

Farmers First

PHASE:	(1) Research Station	(2) 50 – 500 Farmers	(3) 500 – 20,000 Farmers	(4) Full Scale
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Introduction

According to farmer surveys conducted by One Acre Fund’s M&E department in the 2016A and 2016B seasons¹ in Rwanda, about 17% of One Acre Fund clients cultivated Irish potatoes. It is even more common (up to 40%) in some parts of the country, like the Congo Nileⁱ. Many regions have little experience growing potatoes, despite rising interest due to high market prices. In areas where potatoes are less common, especially the East, a high proportion of the Irish potatoes that do exist are intercropped with other crops.ⁱⁱ



In a survey conducted in October 2016, One Acre Fund found that of the 55% of farmers who have never grown potatoes before, 47% wish to do so, and the largest barrier is lack of access to clean potato seed.ⁱⁱⁱ The most popular variety across Rwanda, Kinigi, is known for high yields and large tubers and is currently especially difficult for farmers to access in non-traditional areas. One Acre Fund is already selling Kinigi potato seed in 3 districts (Nyamagabe, Nyaruguru, and Rutsiro) where potato cultivation is common, and we might consider expanding sales to other districts in the future.

In 2016A, One Acre Fund conducted a trial of Kinigi potatoes in non-traditional areas, both monocropped and intercropped with maize, in order to test yields and farmer opinions of the variety in those areas and to determine if it would be more profitable to promote potatoes in monocropped or intercropped systems.

In addition to increasing farmer profits, we hypothesize that promotion of potatoes will have a positive effect on food security and nutrition. Potatoes contain similar calorie levels but higher potassium, vitamins B6 and C, and iron than maize per unit. On a given land area, potatoes also produce much higher consumable kilos of production than maize. Furthermore, intercropping can help to increase total production per unit land area, a crucial strategy to enhance food security for farmers with tiny land sizes, and it increases ground cover, which can help to decrease erosion and improve soil health. We did not attempt to scientifically quantify these benefits during this trial, but they should be taken into account as additional benefits over the pure yield and profit impacts that we did quantify.

11 t/ha	Average yield for Kinigi mono-crop potatoes	39%	Single-season profit increase of maize-potato intercrop over maize monoculture
40	Farmer fields in the trial	100,800	Farmers in districts where OAF does not yet sell Kinigi potatoes who either grow potatoes or wish to do so

¹ A Season in Rwanda refers to crops planted in Aug-Oct of the preceding year and harvested in Jan-Feb of the relevant year, so 2016A crops are planted in Aug-Oct 2015. B Season in Rwanda refers to crops plants in Feb-March of the given year and harvested in May-June of that same year.

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Objectives

- Test the general level of production and farmer interest in Kinigi variety potatoes in the East and Lake Kivu zones of Rwanda where potatoes are less commonly grown but there is interest among farmers to begin cultivation.
- Measure the relative production and profitability of potatoes when compared to maize in these non-traditional areas, as well as the relative profitability of intercropping maize with potatoes compared to the more common practice of intercropping maize with beans.

Hypotheses

- The maize mono-crop will likely prove more profitable than the potato mono-crop, but the potato-maize intercrop will have the highest profits and a “Land Equivalency Ratio” (LER) over 100%.
- Kinigi potatoes will prove generally successful in Lake Kivu, and possibly also in the Eastern Ridges, and farmer interest will be high in both areas.

Methodology

Location Details:

District	Site	Ag Zone	Altitude (m)	Rainfall (mm/year)	Temperature range, rainy season (°C)	pH
Ngoma	Bugera	Eastern Ridges	1,400-1,700	1,000-1,200	15-30	5-5.5
Nyamasheke	Rwesero	Lake Kivu	1,400-1,800	1,600-2,300	13-24	5-6

Trial Farmer Characteristics:

District	Site	Number farmers	One Acre Fund client	% Planted mono-cropped potatoes before	% Grew maize-bean intercrop before	% Grew maize-potato intercrop before	% Knew Kinigi variety
Ngoma	Bugera	20	90%	50%	70%	20%	0%
Nyamasheke	Rwesero	18	50%	0%	61%	6%	0%

Experimental Design and Treatments:

Twenty farmers were recruited to participate in the trial in each site. Every farmer contributed about 300 m² of land, which was verified to be uniform with regard to soil type, slope, previous season crop, and inputs, and to lack any trees or other obstacles. The land per farmer was divided into 4 side-by-side sections of 75 m² each, with the same length and width dimensions. Every plot for a single farmer was planted on the same day, with the same type and quantity of compost. Farmers were allowed to make their own pest and disease control decisions, though they had to treat the same crop in different treatments in the same way.

