EFFECT OF SWEETPOTATO- RICE SEED CROP ROTATION ON YIELD AND PEST AND DISEASE PREVALENCE IN THE AGORO RICE SCHEME (LAMWO DISTRICT, UGANDA)

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Background

- Sweetpotato is an important crop in Uganda
- Most households plant SP
  - ***Northern Uganda produces about 16% of the national sweetpotato output***

Background

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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 one of the emerging crops grown currently in Uganda.
  - *In 2008/09, N. Uganda produced 23% of total rice in Uganda*
- In most rainfed (and some irrigated) lowlands , rice is grown during the first season, and the land left under fallow until the next planting the following year.
- The fallow period means that hardpans develop making land preparation for the next rice planting tedious and costly.

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%).
- The profit for Sweetpotato-rice rotation (US $ 612) was only second to rice-soybean- rice (US$644) but greater than the rest of the rotations. Rice-sweetpotato rotation 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

Objectives

Main Objective: Assess technical, economic and social viability of sweetpotato vine and rice seed rotation system in northern Uganda

Research questions:

1. What is the influence of SP-Rice seed crop rotation on;

– Pest and disease prevalence and

– SP root & vine yield

– Rice yields.

2. What is the cost-benefit of the SP-Rice rotation to provide basic seed in a timely manner to decentralized multipliers in the sweetpotato seed value chain?

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				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 0.5m apart, at spacing of 30cm between 30 cm cuttings.

