# Sweetpotato Seed Production in a Low Virus Pressure Rice Scheme: Win-win Through Rotation

Gerald Kyalo, Jimmy Lamo, Simon Zziwa, Srinivasulu Rajendran, Simon Alibu, Moses Ekobu, Sam Namanda, Jan Low, Margaret McEwan, Robert O.M. Mwanga

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# Background

- Sweetpotato is an important crop in Uganda
- Northern Uganda produces about 16% of the national sweetpotato output

# Background

After a long dry season, farmers in N. Uganda normally experience a shortage of SP planting materials, and are forced to pay for them.

# Background

Rice is a new crop in Uganda, but quickly becoming important

In 2008/09, N. Uganda produced 23% of total rice in Uganda

# Rice Production: Farming systems

Irrigated

Rainfed Lowland

Upland

# Background

- In N. Uganda, rice is grown mainly in the first season, and the land left to naturally fallow until the next planting.

- The fallow period means that hardpans develop making land preparation for the next rice planting tedious and costly.

- Volunteer rice plants during the fallow period can be a source of  seed contaminants, pests and disease for the next rice crop

# Background

- In Vietnam, a rotation of rice with sweetpotato significantly improved rice yield and increased nitrogen fertilizer-use efficiency of rice (NUE following sweet potato (29%) Vs NUE following rice (19%).
- Profit from Sweetpotato-rice rotation (US $ 612) was only second to rice-soybean- rice (US$644) but higher than all other rotations.
- A rice-sweetpotato rotation system is therefore worth exploring for rice growing systems in Uganda.

*NUE - Yield per unit input of fertilizer- a measure of how well plants use applied fertilizers or inputs*

# Background

- Continuous monocropping of sweetpotato results in yield declining – due to;
  - Declining soil fertility
  - Nematode and weevil population buildup (Hartemink, 2000).
- In Orrisa, India, sweetpotato is rotated with upland rice to regain soil fertility and suppress weeds and weevil (Nedunchezhiyan *et al*, 2006).

# Background

- In 2013 and 2014, NARO released new high yielding upland & lowland rice varieties.
- The new varieties are high yielding, taste better and withstand diseases better than local varieties.

- However, seed of the new varieties limited. It takes years for seed of new varieties to reach farmers in remote areas – like Agoro

# Seed production initiatives in Uganda

SASHA
Sweetpotato Action for Security and Health in Africa

**LOCAL COMMUNITY**

- ✓ Land
- ✓ Labour

**VINAYAK**

- ✓ Over $ 3m in capital investments
- ✓ 50 Out growers

**NARO/AfricaRice**

- ✓ High-yielding/climate resilient varieties ARICA-5, NERICA-4 & NamChe-3)


# Objective of  Project

Assess technical, economic and social viability of rice-SP rotation system for production of SP vines and rice seed

# Research Questions

What is the effect of SP–rice rotation on yield?

- Rice paddy
- SP root
- SP vine

What is the effect of SP–rice rotation on pest and disease prevalence.

What is the cost-benefit of the two farming options (SP–rice rotation & rice-rice/SP-SP continuous cropping).

# Methodology

**Design:** Randomised Complete Block Design (RCBD) with four replicates.

**Plots:** Measuring 6m x 5m, sweetpotato varieties: NASPOT 11 (Cream fleshed), NASPOT 10 O and Ejumula (both orange fleshed).

SP clean materials sourced from Biocrops Uganda Ltd

**Rice varieties**: New WITA 9, Komboka and Agoro

Rotation schedules/ treatments

| **Season** | **Month Planted** | **Month harvested** | **Rotation** | | **Control** | | **Planting Cycle** |
|---|---|---|---|---|---|---|---|
| | | | Block 1 | Block 2 | Block 3 | Block 4 | |
| **After 2nd 2015** | Dec-15 | May-16 | SP | R | R | SP | 1/ Baseline |
| **1st 2016** | 20-May-16 | 24-Oct-16 | R | SP | R | SP | 2 |
| **2nd 2016** | 2-Nov-16 | 15-Apr-17 | SP | R | R | SP | 3 |
| **1st 2017** | 17-May-17 | 27-Oct-17 | R | SP | R | SP | 4 |

# Methodology

**Fertilizer:** Fertilizers were applied in Rice at planting and at panicle initiation stage (NPK= 30:30:30, 30:0:0 kg/ha). Total fertilizer= 60:30:30 kg/ha)

No fertilizer was applied in SP

However, the rotation SP treatment benefited from residual fertilizers applied in rice.

**Irrigation:** Both SP and Rice were irrigated during periods of drought irrespective of season

Both crops relied mostly on irrigation during the off-season crop (2015 Dec- April &2016 Dec- April)

