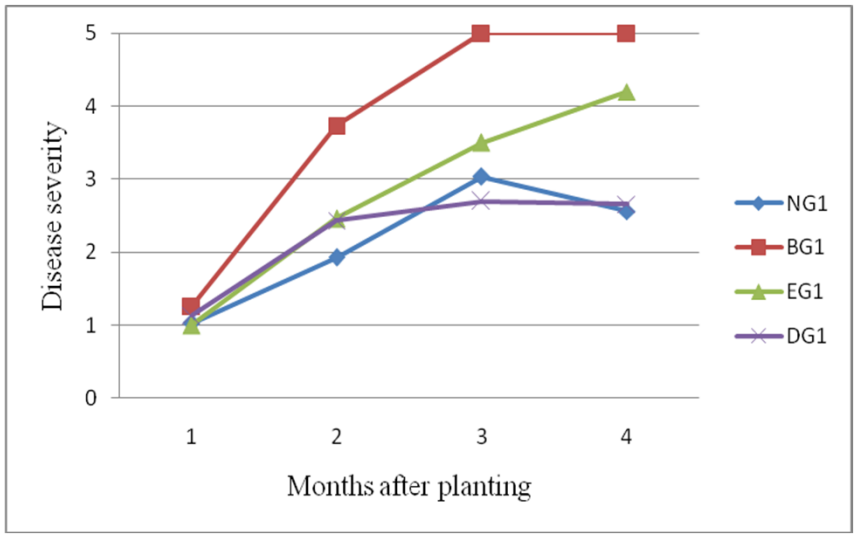
- In all field trials, incidence and severity increases over time and they were significantly different ($P<0.05$) among cultivars and generations

- MUARIK had higher virus incidence than NaSARRI

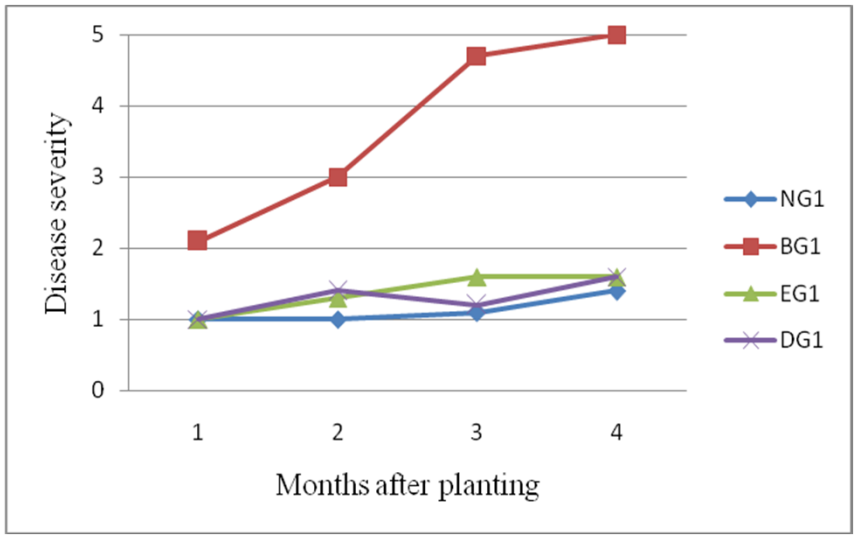
- G1 plants had lowest virus incidence compared to G2 ,G3 and G4 plants within one month after planting

- At MUARIK trials, Cvs. Beauregard and Ejumula were more susceptible to virus infection