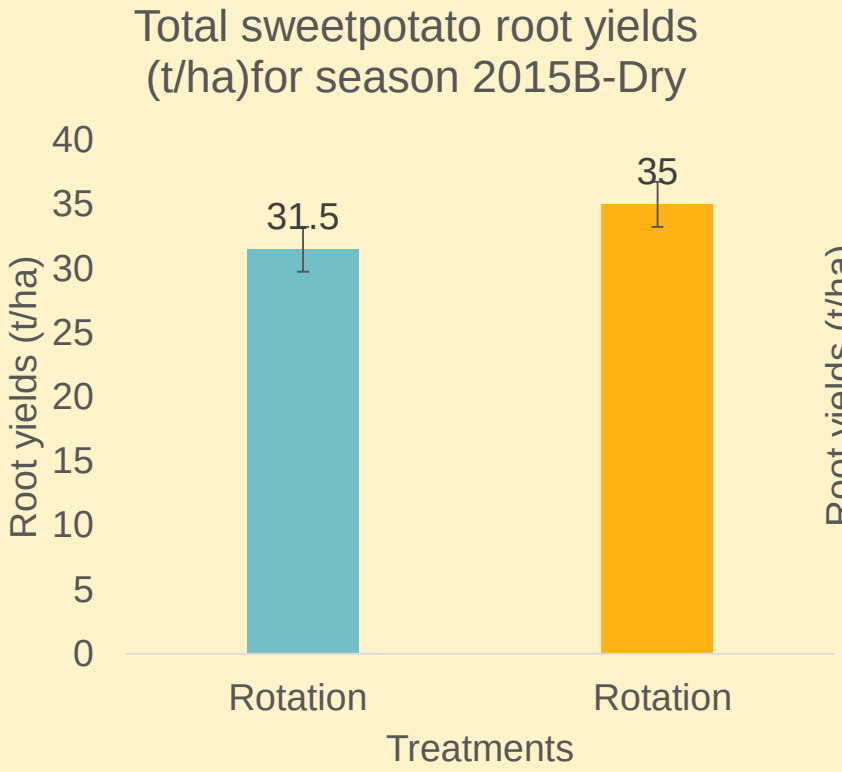
Spacing for Rice : 15cm x 15 cm

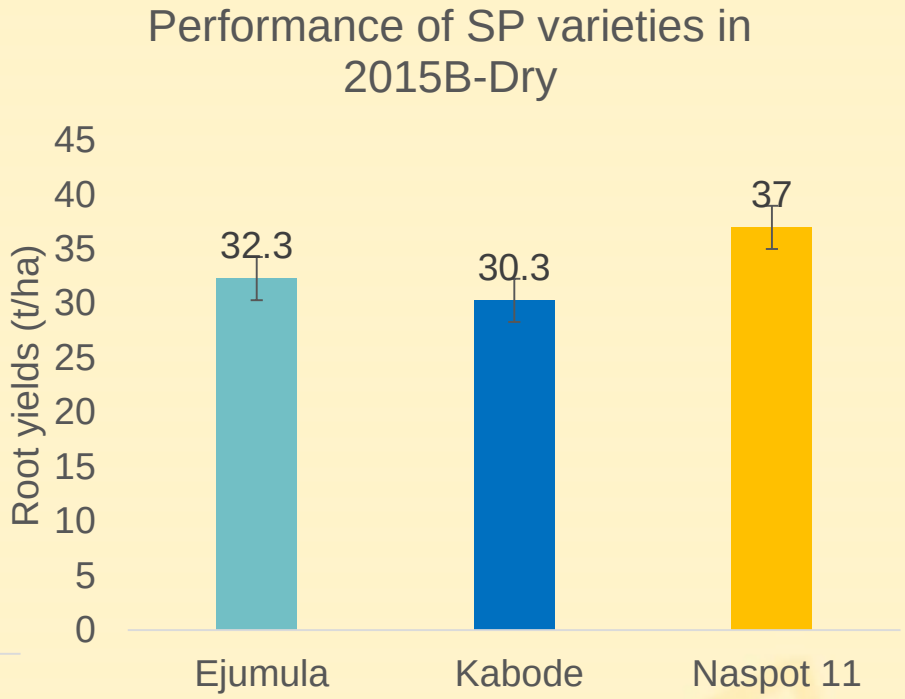
Methodology

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, root and vine weight yield
- SP yield assessed on per plant and area basis
- **Rice**: plant height, number of productive tillers at 90 DAT, grain yield and rice biomass dry weight at harvest
- Cost data on labour and inputs to compute net profit

