Solar-Powered Storage in Mozambique: Lessons Learned and Way Forward

- Design, installation and testing of a solar-powered storage facility (Fig.1) was conducted over four months in Marracuene, Mozambique using fresh roots of four varieties
- The percentage of marketable root weight was above 70% of the initial weight at four months of cold storage in all the four varieties
- There were no significant differences in dry matter, zinc, fructose, glucose, sucrose, and protein from one month to four months of storage.

SASHA Sweetpotato Action for Security and Health in Africa

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Fig 1. Backside of the storage facility showing water outlets from air conditioner, curing room and cold room (Credit: G. Makunde)

What was the problem?

Sweetpotato production is largely supported by unimodal rains in Southern Africa. A lot of sweetpotato roots come to the market at the same time during the year, resulting in gluts and low prices. Farmers retain some varieties in the ground for longer periods of time, harvesting as needed. But other varieties are susceptible to weevil attack once soils begin to crack in the dry period. As orange-fleshed sweetpotato is increasingly demanded in urban markets, having out-of-ground storage to extend availability is key. Given the high cost and irregular supply of electricity, solar-powered storage capability deserves to be explored.

What objectives did we set?

The objectives were to (i) assess the storability and retention of nutrients in four sweetpotato varieties stored under solar-powered cooling conditions over a four-month period in Mozambique and (ii) assess the effect of such cold storage on the shelf-life and stability of culinary characteristics of the four sweetpotato varieties. Three orange-fleshed varieties Irene (29.6% dry matter (DM)), Delvia (31.0% DM), and Sumaia (23% DM) and a local white-fleshed variety (33.8% DM) were evaluated under four treatments. The treatments included checking root quality after 1, 2, 3 and 4 months in cold storage. Each variety was replicated three times. Marketable roots were selected from freshly harvested roots.

Where did we work?

The work was done in Marracuene district, Maputo Province. The South African firm ECOTECH was contracted to design and install the storage facility.

What did we achieve during SASHA Phase 2?

Installation and utilization of solar-powered storage facility at the União das Cooperativas Agrícolas de Marracuene (UCAM). ECOTECH designed and built the solar-powered storage facility in Knysna, South Africa (Fig. 2). It was then installed in June 2018 at UCAM.

Successful storage of sweetpotato roots for a period of four months. There was no in-ground curing of the roots prior to harvest. The curing process took 6 days and roots were transferred into to the cold storage compartment of the container on the seventh day. On average, the curing conditions were less than ideal. Mean temperature was 27°C and relative humidity (RH) 76%, the latter considerably below the recommend 90% RH. The curing room had to use a supplementary heater on occasion when the solar powered system failed to maintain the necessary level of heat. Roots in each crate were sorted before transferring to the cold room--- removing roots which showed any signs of rotting or softening or signs of sprouting.

The percentage of marketable root weight was above 70% of the initial weight at the beginning of four months of cold storage (Fig. 5) in all the evaluated varieties, Irene (Fig. 3), Delvia, Sumaia (Fig. 4) and a local variety.

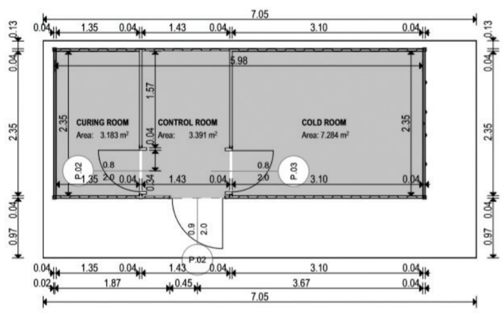

Fig 2. Floorplan of the facility, showing separate curing and cold rooms

Fig 3. Variety Irene after 4 months of storage (Credit: G. Makunde)

Fig 4. Variety Sumaia after 4 months of storage (Credit: G. Makunde)