1. All plots with maize received the following fertilizer quantities:
 - a. Compost at planting: divided equally from the full quantity supplied by the farmer
 - b. DAP at planting: 3 g/hole
 - c. Urea at top dress (when maize had 6 open leaves): 1.5 g/hole
 - d. This was equivalent to 1 kg/are DAP and 0.5 kg/are urea for the mono-cropped plot

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2. All plots with potatoes received:
 - a. Compost at planting: divided equally from the full quantity supplied by the farmer
 - b. 6.4 g/hole of NPK 17
 - c. This was equivalent to 3 kg/are NPK 17 for the mono-cropped plot
3. All plots with beans received:
 - a. Compost at planting: divided equally from the full quantity supplied by the farmer
 - b. DAP at planting: 0.6 g/hole
4. Each treatment involved a different type or quantity of fertilizer, while the fourth treatment also involved top dress (applied in a circle around each plant) after 1 month:
 - a. Maize mono-crop: PAN 4M-21, 75 cm x 40 cm spacing, 2 seeds/hole
 - b. Potato mono-crop: Kinigi, 60 cm x 40 cm spacing
 - c. Maize-potato intercrop: PAN 4M-21 with 1 m x 40 cm spacing, 2 seed/hole, 1 line Kinigi between each maize line, 40 cm spacing between holes
 - d. Maize-bush bean intercrop: PAN 4M-21 with 1 m x 40 cm spacing, 2 seed/hole, 2 lines of local bush beans between each maize line, 20 cm between holes, 2 seed/hole

Variables measured: All input types and quantities applied, germination rates, dates of key growth stages, disease severity levels, any problems encountered, dates of weeding, number of plants, cobs (of different sizes), tubers harvested, total kg harvested, farmer preference, and reasons for preference after harvest.

For the intercropping treatments, we calculated the Land Equivalency Ratio (LER), which is a standard metric used to assess the relative productivity of intercropping when compared to mono-cropping. An LER over 1 suggests that intercropping is more productive than mono-cropping

Results

Treatment	N	Maize yield t/ha	Potato or bean Yield t/ha	LER	Revenue USD/ha (vs control)	Single-season profit USD/ha (vs control)	Farmer preference	Potato disease problem
Maize Mono-crop	38	6.28	--		1,012 a	925 a ²	26%	
Potato Mono-crop	38	--	10.96		2,075 b (105%)	1,000 a (8%)	26%	67%
Maize-Potato Intercrop	38	6.04	4.90	1.54	1,862 b (84%)	1,287 b (39%)	34%	39%
Maize-Bean Intercrop	38	5.59	0.77	1.36	1,162 c (15%)	1,037 a (12%)	16%	

Assumptions:

Exchange rate: 1 USD = 800 RWF

Sales prices for grain: Maize – 178 RWF/kg, Beans – 325 RWF/kg, Potatoes – 155 RWF/kg

DAP price: 410 RWF/kg, Urea price: 355 RWF/kg, NPK 17: 520 RWF/kg

Bean seed price: 350 RWF/kg, Maize seed price: 300 RWF/kg, Potato seed price: 260 RWF/kg (assumes Kinigi will be saved and become like local after introduction)

Kinigi application rate: 22 kg/are in monoculture, 12 kg/are in intercrop (based on actual quantities used in trial)

² Evaluated at p = 0.05 (95% confidence level). In this chart, yield followed by a similar letter indicates no statistically significant difference between other yield numbers followed by the same letter.