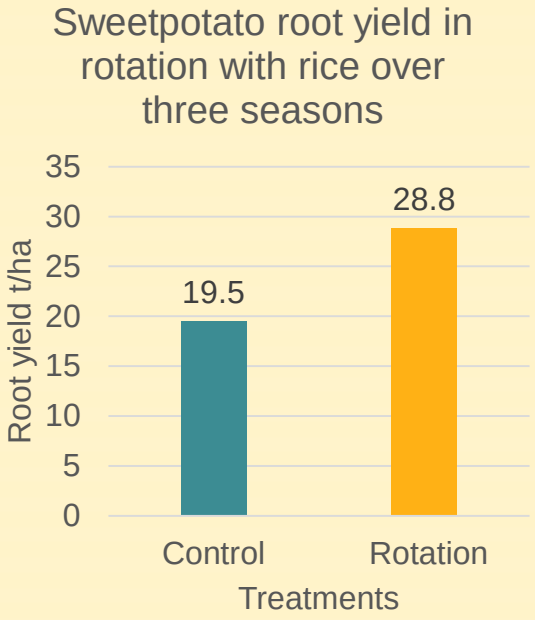
Results

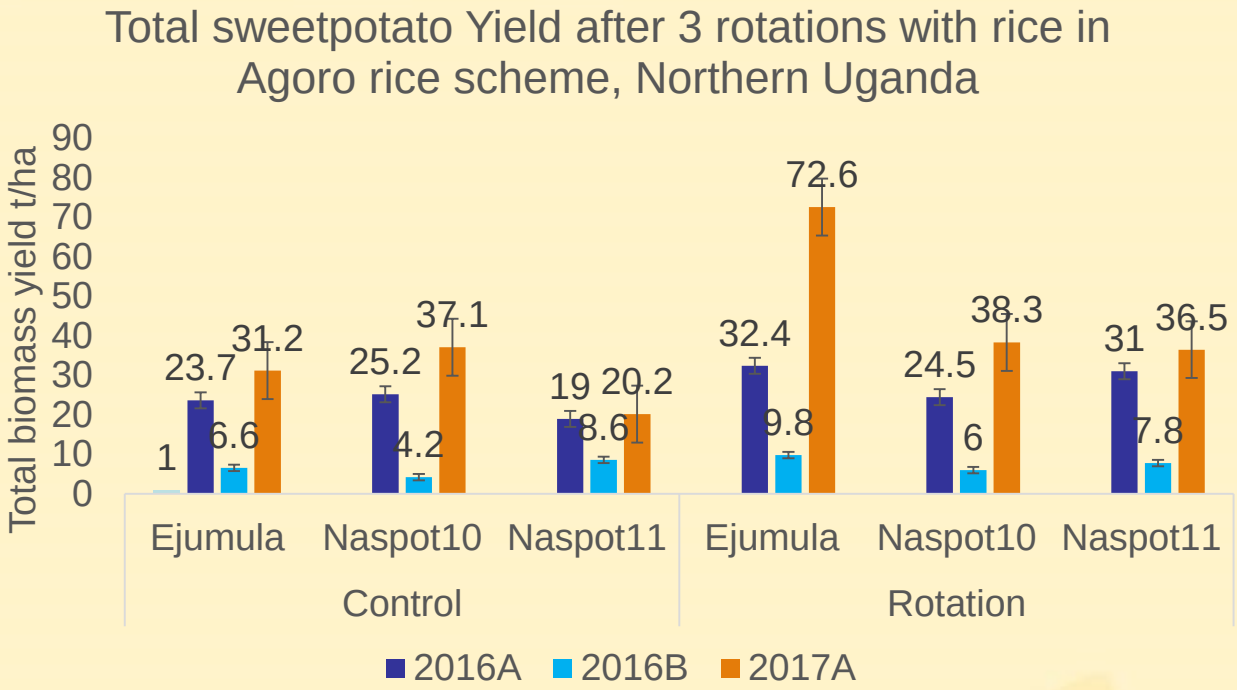




- No significant difference between treatments, varieties

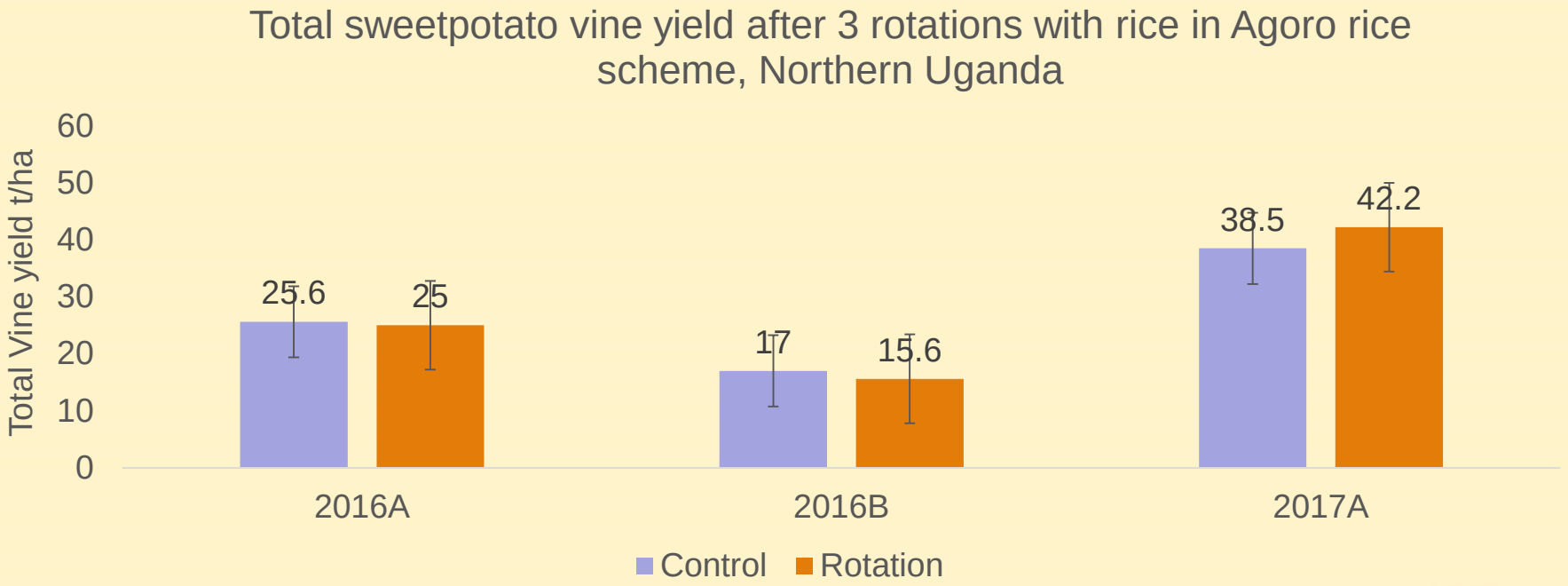
Results





- 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

Total vine yield (t/ha)



