We build international fruit and vegetable research partnerships that improve livelihoods in developing countries.

Innovative Energy Solutions for Horticulture

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Rationale

Among the most promising disruptive technologies for application to horticulture are those that address the use of energy in the production, marketing, and processing of horticultural crops

We proposed to test

- D.C. air conditioner/CoolBot for a solar-powered cool room
- In-village solar panel construction to reduce the cost of photovoltaic supply
- Inexpensive photovoltaic pumping based on R.V. water pumps
- Adsorption refrigeration using Zeolite beads
- High intensity LEDS for a solar-powered germination cabinet
- Vacuum-sealed straw bales for building inexpensive insulated rooms
- Aerogel panels for high-quality insulation
- Peltier-effect cooling for small-scale transport
- Low-cost air suspension for small-scale transport
- Simple solar dryer for fruits, vegetables, and grains
- Facilitated solarization for weed and soil-borne disease control

Stack solar dryer

- We have designed an improved solar dryer for fruits and vegetable that should work with fish, meat, and grains
- The key feature is a 2m stack to induce high airflow
- The geometry increases energy collection in the morning and evening and focuses air flow around the drying trays
- The dryer could be a key technology in the 'dry chain'

Photovoltaic pumping

- We combined a small solar panel (50W) with a simple irrigation filter, and an inexpensive yet reliable pump designed for use in RVs,
- A HortCRSP PI implemented the system on a small scale in Malawi, and cooperators there are now evaluating ways to scale-up implementation.

Peltier-effect cooling for transportation

- High capacity Peltier cooling systems have been developed for use with modern computer chips
- They are very cheap, but less efficient than the conventional compressor systems
- They use a lot of electricity, but are easy to install in an insulated box to provide cooling
- We plan to test the use of Peltier coolers in an insulated box on the back of a pickup truck or, with a PV panel, on a bicycle trailer
- The truck will be fitted with an additional alternator to provide the needed electricity

	Stack Dryer	Cabinet Dryer
Capital cost ($)	38.93	58.84
Fruit capacity, fresh weight (kg)	4.5	2.25
Time to dry fruit to 10% MC (11h days)	2.0	5.5
Cost per drying capacity ($/kg-day)	7.33	26.66
Average air temperature leaving dryer – ambient (°C)	15.2	9.3
Air velocity past fruit (m/s)	0.63	0.11

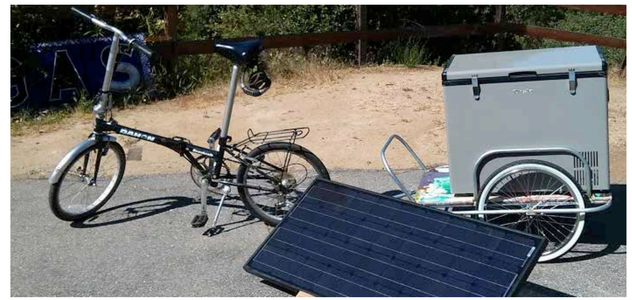
Testing

We compared the effectiveness of the stack dryer with that of a traditional cabinet dryer.

- The stack dryer required only 2 days to drop the tomato moisture content to 10% compared with 5.5 days for the cabinet dryer.
- The stack dryer cost $7.33 per kg-day drying capacity compared with $26.66 per kg-day for the cabinet dryer.

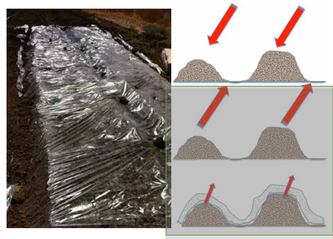
Small-scale cool transport

- Small-scale DC coolers are available commercially
- With a 100 W solar panel, this unit can cool 50 kg of product in one day
- We have designed a small trailer that can carry the cooler
- Or a well-insulated box
- Soft tires provide simple air-suspension



Facilitated solarization

Much of the labor in horticulture is for weed control.
Herbicides are not a sustainable option.
Solarization is effective takes several weeks
In our system, an insulating layer is placed over the plastic film each afternoon and removed each morning
This results in higher soil temperatures within days
Future experiments will test different insulating materials



DC air conditioner for a solar-powered coolroom

- Air conditioners powered directly by DC are now commercially available
- We plan to test one with our CoolBot-controlled room
- We have developed a spreadsheet that models heat flows in coolrooms
- A well-insulated room full of produce holds temperature sufficiently well to eliminate the need for night-time cooling
- We are planning a competition for alternative designs for off-grid cooling

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