**SP planted** using a dual-purpose method on ridges 0.5 m apart, at spacing of 30cm between 30 cm cuttings.

**Spacing for Rice** : 30 cm x 15 cm

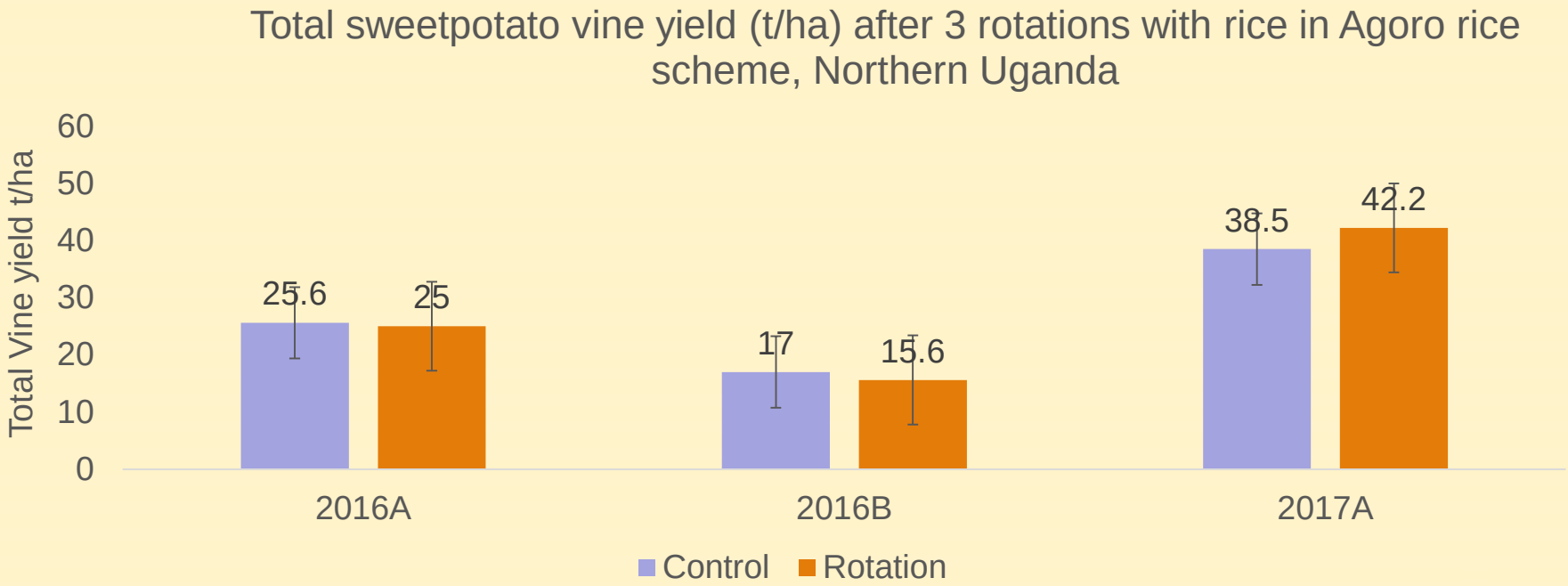
# Methodology

Data collected

- **SP:** Incidence and severity of SPVD and *Alternaria blight*, weevil infestation (scale of 1-9,1- no infection/ infestation, 9-severe), plant vigour
- SP yield (Vine, root)
- **Rice**: Plant height, number of productive tillers at 90 DAT, grain yield (adjusted to 14% moisture content) and rice biomass dry weight at harvest

- Cost data on labour and inputs to compute net profit

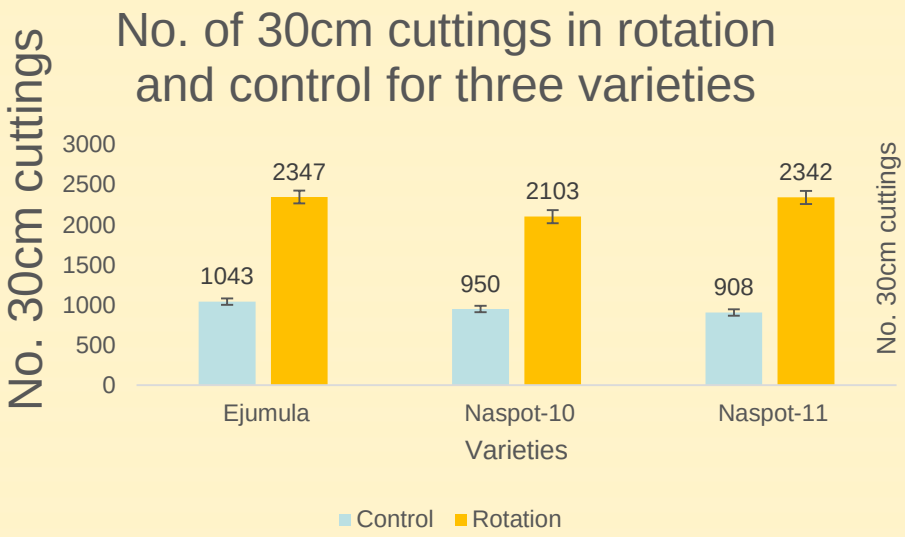
# Results - Sweetpotato

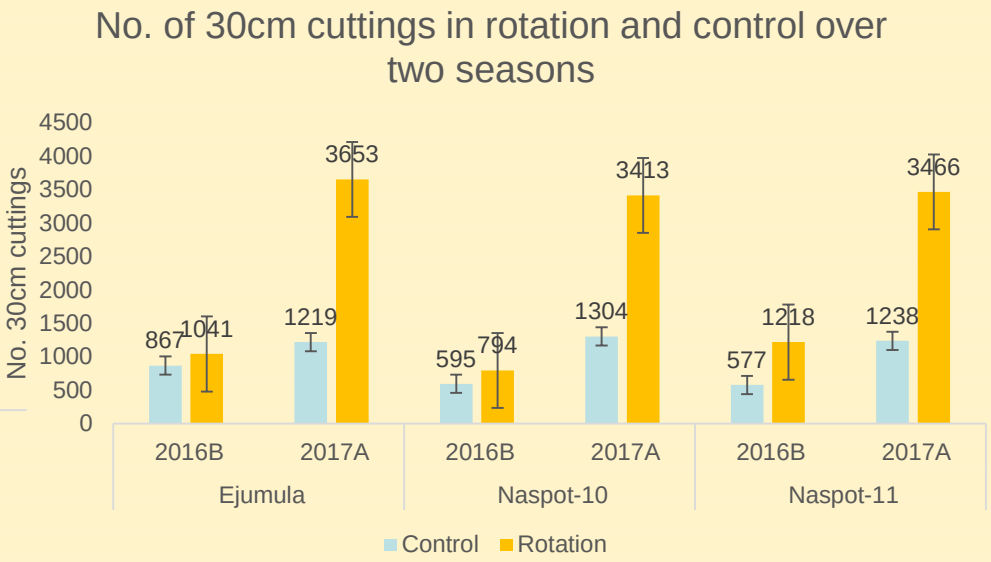



$LSD_{0.05}$ Season= 9.6

- Vine weight was not significantly different across treatments, varieties significant across seasons
- The interaction between treatment and season was significant (P<0.001) because of the poor performance in 2016B