$LSD_{0.05}$ 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

Harvest index

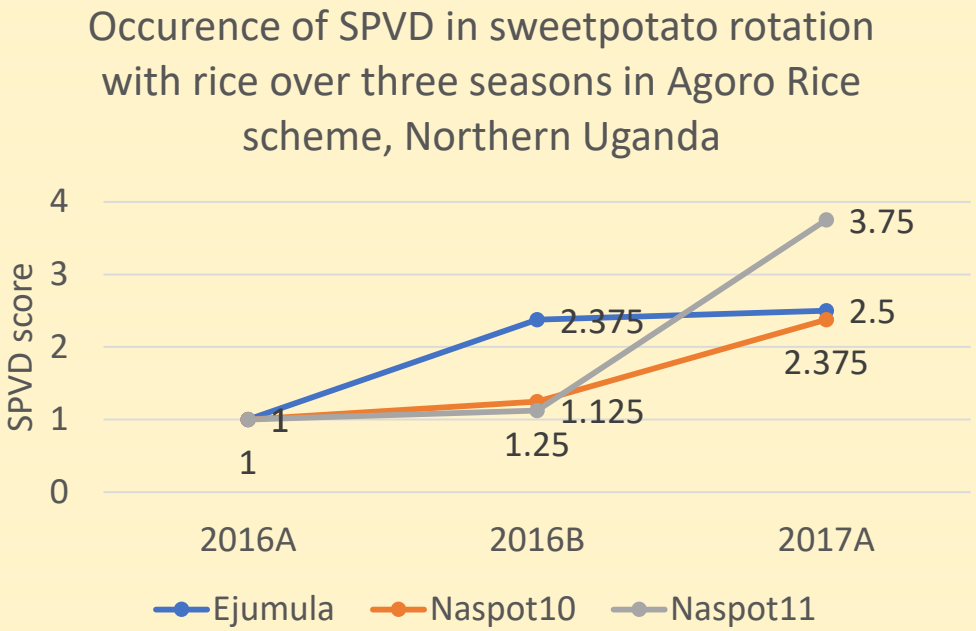
Table 1: Harvest Index of 3 varieties in rotation with rice for 3 seasons

		Season				
Treatment	Variety	2016A	2016B	2017A	Variety Mean	Treatment mean
Control	Ejumula	0.60	0.39	0.49	0.49	0.44
	Naspot10	0.49	0.26	0.56	0.44	
	Naspot11	0.48	0.28	0.43	0.40	
Rotation	Ejumula	0.63	0.46	0.73	0.61	0.52
	Naspot10	0.57	0.34	0.57	0.49	
	Naspot11	0.53	0.28	0.53	0.45	
Mean		0.55	0.46	0.55		0.48
CV (%)				6.40		

- $LSD_{0.05}$ Trt= 0.06, $LSD_{0.05}$ Variety= 0.04, $LSD_{0.05}$ Season= 0.06
- Treatments, variety and seasons had a significant effect on harvest Index
  - No interaction was significant

Incidence of *Alternaria blight*, SPVD

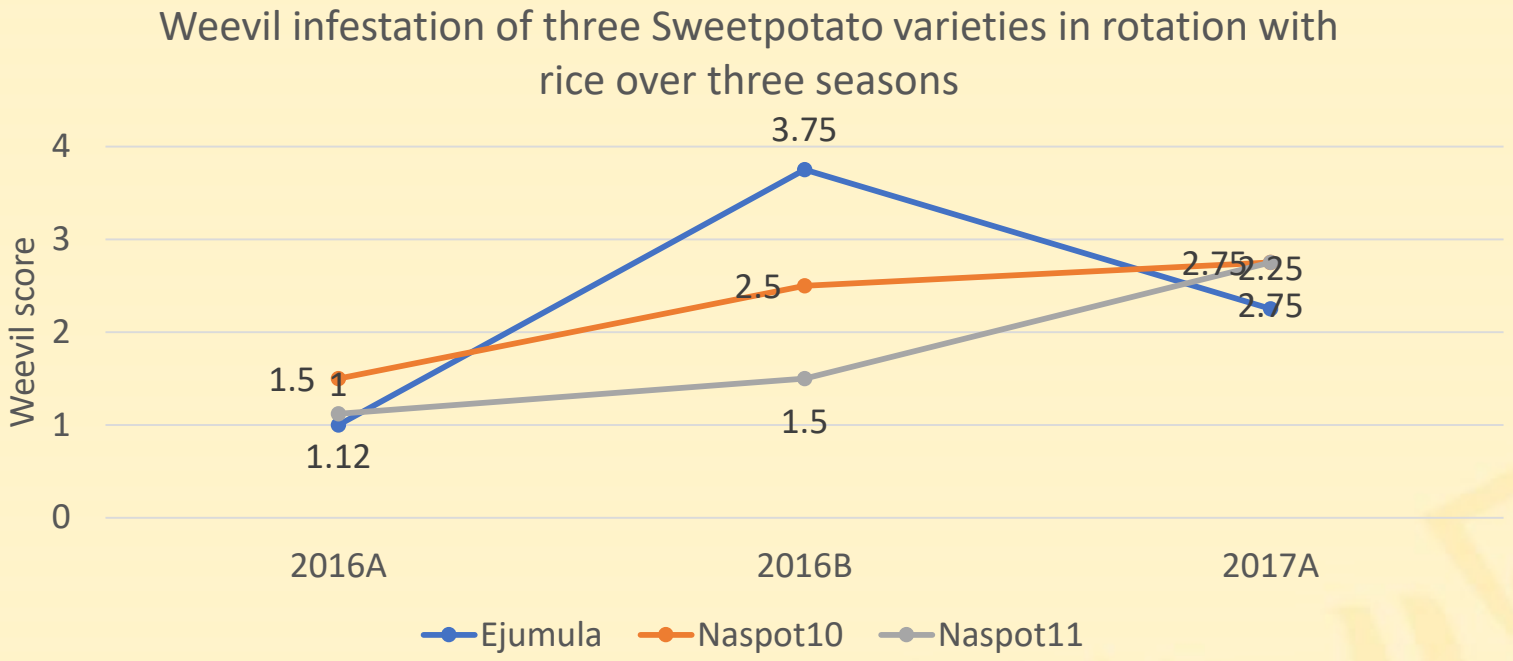
- Incidence of *Alternaria Blight* was not significant across treatments and varieties
- Incidence of SPVD was not significant across treatments but significant across seasons
  - Interaction between variety and season for SPVD was significant (P<0.001)