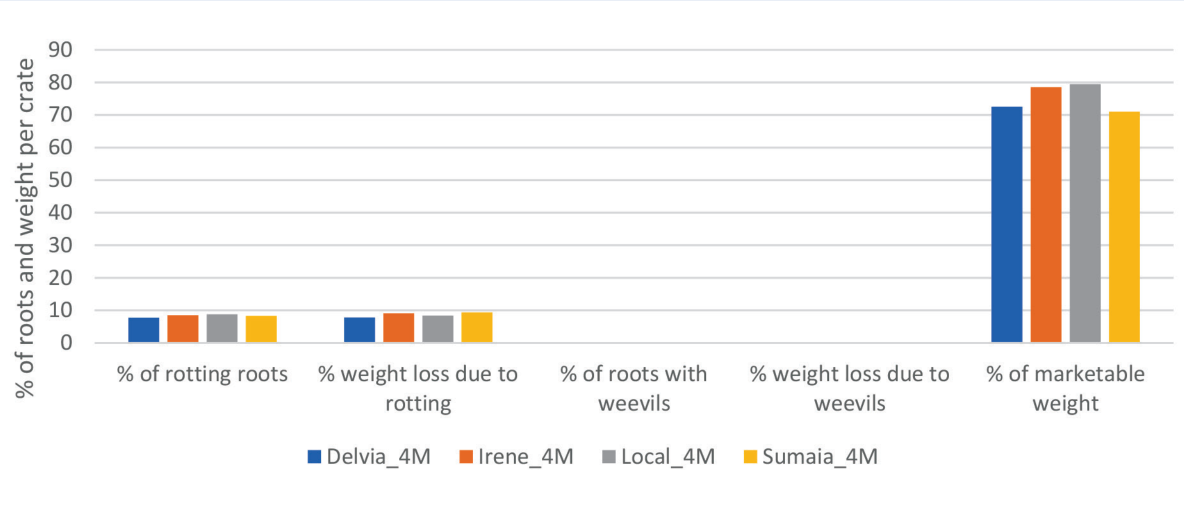

Fig 5. Marketable root weight, losses due to rotting and weevil damage expressed as a percentage relative to the initial number of roots and root weight per crate at the beginning of 4 months of cold storage (post-curing)

Root quality maintained during long storage. There were no significant differences in dry matter, zinc, fructose, glucose, sucrose, and protein from one month to four months of storage. Storage duration had small effects on cooking taste. Overall, the cooking taste was good at one month and decreased to fair in subsequent months. Delvia, Irene and the local variety had a good cooking taste even at four months of cold storage, but Sumaia had poor taste. However, there was considerable loss of beta-carotene after 2 months of storage for Delvia and 3 months of storage of Irene, but not in Sumaia, even at 4 months.

Where there any key challenges or lessons learned?

Curing is a key ingredient for long sweetpotato shelf life. The curing process allows wound healing and facilitates identification of bad roots (with soft rots) to be selected out before storage. The curing capacity of the unit needs to be improved.

The external environment mainly sunlight, relative humidity and temperature have an important influence on the efficiency of the solar powered storage facility. Rainy and cloudy days affect the energy conversion and movement. The unit was able to maintain an average desired temperature of 15°C (range 13-17°C) and 88% RH (range 67-97%), while mean ambient conditions outside the unit were 23°C (range 12-45°C) and 70% RH (range 9-100%).

Frequent monitoring of the storage facility was required to control carbon dioxide built up in the storage room.

Under both curing and storage processes water should never touch the roots. Water promotes rotting. In addition, no roots should be cleaned by washing with water prior to curing. Use brushes to dust away soil particles.

Boxes used for curing should be changed when roots are moved to the storage room (Fig. 6). This gives assurance that the boxes are dry and no chance of retaining moisture.

What's next?

The next cohort of solar powered storage trials will be run from August 2019, comparing roots from dehaulmed and non-dehaulmed plots. Meanwhile, storability of roots as a 'trait' has been incorporated into sweetpotato breeding programs in Southern Africa. We will continue to work on improving conditions in the storage facility to lower losses, especially due to rot. With current levels of loss, it does not pay to store roots for four months.

Fig 6. Storage of roots in wooden boxes (Credit: G. Makunde)

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