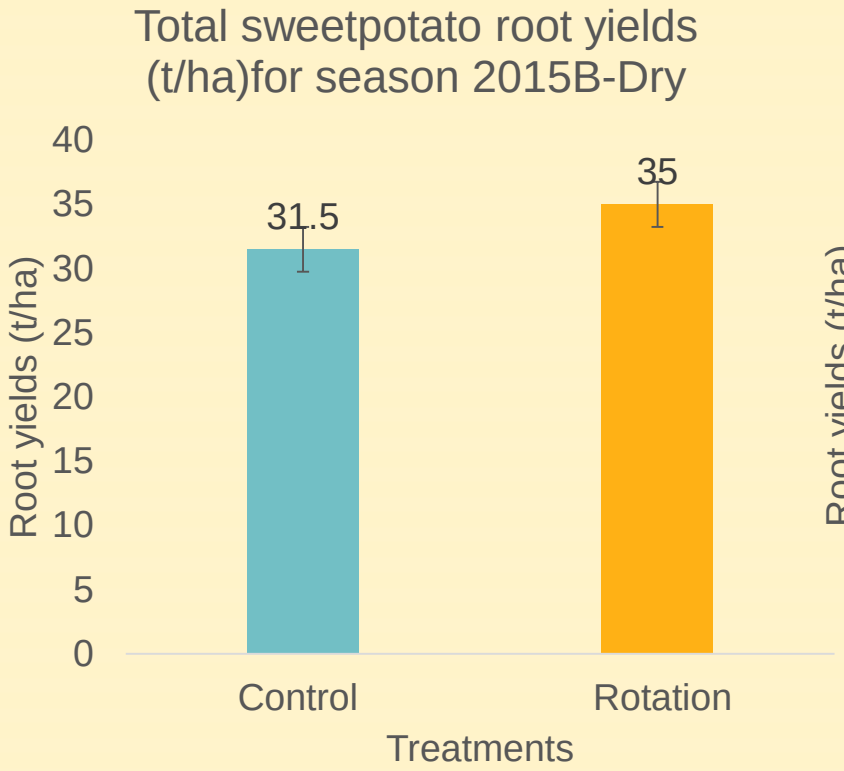
# No. Vine cuttings

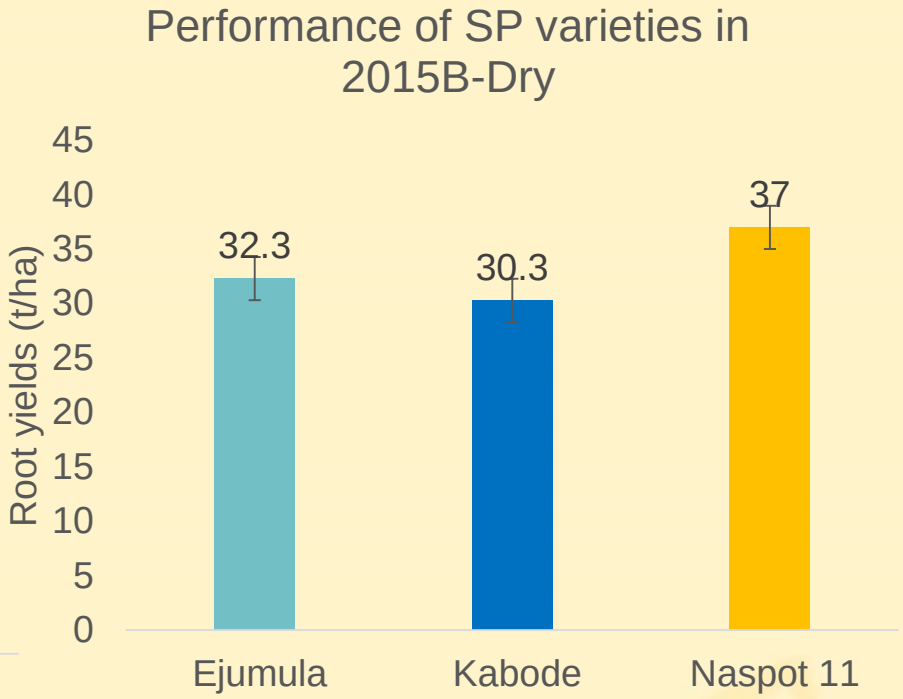



- No. of 30cm cuttings were significantly different across treatments (P=0.004), $LSD_{0.05}$ Treatment= 525
- Overall, more 30cm cuttings were produced in rotation than control.