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	

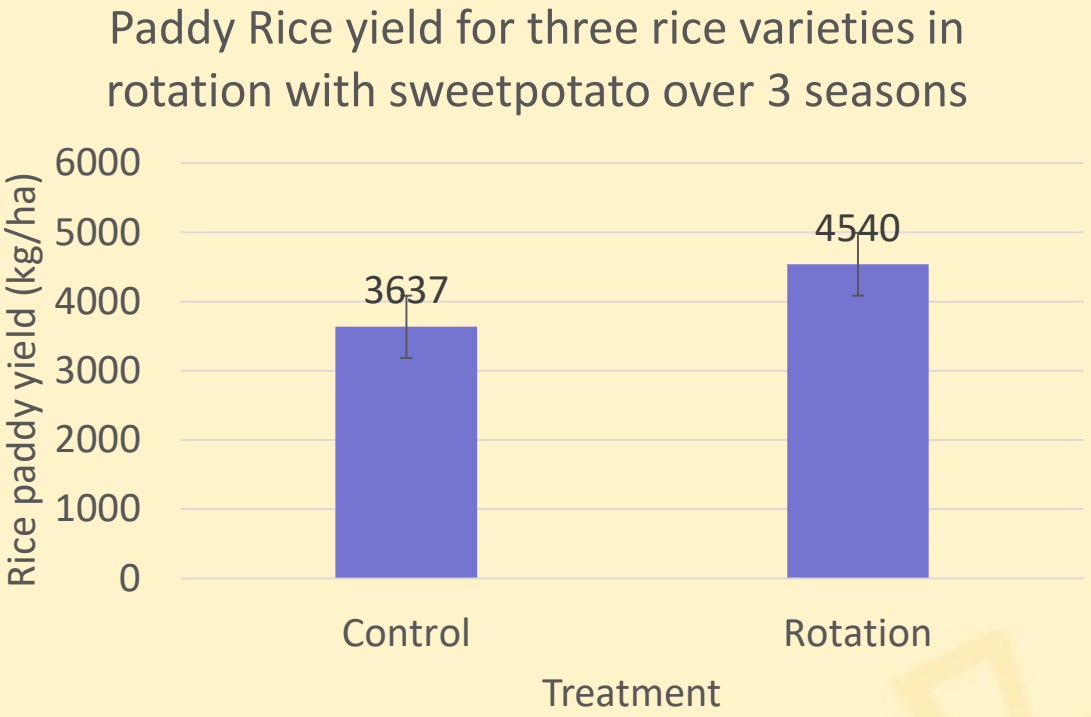
Weevil infestation

- 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 yield

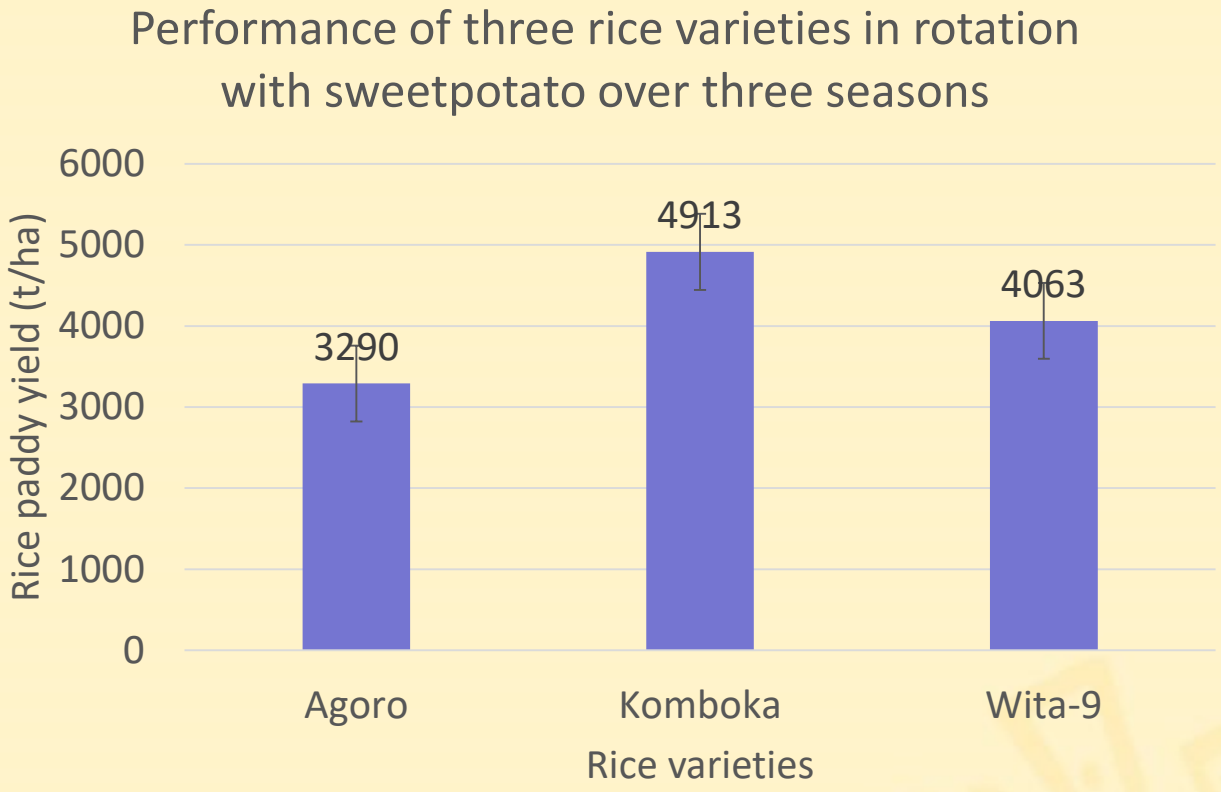