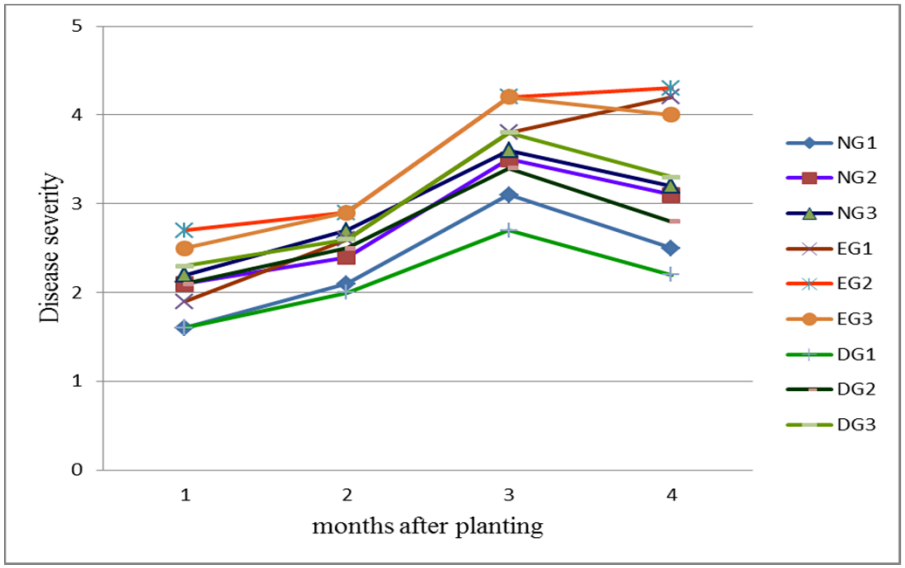
Disease progress curve following natural infection of healthy sweetpotato cultivars planted at MUARIK and NaSARRI respectively during the 1st, 2nd, 3rd and 4th field trials