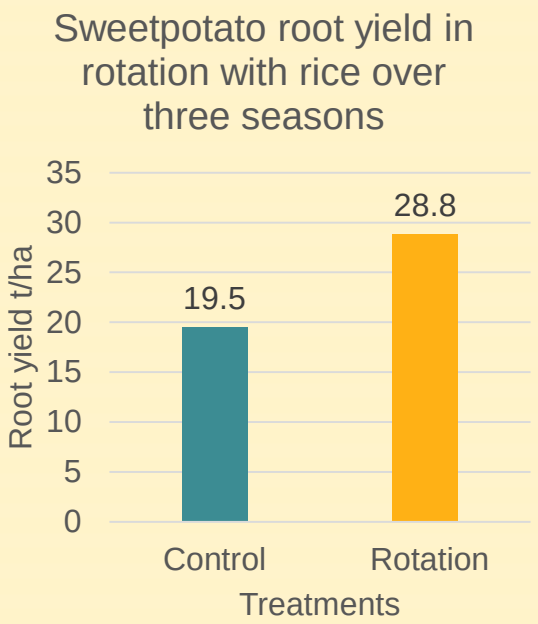
# Root yields

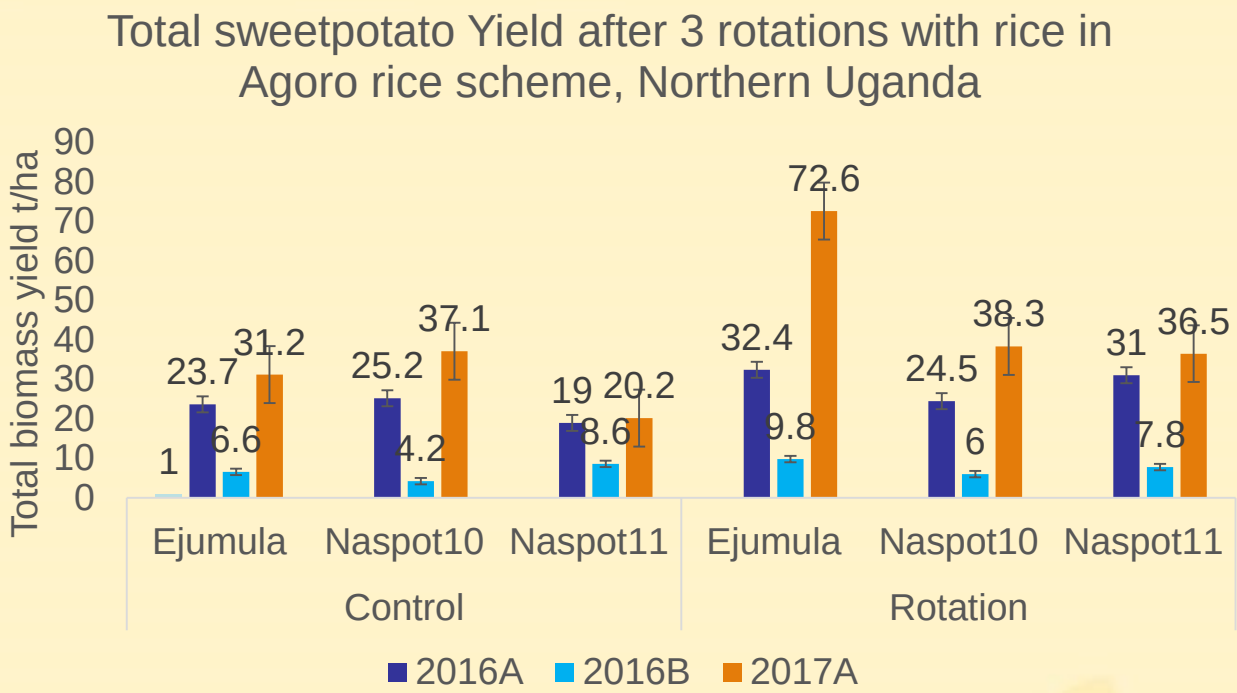



- No significant difference between treatments, varieties

# Root yields

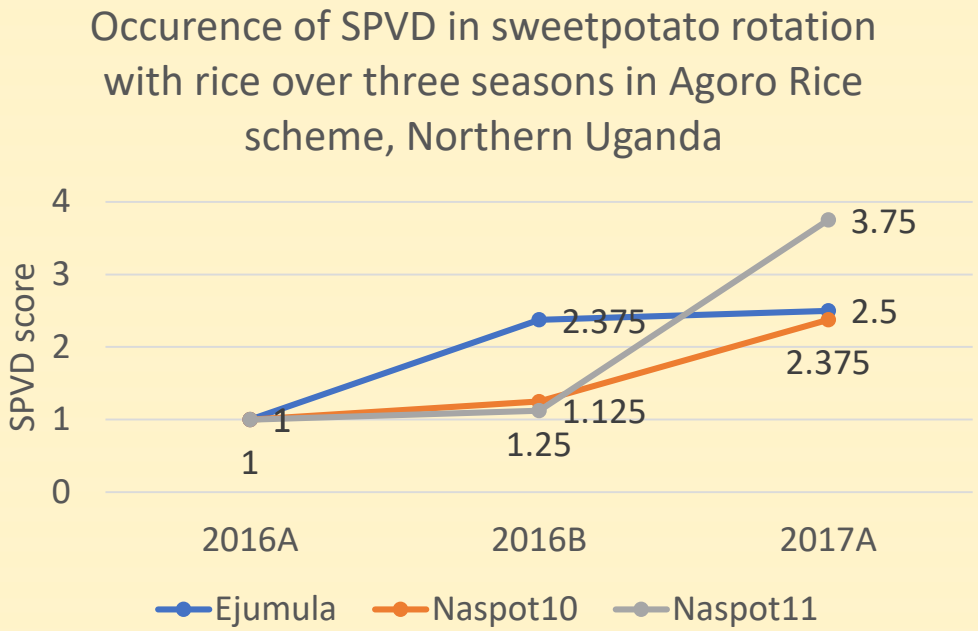



- Rotation had a significant effect on SP root yield P=0.014
- Root yields in the rotation were higher than control in all 3 seasons
  - The low yields in 2016B were as a result of extended dry periods- No water in dam for irrigation