- Paddy yield of rice grown after sweetpotato was significantly higher than the control (P=0.001) where rice followed rice



$LSD_{0.005}$= 240.7

Rice yield

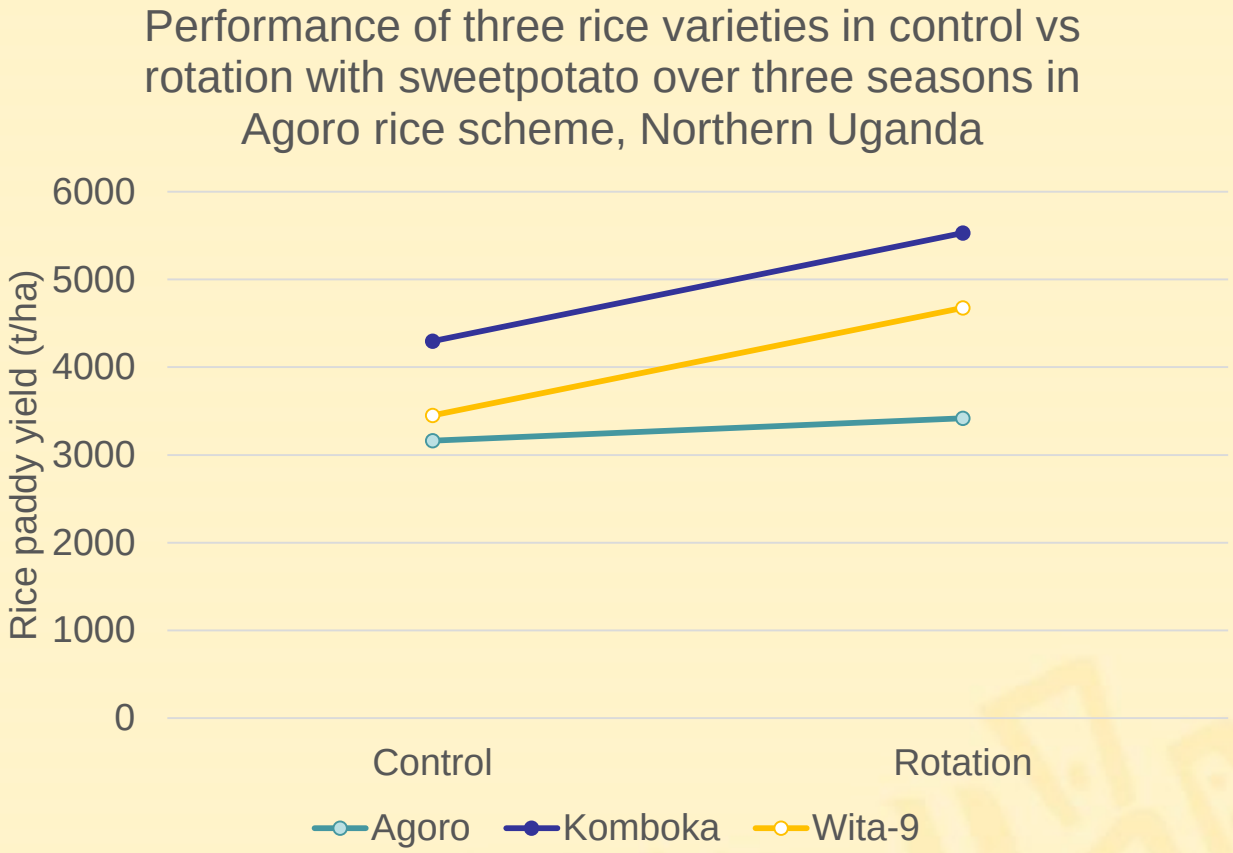
- There was a significant difference (P <.001) in yield performance of the rice varieties



