Solar-Powered Sweetpotato Fresh Root Storage: The Challenge Continues

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The trial reported here builds on our previous trial which showed how solar-powered fresh orange-fleshed sweetpotato root storage could be used by a processor to smooth supply. After 4 months storage at 20-23°C, over 70% of the root weight of all treatments (and >88% for variety Vita) was able to be processed into the vitamin A-rich puree (steamed and mashed). Now, we wanted to see if lower storage temperatures of ≤15°C could cost-effectively reduce or delay root rotting and sprouting and prevent the development of weevil-life stages within roots, while retaining the beta-carotene content.

Fig. 1 Sweetpotato crates loaded into solar-powered container store at trial set-up at Organi Ltd, Home Bay County, Kenya (Credit Tanya Stathers, NRI)

What is the problem?

The pronounced seasonality of sweetpotato production and prices, adverse weather conditions, and fluctuation in market-demand are challenges faced by the nascent OFSP puree supply chain. Puree is being used by Kenyan supermarket chains for producing vitamin A-rich bread.

A constant year-round supply of high quality OFSP roots is required to produce the OFSP puree. This can be achieved through a combination of staggered production, purchase from different geographical areas, and the storage of fresh OFSP roots to cover periods of low supply.
Sweetpotato roots are stored for up to 9 months in sophisticated purpose-built stores in the US and South Africa, where temperatures of ≤ 15°C are used. In our previous trial, we managed to store fresh OFSP roots at 20-23°C for four months in a solar-powered evaporatively cooled store and process over 70% of the root weight of all treatments (and >88% the variety Vita) into puree. However, we wanted to investigate whether we could achieve cooler storage temperatures, and reduce or delay root rotting and sprouting, prevent development of weevil life-stages within roots, and retain the trans beta-carotene content. We also wanted to investigate how storage effects root marketability and determine the effect of different handling strategies to minimize quality deterioration. These strategies included: removal of the above ground plant (dehaulming) 4 days before harvest; which is thought to promote skin thickening; dry and wet methods of soil removal and postharvest curing to promote healing of harvest wounds.

What do we want to achieve?

Effective and economically advantageous commercial-scale solar-powered storage of fresh orange-fleshed sweetpotato roots for processing into puree, in a tropical area of Sub-Saharan Africa.

Where are we working?

The fresh sweetpotato root storage trial was set-up using a solar-powered converted shipping container store at the Organi Ltd. sweetpotato processing plant in Homa Bay county, Kenya.

How are we going to make it happen?

The NRI postharvest engineer converted a shipping container into an insulated solar-powered controlled temperature and relative humidity storage chamber at the Organi Ltd. processing plant.
The effectiveness of storage was tested using OFSP that had been subjected to four different treatments.

- W-NH = roots harvested by ox-plough and then washed and sun-dried before storage,
- UW-NH = roots harvested by ox-plough and the soil on them dry manually removed,
- W-DH = de-haulming the plant 4 days prior to ox-harvest and roots washed and sun-dried,
- UW-DH = de-haulming 4 days prior to ox-harvest and any soil dry manually removed.

Partners

- Natural Resources Institute (NRI),
- University of Greenwich, UK
- International Potato Center (CIP), Kenya
- Organi Ltd., Homa Bay, Kenya

Figure 2. Sorting and counting raw root during the 4 months storage sampling assessment at Organi Ltd, Home Bay County, Kenya (Credit Dancan Omondi, Organi Ltd.)

The undamaged OFSP roots were placed in wooden crates in the store (Fig 1) in a randomized experimental design and cured at 28-30°C and 95% relative humidity (rh) for four days, prior to then storing them at ≤ 15°C and 90% rh.

The trial assessed the quality and utility of the stored roots after 0, 4, 8, 12 and 16 weeks storage. At 0, 8 and 16 weeks storage, 25 kg of roots from each treatment were processed into puree and the ease of root preparation, puree sugar content, stickiness, thickness and colour were assessed. Additionally, raw roots and puree samples were sent for beta-carotene content laboratory analysis.

Who are we working with?

This fresh root storage trial was designed and managed by researchers from the Natural Resources Institute (NRI) of the University of Greenwich, UK and the International Potato Center (CIP) in Kisumu and Nairobi, in conjunction with staff at Organi Ltd.

What have we achieved so far?

Although our previous storage trial showed that solar-powered fresh root storage was an effective way for processors to extend and manage the availability and quality of sweetpotato roots for processing into puree, the root quality from this trial was disappointing despite achieving the desired lower temperature (13.5-15°C).

After 4 months of storage (Fig 2), the roots had lost between 26 – 38 % of their weight, with slightly higher weight losses experienced in the crates of roots that had been washed and slightly lower weight losses in the crates of roots harvested from plants that had been dehaulmed 4 days prior to harvest. Only 35 - 56 % of the root weight was suitable for processing into puree after 4 months storage. This was mainly due to the extremely high incidence of rotting (47 - 67% of roots) and weight loss that occurred (Fig 3).

On the positive side, there was only minimal incidence of sprouting, weevil damage and no rodent damage in the current trial during the 4 months storage. However, the very high incidence of rotting and associated shrivelling meant only 21-40% of the roots were still of marketable quality after 4 months storage.

What's next?

The unacceptably high incidence of rotting which occurred during this current trial was unexpected, and the focus is now on understanding the causal factors so that the handling and storage strategy can be adapted to minimise rotting and optimise quality. Data from a CO_2 sensor in the store indicated that the rate of root respiration was very high, indicating that the roots were stressed. This contributed to the high rate of weight loss. This may have been due to CO_2 accumulation and the response to rot development. After one month the level of surface mould was particularly high for washed roots, which would have increased the fungal spore load in the store. Trials to test the impact of curing conditions (temperature and humidity) and storage duration on rot development will be carried out. Furthermore, increased ventilation will be installed in the store to prevent CO_2 build-up.

Results did indicate that dehaulming of plants 4 days prior to harvest reduces storage weight loss of roots, while washing appeared in this trial to increase it. These findings will be useful for follow-on trials. Moreover, some varieties will store better than others, and as exploration of this root storage approach develops, comparison of the storage characteristics of different OFSP varieties should be undertaken.

In parallel to optimizing the technical aspects of the store, an economic analysis is on-going to investigate strategies to reduce capital investment and running costs to widen the applicability of the storage approach.

Fig. 3 Normal harvest unwashed roots after 4 months storage displaying the high incidence of rotting which occurred in this trial (Credit Benard Otieno, Organi Ltd.)

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