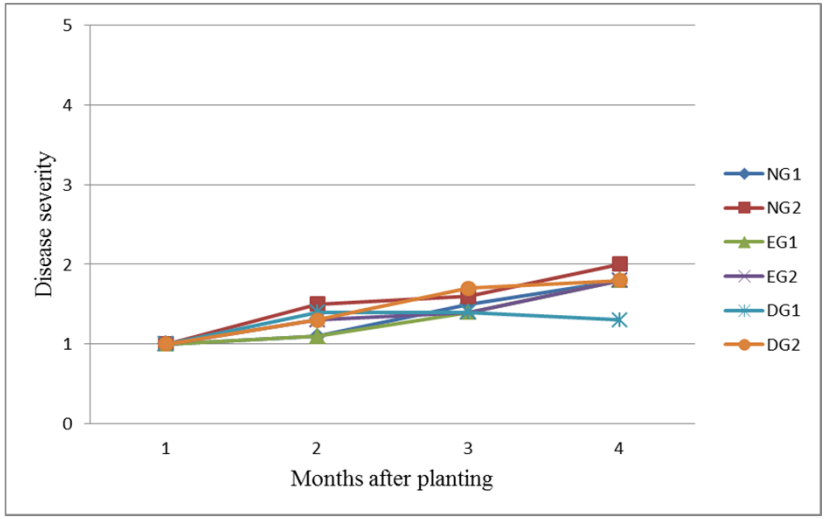
Trial 1 kabs



Trial 1 serere

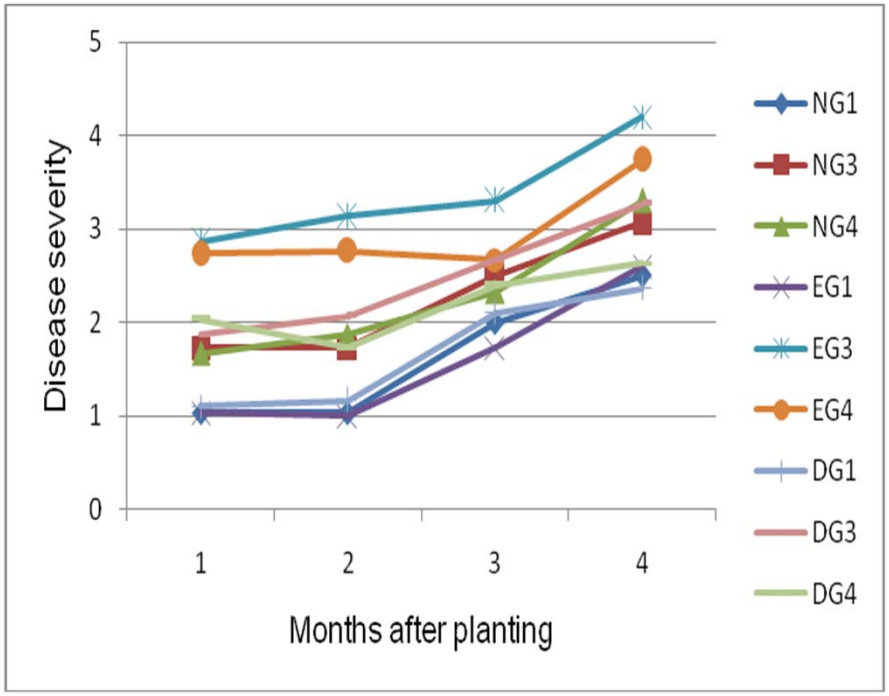


Trial 3 kabs

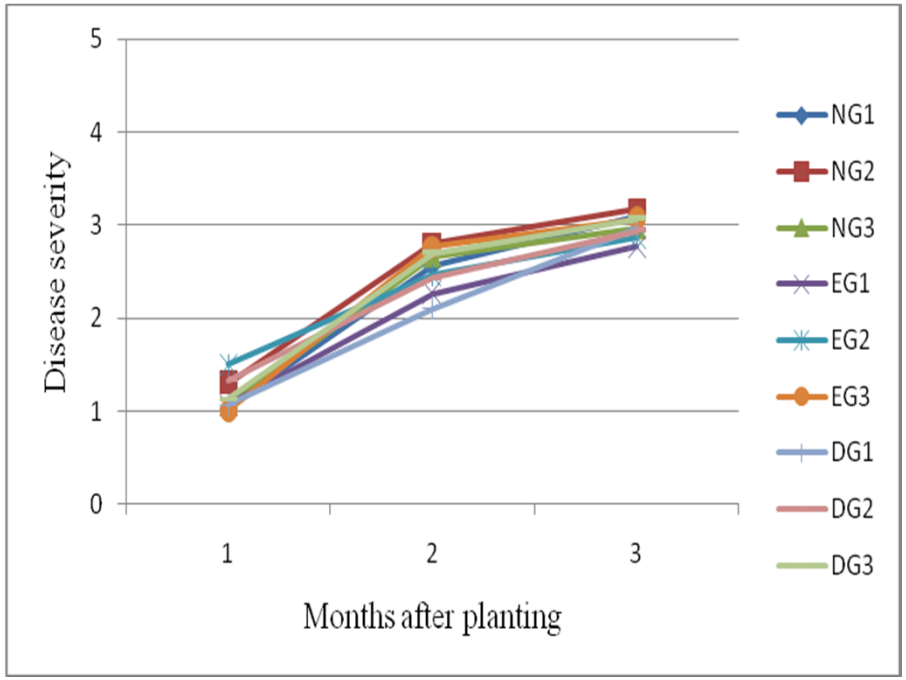


Trial 2 serere

Disease progress curve following natural infection of healthy sweetpotato cultivars planted at MUARIK and NaSARRI respectively during the 1st 2nd, 3th and 4rd field trials



Trial 4 kabs



Trial 3 serere

N = NASPOT 1, E = Ejumula and D = Dimbuka, G = Generations, 1, 2, 3 number of times of field production

Viral infection of sweetpotato roots

•For randomly selected roots, 100% sprouts except Dimbuka from MUARIK developed virus symptoms

• Root sprouts from symptomless mounds of Cv. Naspot1 and Dimbuka from MUARIK were symptomless while Ejumula, all developed virus symptom

• Root sprout from NaSARRI did not show symptom except when grafted on I.setosa and all Beauregard showed symptom

•NASPOT 1 developed leaves morphologically different from the wild type

Root sprout showing virus symptom

NASPOT1 root sprouts different from the wild type

Serological detection of sweetpotato virus

- Samples from G1 had lower virus detected compared to G2 , G3 and G4

- 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 positve 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 all the four field trials, there was significant yield difference ($P<0.05$) among cultivars both at MUARIK and NaSARRI

- Significant differences ($P \leq 0.05$) were also detected among generations in the 3rd and 4th field trial but not in 2nd trial.