$LSD_{0.005}$= 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.



Cost of sweetpotato root & vine and rice seed production by rotation (season)-wise (total four blocks – area 1440 m^2).

Intervention	Treatment			Control		
	Rotation 1	Rotation 2	Rotation 3	Control 1	Control 2	Control 3
Cost Category	Total Cost (Treatment)	Total Cost (Treatment)	Total Cost (Treatment)	Total Cost (Control)	Total Cost (Control)	Total Cost (Control)
Input Cost	190406	163925	165714	190406	182325	176154
Labour Cost	507500	456500	476500	471500	436500	440500
Fixed Cost	98555	104537	108784	98555	110438	108784
Total Wastage Cost	31659	33928	35809	36207	42326	54831
Total Cost	828120	758890	786807	796668	771589	780268
			Ratio			
Input Cost	23	22	21	24	24	23
Labour Cost	61	60	61	59	57	56
Fixed Cost	12	14	14	12	14	14
Total Wastage Cost	3.8	4.5	4.6	5	5	7
Total Cost	100	100	100	100	100	100

- Labour costs occupied huge share from the total costs in both treatment and control
- Share of input costs goes down in the rotation when number of rotations increases

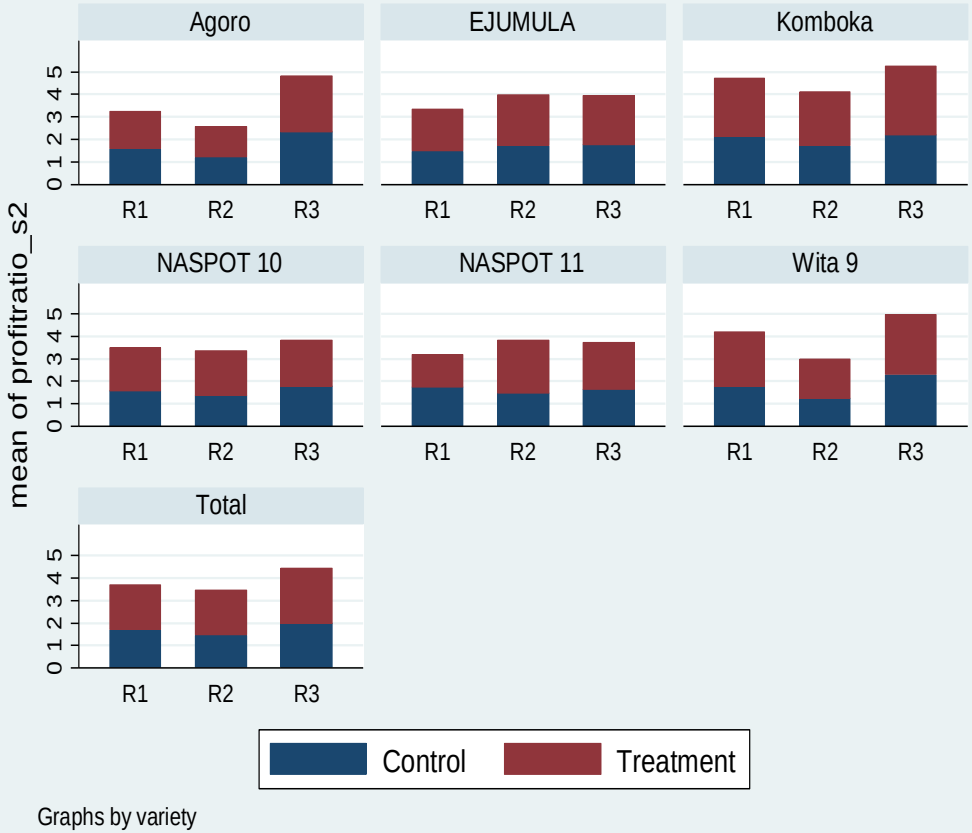
Comparison between Treatments Vs Control for Net Profit