# Incidence of *Alternaria blight*, SPVD

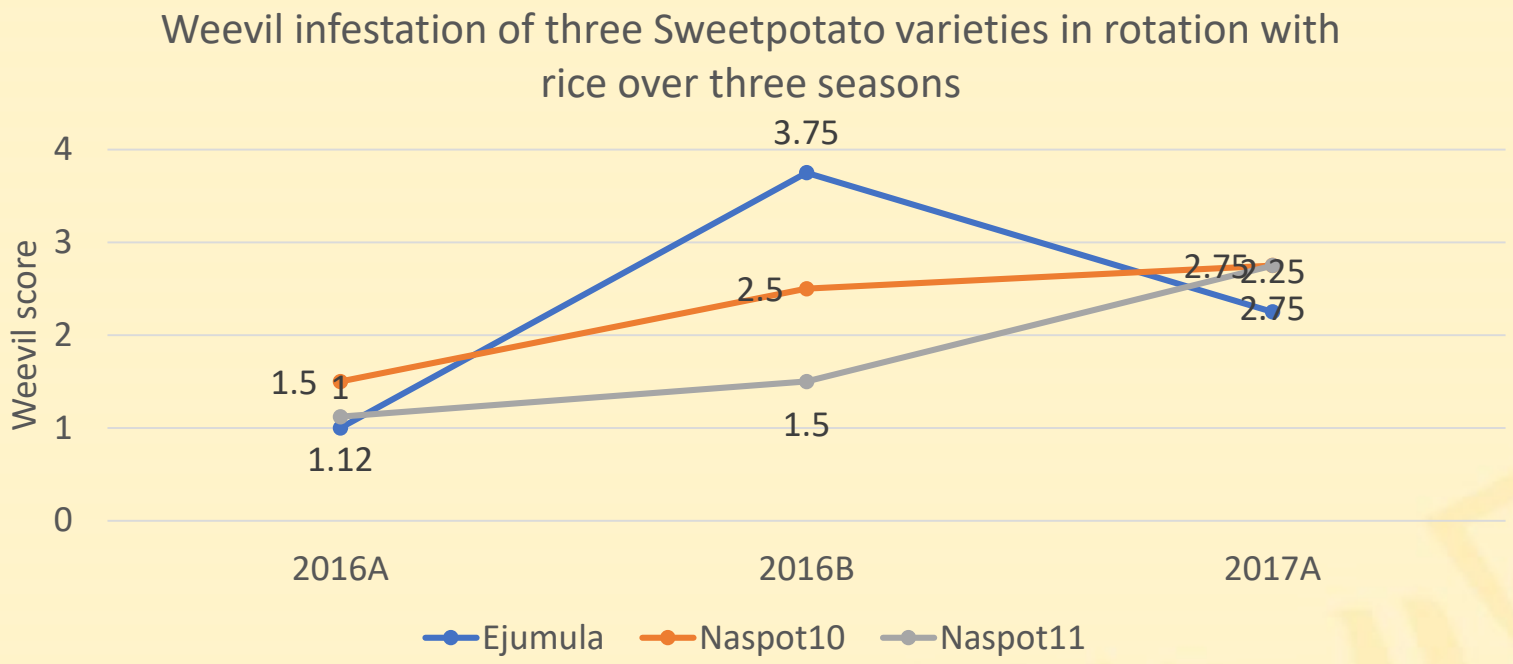
- Incidence of *Alternaria Blight* was not significant across treatments and varieties
- Incidence of SPVD was not significant across treatments but significant across seasons
  - Interaction between variety and season for SPVD was significant (P<0.001)




| Environment | Variety | No. of samples tested | Number of viruses tested positive | | | #viruses detect |
|---|---|---|---|---|---|---|
| | | | Total +ve | SPCSV | SPFMV | |
| Open fields Agoro | NAS11 | 26 | 13 | 11 | 4 | 2 |
| | NAS10 | 35 | 19 | 3 | 16 | 2 |
| | Ejum | 31 | 7 | 3 | 7 | 2 |
| | Total | 92 | 39 | 17 | 27 | |