Interpretation and Discussion

- Kinigi potatoes generally performed well in both of the non-traditional potato regions in this trial:
 - Eastern Ridges
 - 11.7 t/ha average yields in a mono-crop
 - 12.8 t/ha median yields in a mono-crop
 - 0% of fields with yields less than 4.0 t/ha
 - Lake Kivu
 - 10.2 t/ha average yields in a mono-crop
 - 9.8 t/ha median yields in a mono-crop
 - 11% of fields with yields less than 4.0 t/ha
- The higher LER suggests that growing potatoes intercropped with maize is more efficient and will lead to higher total production than growing either crop in a side-by-side monoculture. By comparison, maize-beans intercropping had an LER of 1.36.
- The potato-maize intercrop had the highest farmer preference (34%), although not by a wide margin. However, looking at both potato treatments combined (in intercrop and monoculture), preference for growing potatoes in some fashion is 60%.
- Profits, using our current assumptions, are also highest for the potato-maize intercrop, and this is the only treatment with a statistically higher profit than the maize monoculture control (39% higher).
- Potatoes are only profitable because we used a price of 260 RWF/kg for seed in the calculations.
 - This price was the average local potato seed price reported by farmers in the trial for varieties other than Kinigi that they can find on local markets
 - Currently, when TUBURA sells Kinigi seed we charge 750 RWF/kg because of the high price of buying, packaging, and transporting certified seed
 - Here we assume a lower price is fair, because after the first season, farmers will save the Kinigi seed and replant without paying more, and eventually the variety will become like a local variety
 - If we use the 750 RWF/kg price for Kinigi in profit calculations, then both the intercrop and mono-crop treatments with potatoes are highly unprofitable

Next Steps

- If possible, we will promote intercropping of maize and potatoes in the future
 - This will require discussion and agreement with the government, which does not currently support intercropping of maize and potatoes
 - If we come to an agreement on this point, then we will organize demonstration plots and trainings of farmers to explain and show the benefits of intercropping
 - We will consider promotion of this practice everywhere and even for local varieties, but especially highlight it as we begin selling Kinigi potatoes in non-traditional areas
- One Acre Fund is already selling Kinigi potato seed in 3 districts in the Congo-Nile ag zone (2016B and 2017A), and we will continue to do so in 2017B
- It could be impactful to extend the variety to non-traditional areas like Lake Kivu and Eastern Ridges, as long as we can either lower the price or ensure that farmers can save the seed and thus find a lower price for this seed variety in the future. To support this plan, we are doing the following:
 - Run a 2017A trial on Kinigi and other potato varieties that includes a higher sample size of farmers in the Eastern Savannah, Eastern Ridges, Lake Kivu, Central Plateau, and Cyangugu agro-ecological zones where potatoes are less common, in addition to the Congo Nile zone where they are most common
 - Repeat this trial on intercropping from 2016A in the 2017A season but with a larger sample size and across a wider range of agro-ecological zones

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- Run a trial in 2017B on saved seed from the 2017A trial in order to test best-practice seed saving methods and estimate second-season yields
- Write and implement a seed-saving training for One Acre Fund clients at harvest time in 2017A and do follow-up surveys to check on compliance and success levels
- Work with multipliers to find reliable Kinigi potato supplies so that One Acre Fund can sell this variety for a lower price
- Continue to implement pre-emptive steps to ensure supply and quality of Kinigi potatoes as we increase trials and sales:
 - At times we have run into difficulties with:
 - Getting consistent disease-free potato seed at adequate quantities for scale
 - Ensuring low rotting during warehouse storage and transport inside packages
 - Helping farmers to save Kinigi seed for the following season while ensuring on-time sprouting, since the variety has a long dormancy period
 - Solutions taken have included:
 - Visiting fields before and during harvest, together with RAB Inspectors, and only taking certified-quality tubers
 - Testing lots for bacterial wilt and using a lower threshold of acceptability (2%)
 - Doing sorting and packaging of potatoes only 1-2 days before distribution
 - Packaging and shipping potatoes inside breathable mesh bags
 - Advising farmers on good seed saving and storage methods, including harvest of tubers for seed 1 month after maturity and application of fungicides during storage

References

ⁱ 2016A & 2016B Crop Mix Surveys. Monitoring & Evaluation Team- One Acre Fund Rwanda.

ⁱⁱ 2016A Extended Crop Mix Survey. Agricultural Integration Team- One Acre Fund Rwanda. September 2015. [Link](#)

ⁱⁱⁱ Sweet Potato and Potato Baseline Survey. Agricultural Integration Team- One Acre Fund Rwanda. October 2016. [Link](#)