Increasing Crop Productivity in Rainfed Rice Systems of Central Uganda

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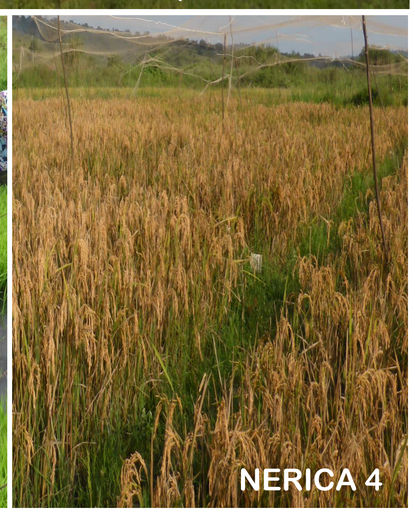
Introduction

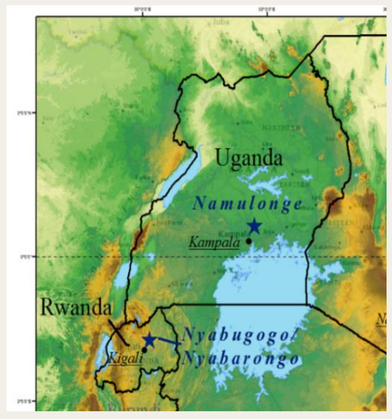
East African wetlands have high potential for agricultural production but they are widely unused. We investigated agronomic options for rice production at different positions of a valley bottom swamp in Uganda aiming to:

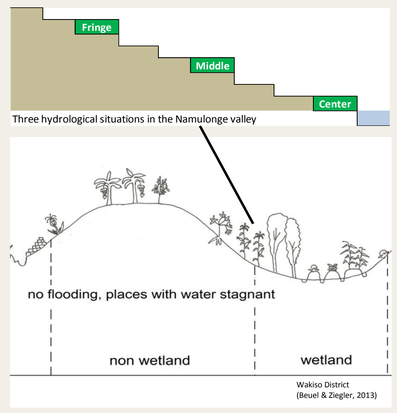
- **Assess key yield-limiting factors in rice (bunds (water), weeds, nitrogen)**
- **Investigate effects of mineral and organic fertilizers on productivity and N efficiency**
- **Compare hydrological zones and their influence on rice productivity for different management options**



Site

- **Uganda, Namulonge inland valley swamp**
- **Tropical climate with two rainy seasons**
- **Seasonally flooded gley soils**
- **Diverse land use (horticulture, cereals, forest)**





Uganda, valley positions and wetland type

Soil properties 2014	pH 1: 2.5 H2O	Total N g kg-1	Total C g kg-1	EC µS/cm
Center	5.0	2.0	24.4	127.1
Middle	5.4	1.1	15.0	76.6
Fringe	5.0	1.4	21.7	64.4

Soil properties at planting in 2014 after green fallow

Material & Methods

- **Transplanted rice *(cv* NERICA-4)**
- **Three valley positions (fringe, middle, center)**
- **Six treatments in four reps as randomized complete block design**
- **Three consecutive years (2014, 2015, 2016)**

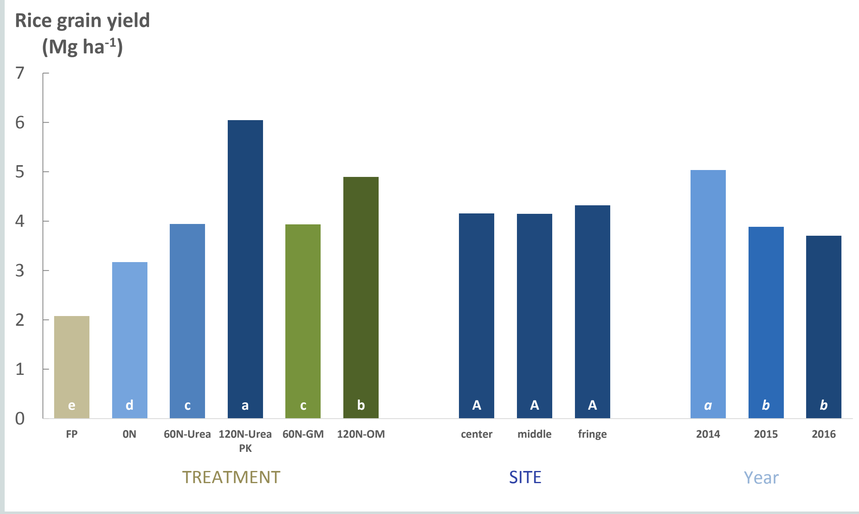
Topic	Treatment	Agronomic details	Abbrev.
yield gaps (YG)	farmers' practice	no bunding, 1 time weeding, 0 N	FP
	bunding, weeding	0 N	0N
	mineral nitrogen	60 kg N ha^{-1}	60N-Urea
	max. attainable yield	120 kg N ha^{-1}, 60 kg P ha^{-1}, 60 kg K ha^{-1}, irrigated	120N-Urea PK
alternative options	green manure	2 month pre-cropped *L. purpureus* (60 N)	60N-GM
	organic manure	pre-cropped *L. purpureus* + chicken manure (120 N)	120N-OM