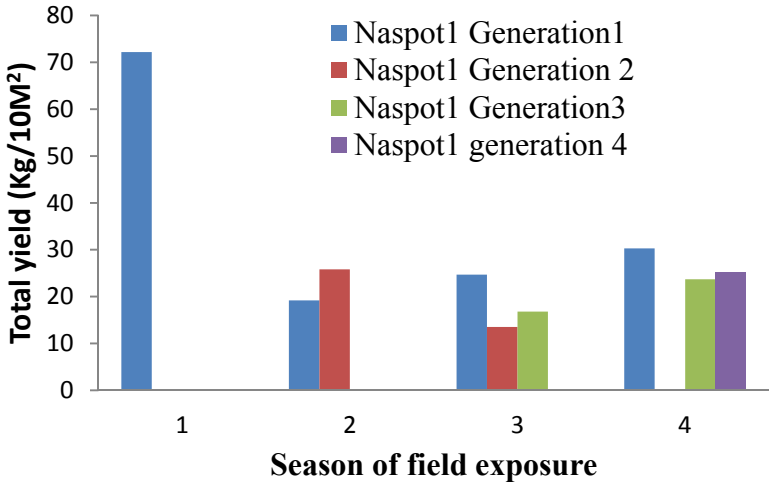
- The total yield, Marktable yield, total number of storage root and marketable number of storage root for G1 plant was higher across cultivars in both locations except for NASPOT1 2nd trial at MUARIK

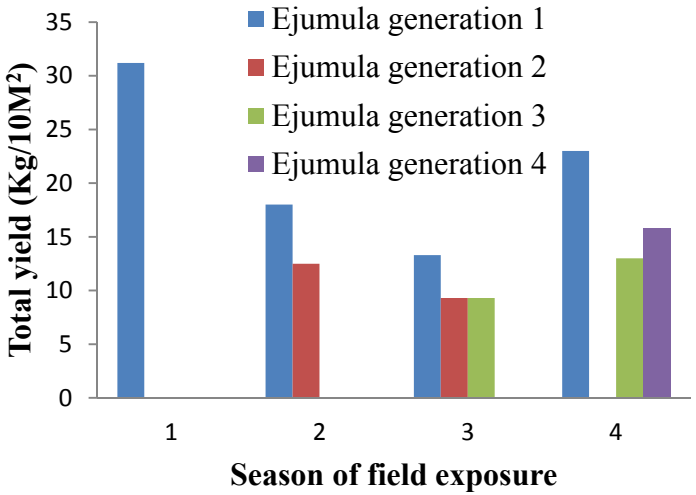
- NASPOT1 had the highest yield while Beauregard had the least in both locations.

- No marketable yield for cultivar Beauregard was recorded at NaSARRI trial.

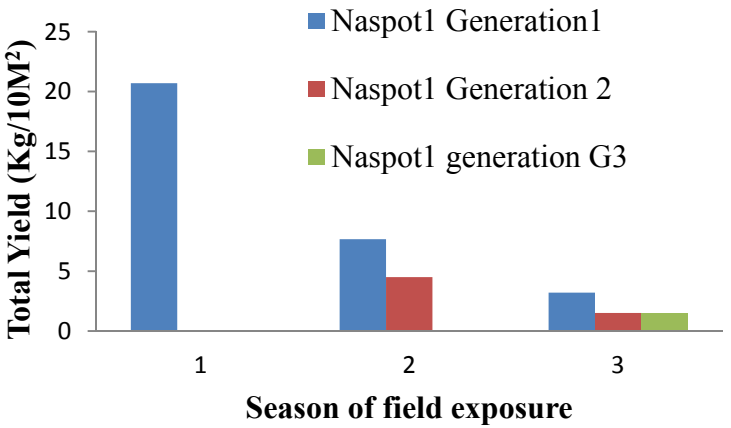
Total yield of sweetpotato cultivars under diferent cycles of field exposure both at MUARIK and NaSARRI