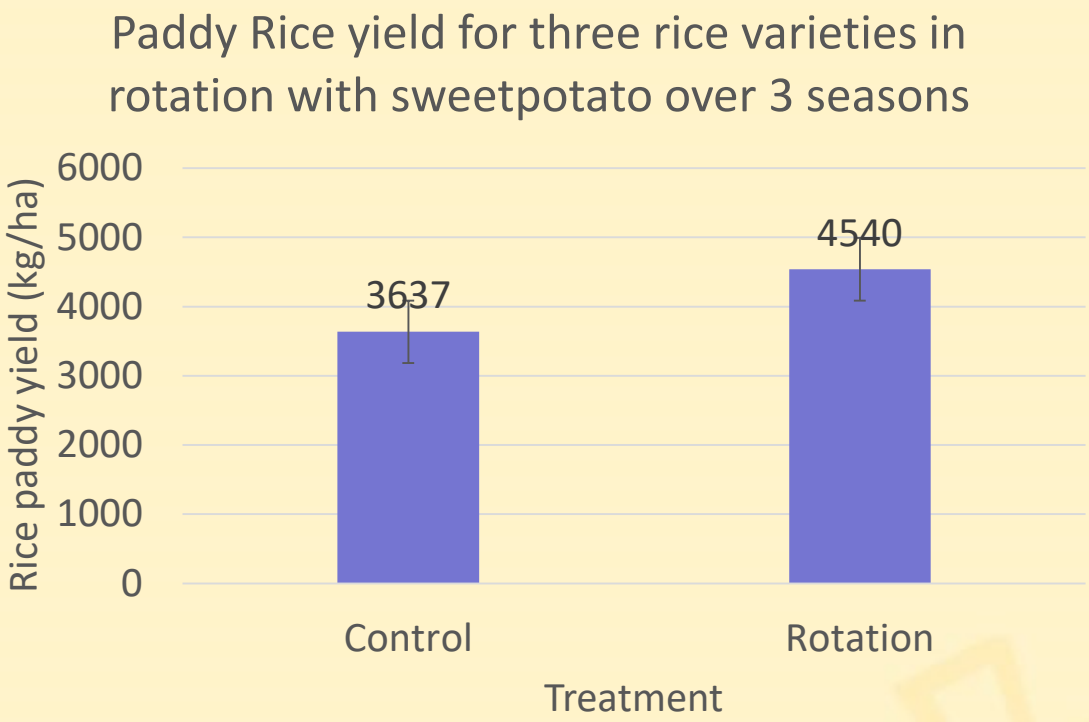
# Weevil infestation

- Weevil infestation was not significant across treatments and varieties but significant across seasons
- There was a significant interaction between variety and season (P=0.005)



# Rice Results

- Paddy yield of rice grown after sweetpotato was significantly higher than the control (P=0.001) where rice followed rice