Overview of six treatments

Findings

- **Farmers' yields : 2.1 Mg ha^{-1}**
- **Attainable yields: 6.0 Mg ha^{-1}**
- **Applying 60 kg N ha^{-1} (mineral or organic), additional weeding and building of field bunds double current farmers' yields**
- **Repeated application of organic manure (120 kg N ha^{-1}) provokes cumulative effects increasing yields**

Results – Rice



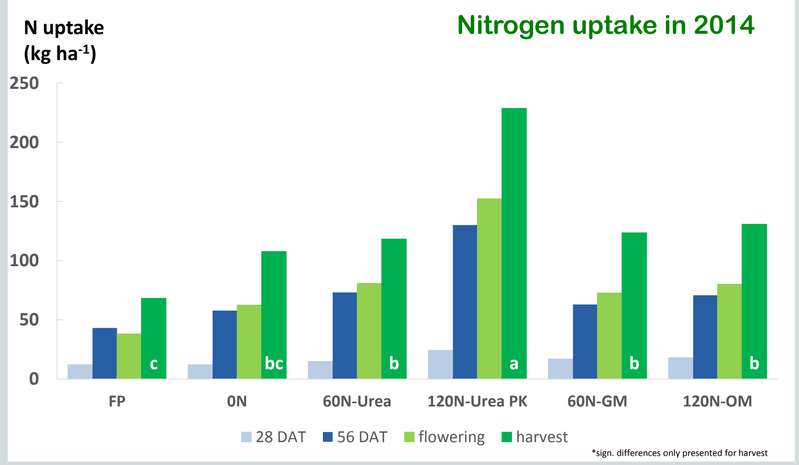
Development of total plant dry matter for six treatments and three sites at four sampling stages in 2014. Maximal dry matter accumulation of 19.1 Mg ha^{-1} (120N-Urea PK) compared to farmers' practice with only 8.2 Mg ha^{-1}.

Agronomic Efficiency 2014	Center kg grain kg-1 N applied		Middle kg grain kg-1 N applied		Fringe kg grain kg-1 N applied	
60N-Urea	2.5	b	13.4	a	7.9	ab
120N-Urea PK	23.3	a	25.6	a	22.7	a
60N-GM	12.8	ab	25.8	a	0.0	b
120N-OM	17.4	ab	12.7	a	0.5	ab

Agronomic efficiency (AE) of six treatments at three sites in 2014. Highest AE is reached by 120N-Urea PK ranging from 23-26 kg grain harvested per each kg N applied. High variability of AE for organic fertilizers at the different valley positions ranging from 0–26kg grain per kg N applied.

Yield across six treatments, three sites and three years:

- **Farmers' practice show a considerable yield gap**
- **Higher management intensities increase yields significantly (field bunds, weeding and fertilizers)**
- **60N-Urea and 60N-GM reach same yield levels**
- **A significant higher yield in the first year was caused by mineralization effects after green fallow**
- **Rice productivity was not effected by valley position**



Nitrogen uptake of six treatments and three sites at four sampling stages in 2014. Maximum N uptake of 200 kg ha^{-1}. The high uptake is a result of nitrogen mineralization from green fallow residue.

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Ministry of Water and Environment Republic of Uganda
INRES Institut für Nutzpflanzenwissenschaften und Ressourcenschutz
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