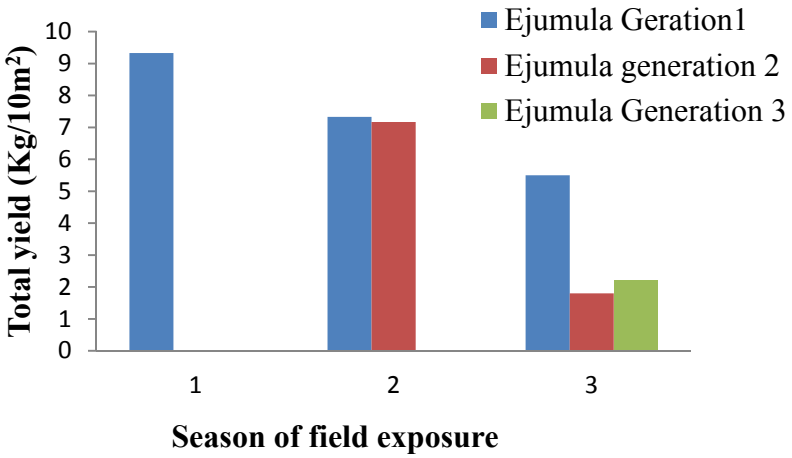
MUARIK





NaSARRI





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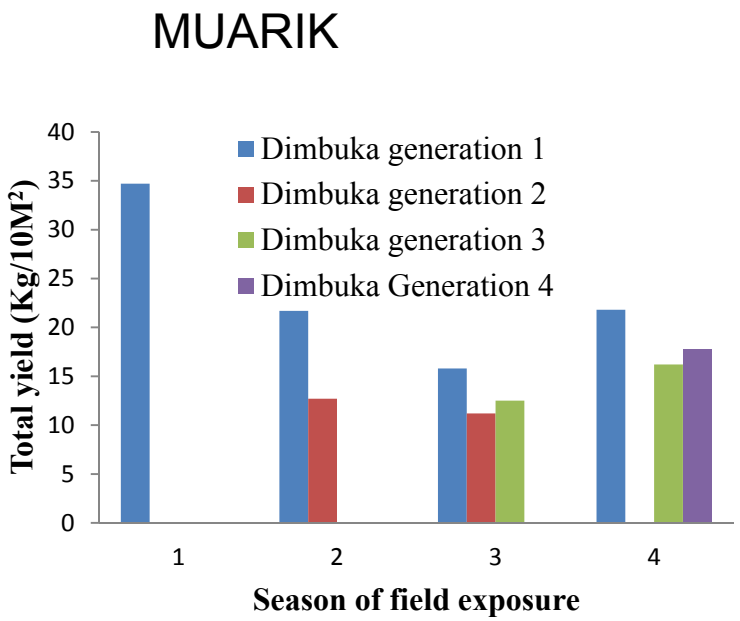

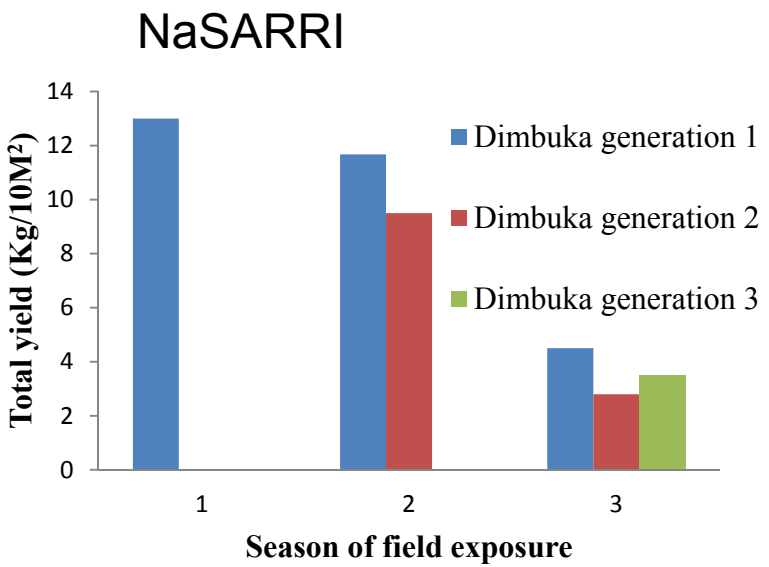

Discussion

- High virus incidence in G2, G3 and G4 one month after planting 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.
- The varied appearance of root sprout from the wild type could probably be due to mutation hence need to determine mutation rate in sweetpotato roots.

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.

• Healthy planting material grown in isolation produce high yield than that grown together with already field exposed material. Farmers should therefore plant their healthy seed in sweetpotato free field

•Roots are good sink for viruses in areas with high SPVD incidence (MUARIK). Use of roots as source of planting material is suitable in NaSARRI and it should be obtained from symptomless plants prior to harvesting.

Acknowledgement