$LSD_{0.005}$= 240.7

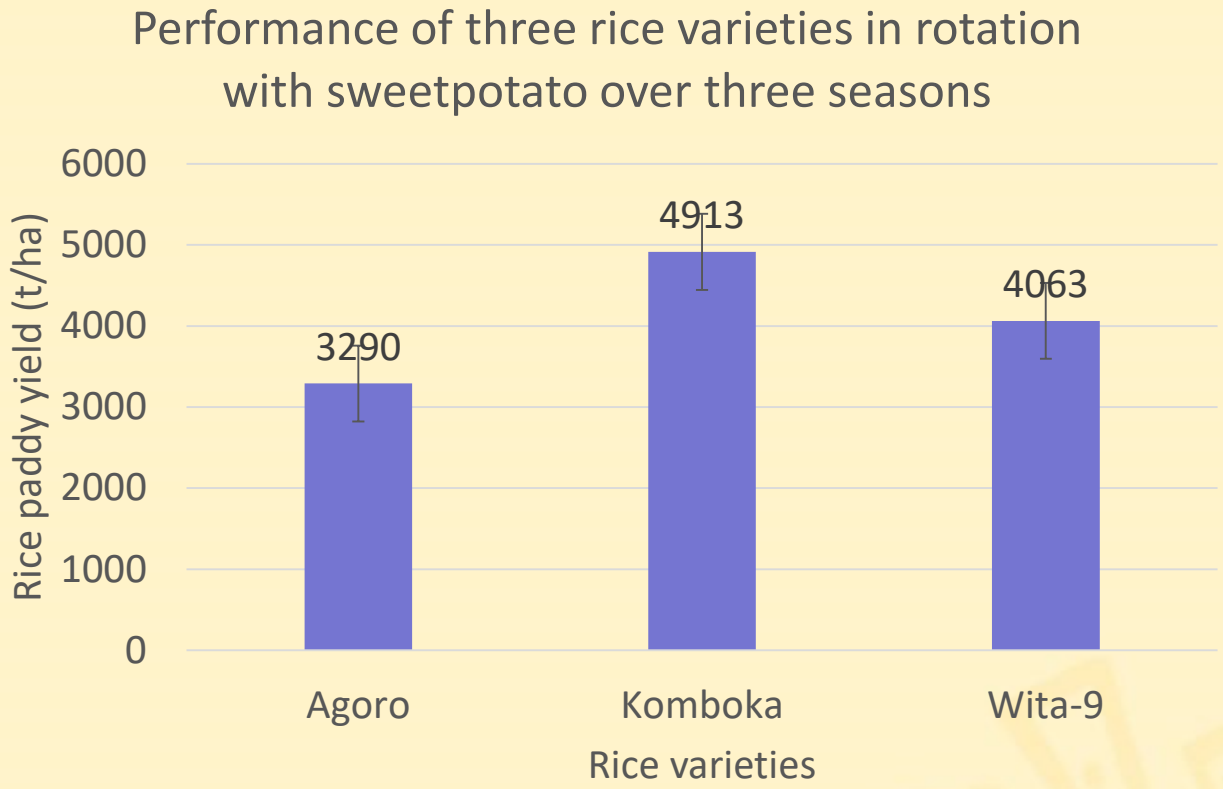
# Rice results






# Rice yield

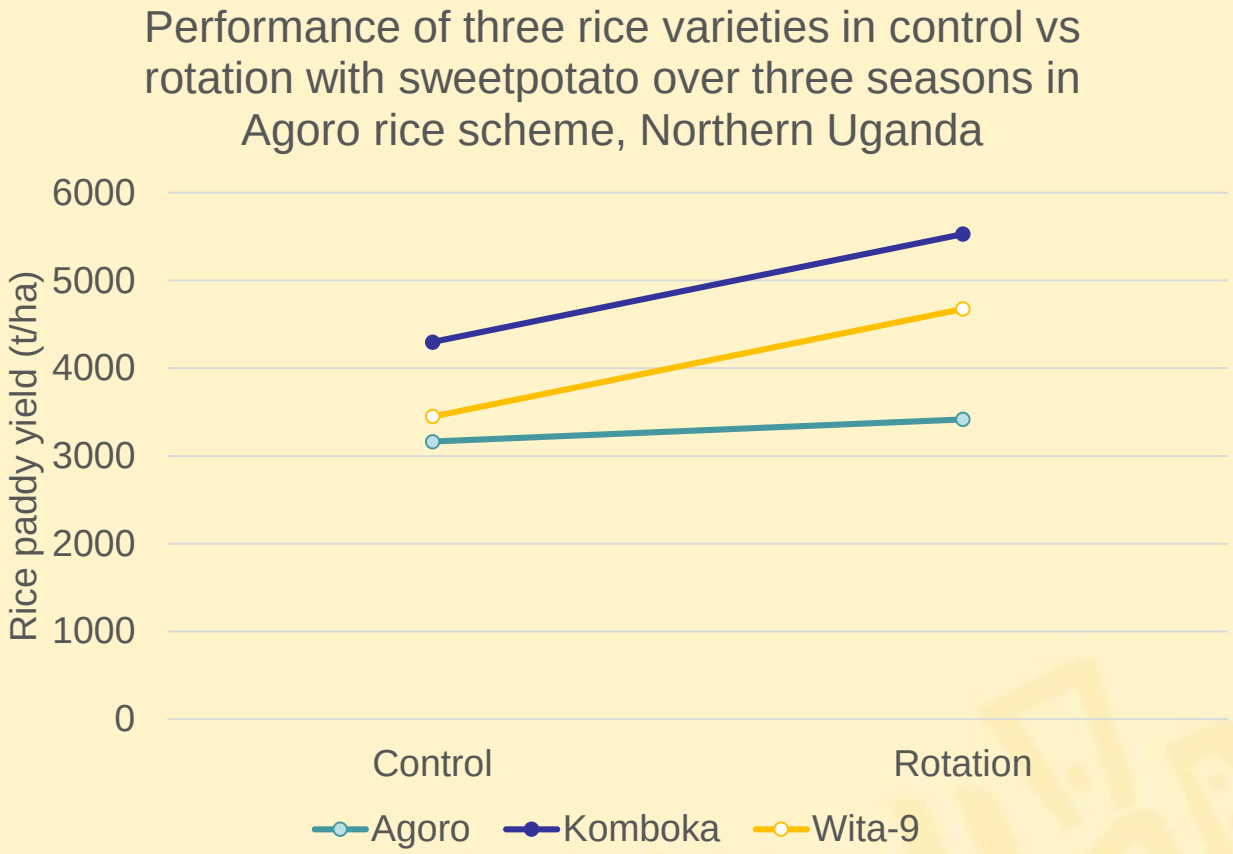
- There was a significant difference (P <.001) in yield performance of the rice varieties




$LSD_{0.005}$= 682.9

# Performance of rice varieties

- The rotation produced yield gains in the 3 rice varieties tested.
  - WITA-9 35%
  - KOMBOKA 29%
  - Agoro 8% above the control.



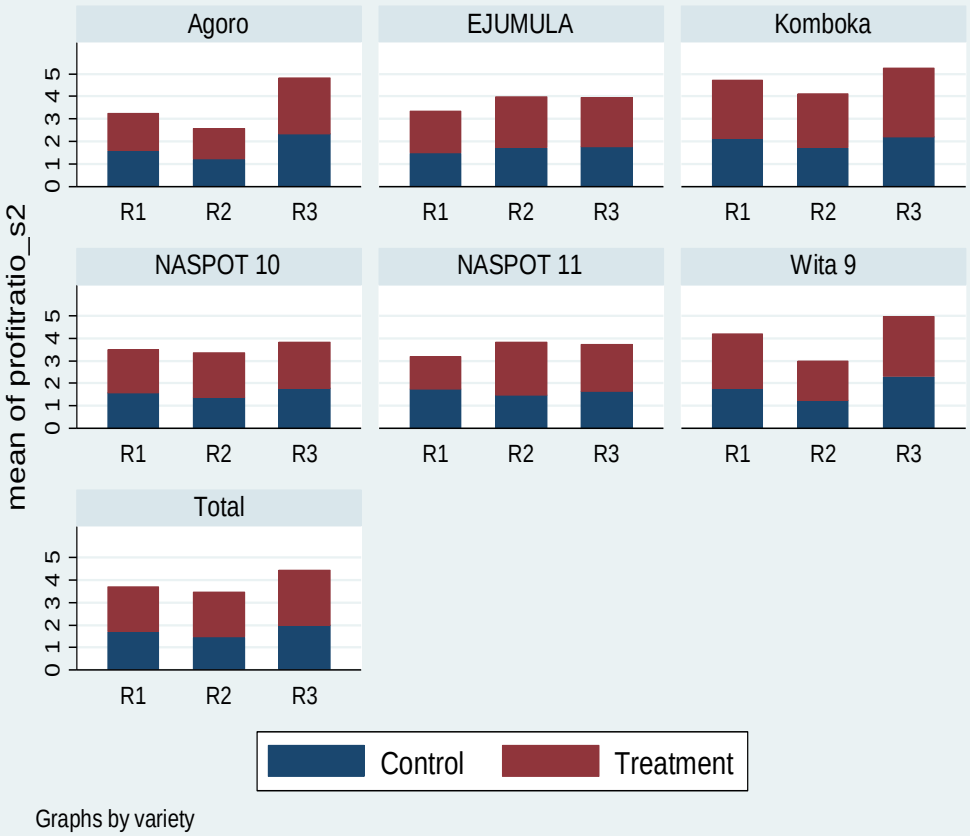
# Comparison between Treatments Vs Control for Revenue to cost ratio

