

Low-Cost Natural Building Options for Storing Seeds in Southeast Asia



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Introduction



Given the proper facilities necessary to store seeds long-term, whereby low temperature and low humidity are kept stable over time, it is very possible to store most orthodox seeds for several years at a time in the tropics (Harrington, 1972). Unfortunately, implementation and maintenance of the proper facilities can be very costly. Thankfully, many diverse options currently exist, from expensive, high-tech facilities down to low-cost, low-maintenance models. At ECHO, we operate our own range of seed storage facilities at our various seed banks around the world (Below).



Figure 1. (A) ECHO Global Farm Seed Bank Cold Room, climate-controlled for temperature and humidity. (B) ECHO Global Farm Container Cold Room, retrofitted refrigerated shipping container. (C) ECHO Asia Impact Center, foam insulated split-unit A/C cold room.

Materials & Methods

Comparing Earth Bag Houses, Hillside Bunkers, and Buried Cisterns:

Using lablab - *Lablab purpureus* (L.) - seeds were stored over the course of one year inside of three different natural building facilities, including (1) an Earth Bag House, (2) a Hillside Bunker, and (3) a Buried Clay Cistern (Figure 2). Seeds were placed inside of each facility, with half of the seeds being (A) Sealed in jars using a modified Bicycle Vacuum Pump (Bicksler, 2015; Thompson, 2016), while the other half remained (B) Unsealed in Paper Bags. Four separate batches were placed in each storage facility in order to test seeds for Seed Moisture Content and Germination rates over the course of months 3, 6, 9, and 12, with containers remaining unopened until testing during their respective months.

In addition to testing and monitoring the viability of these seeds stored in these environments, data loggers were placed inside and outside of each of these facilities to track storage conditions over the course of one year, specifically temperature and relative humidity. Data loggers recorded temperature (oC) and relative humidity (%) every hour.

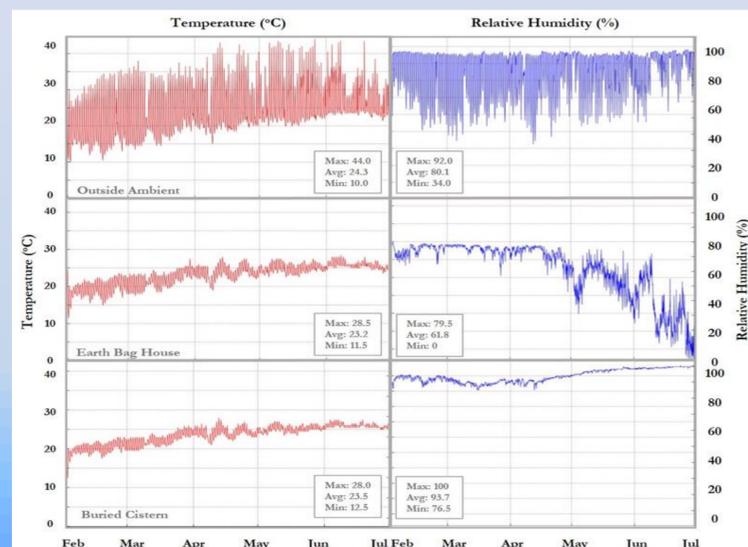
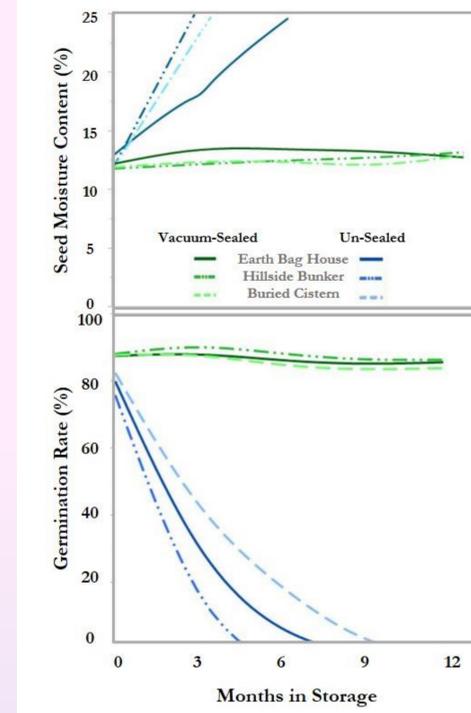