Condition	Net Profit – Level of significance
Both Paddy & SP	*** (1% level)
Paddy only	** (5% level)
SP only	* (1% level)
Overall Rotation Effect on net profit	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)	The net profit ratio significantly increases when number of rotation increases. The significant differences at 15% level can be seen only at 3rd rotation; komboka variety might be better option to rotate with NASPOT 10
SP (NASPOT 11)	Not significant; if we rotate rice with sweetpotato NASPOT 11, when might have to rotate more times.
SP (EJUMULA)	**(5% level); The net profit ratio significantly increases when number of rotation increases.

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

Average net profit, by variety and intervention

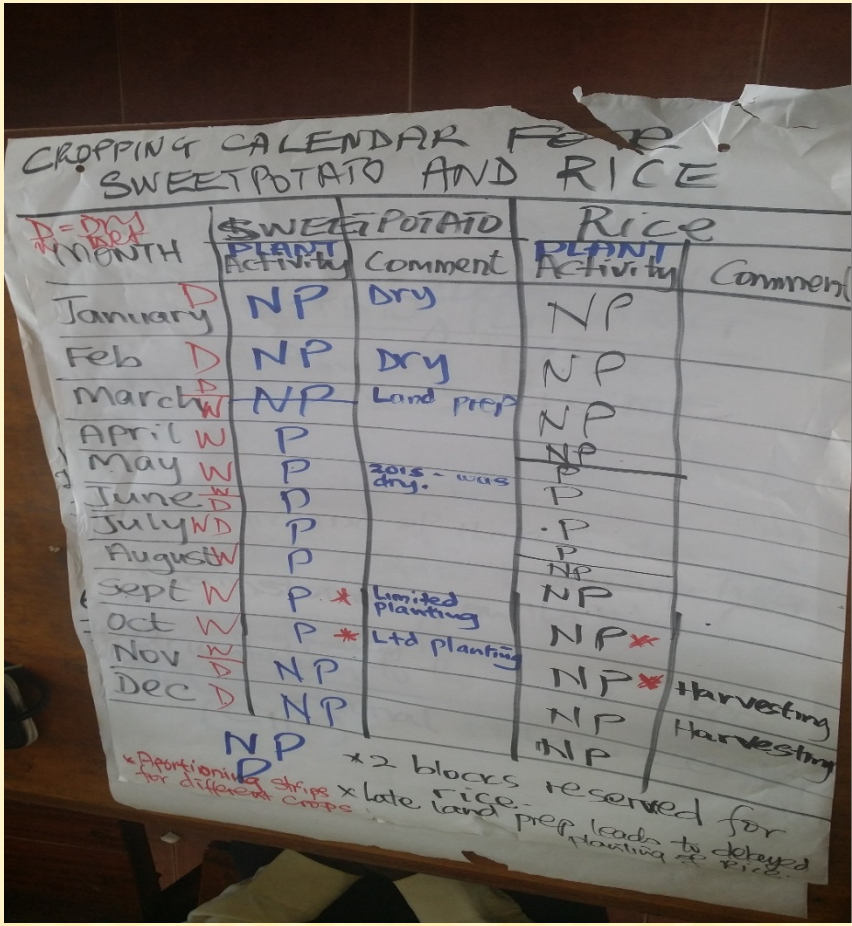
- There was a significant difference in mean net profit ratio between treatment and control
- The net profit ratio in rotation was significantly higher than control by 0.43
- The overall impact of rotation was significant for both crops.
- Increasing number of rotations resulted in increase in net profit.
- Overall, impact of rotation is significant on the net profit 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
- Contributes to provision of food and income early in the cropping season when granaries are empty
- This result and others in Vietnam and Madagascar confirm that SP can positively integrate in the rice growing system



Conclusion

"Rotation of sweet potato 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 sweet potato 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"

2017A

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Thank You!