| Condition | Revenue to cost ratio– Level of significance |
|---|---|
| Both Paddy & SP | *** (1% level) |
| Paddy only | ** (5% level) |
| SP only | * (1% level) |
| Overall Rotation Effect on Revenue to cost ratio | Significantly increased |
| Paddy (Wita 9) | Insignificant; but number of rotation increases with significance. |
| Paddy (Komboka) | * (1% level) |
| Paddy (Agoro) | Insignificant; but if we rotate more times, significance level increases |
| SP (NASPOT 10) | * (1% level) |
| Rotation level (NASPOT 10) | Revenue to cost ratio significantly increases when number of rotation increases. komboka variety might be better option to rotate with NASPOT 10 |
| SP (NASPOT 11) | Not significant; if we rotate rice with sweetpotato NASPOT 11, we might have to rotate more times. |
| SP (EJUMULA) | **(5% level); Revenue to cost ratio significantly increases when number of rotation increases. |

*Note: "*" "**" "***" indicates 1%, 5% and 10% significant level (equality test – t-test);*

# Revenue to cost ratio, by variety and intervention

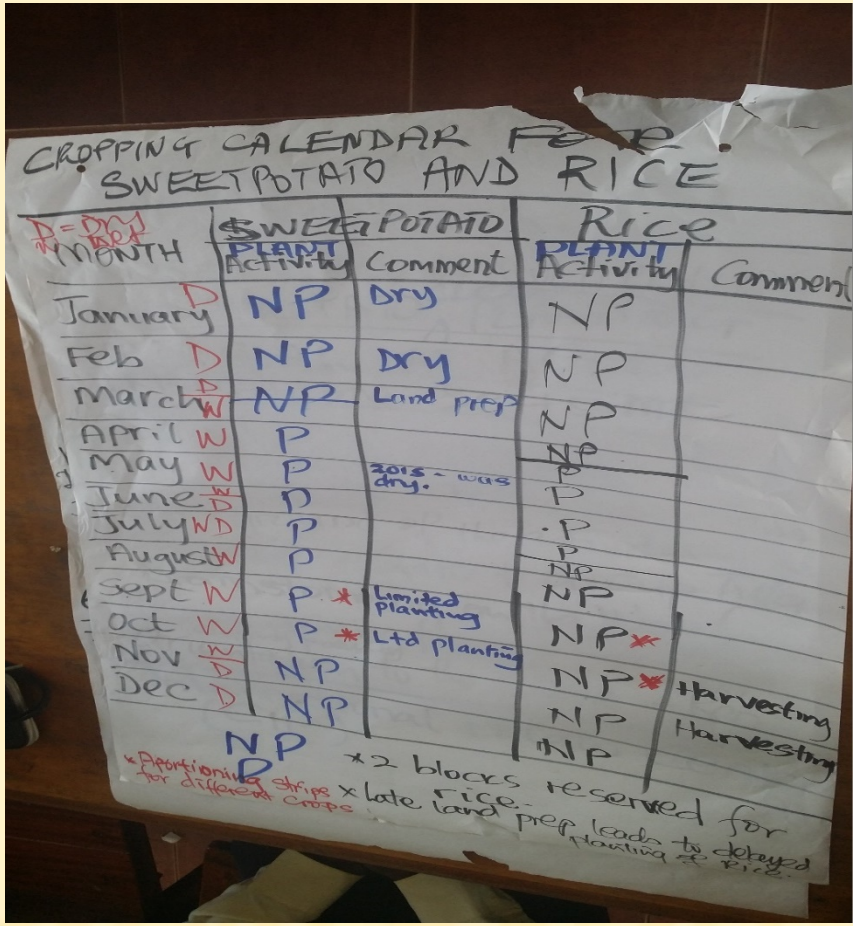
- There was a significant difference in mean revenue to cost ratio between treatment and control
- mean revenue to cost in rotation was significantly higher than control (2.15 for rotation and 1.72 for mono-cropping) by 0.43
- The overall impact of rotation was significant for both crops.
- Increasing number of rotations resulted in increase in revenue to cost ratio.
- Overall, impact of rotation is significant on the revenue to cost ratio for *NASPOT 10 and Komboka.* Therefore, Komboka variety might be a better option for rotation with *NASPOT 10 or Ejumula*.



# Conclusion

SP-rice rotation:

- Provides an opportunity to utilize rice fields when they would otherwise be under fallow,
- Increases seasonal availability of SP planting material
- Increases yields for both rice and SP, and eases land preparation for rice
- This result and others in Vietnam and Madagascar confirm that SP can positively integrate in the rice growing system



# Benefits of SP–rice rotation

- SP grown in the dry season also provides food early in rainy season when food stocks are low (most food is sold-off and granaries are empty)

- Four tons of rice foundation seed of Komboka, WITA 9 and Agoro was produced and shared by participating farmers from the local community of Agoro.

# Conclusion

"Rotation of sweetpotato and rice saves labor because rice planted after sweet potato is weeded only once (unlike in the case of rice monoculture)"

"The varieties of rice and sweetpotato provided are early maturing, thus saves the family from facing hunger (food security) and they fetch a higher premium in the market before those growing the land races access the market"

# Conclusion

- Sweetpotato-rice rotation has demonstrated benefits for both crops
- It is therefore ready to be scaled out to other irrigation schemes in Uganda and other countries in Africa.
- We are seeking collaboration in scaling out of the rice-sweetpotato rotation technology.




# 2017A

# Acknowledgement

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# Thank You!