Figure 2. (A) Earth Bag Seed Storage Room. (B) Buried Ceramic Cistern for Seed Storage. (C) Hillside Bunker Seed Storage Room

Figure 3. Comparison of Temperature (oC) and Relative Humidity (%) conditions - over a 6 month period - of outdoor ambient conditions and conditions inside of an Earth Bag House and a Buried Ceramic Cistern designed for seed storage in northern Thailand.



Climatic data collected from the Thailand site generally indicate a significant stabilization of temperature and humidity in the Earth Bag House and Buried Cistern compared to Outside Ambient conditions (Figure 3). Temperatures did not drop considerably on average in each of the storage facilities (~23oC), but daily temperature swings were reduced substantially. Relative humidity inside of these natural building facilities was very high overall, even during the dry season (Figure 3).

On their own, these natural earth-building facilities appear to be poor storage facilities for seeds, due to their high rates of relative humidity, which can quickly deteriorate seed quality. In both Thailand and Myanmar, seed germination rates of unsealed seeds plummeted from 94% to less than 50% within just 3 months of storage (Figure 4).

Figure 4. Comparison of seed quality (seed moisture content and germination rate) when stored inside Earth Bag Houses, Hillside Bunkers, and Buried Cisterns over the course of one year, from Myanmar and Thailand sites.

Results & Discussion

However, in combination with vacuum sealing, seed germination rates in each of the 3 storage facilities remained steady over the course of one year, maintaining germination rates above 90% at the end of the experiment.

Conclusions and Outcomes

Over the years, ECHO has scaled its various seed banks around the world to the specific needs of the individual seed bank. Each has its appropriate scale and serves different purposes, from distributing thousands of seed packets a year, to serving the needs of a single community or region. (Table 1) While this data may speak more to the necessity of vacuum-sealing than to the efficacy of natural earth-building techniques for seed storage, it is important to note that in a recent ECHO seed storage experiment we found that vacuum-sealing on its own was not enough to maintain adequate seed viability over the course of one year in Thailand's tropical conditions. The ability to maintain high germination rates over the course of the entire year in this experiment leads us to believe that the combination of vacuum-sealing AND storage in a stabilized environment are what led to extremely effective seed storage practices in this experiment.

	Facility	Location	Details	Size (m)	Avg. Temp. (oC)	Cost (USD)
Long-Term Storage Options	ECHO Global Farm Cold Room (large)	Florida, USA	High-tech, climate-controlled, walk-in cold room	6 x 3 x 2.5	5	35,000
	ECHO Global Farm Shipping Container Cold Room	Florida, USA	Retrofitted refrigerated shipping container, single split-unit A/C system with Cool-Bot sensor	2.5 x 3 x 2.5	-	10,000
	ECHO Asia Cold Room (large)	Chiang Mai, Thailand	Foam insulated, double split-unit A/C system with Cool-Bot sensor	8 x 5 x 2.5	15	5500
	ECHO Asia Cold Room (small)	Mae Ai, Thailand	Foam insulated, single split-unit A/C system with Cool-Bot sensor	5 x 3 x 2	6	3250
Year-to-Year Storage Options	Earth Bag Storage House	Mae Ai, Thailand	Clay and rice hull filled bags, stacked walls with thatched roof	4diam. x 1.7h	23	750
	Hillside Bunker	Mae Ai, Thailand	Dug-out storage nook, in primarily clay-based hillside or sloping land	2 x 2 x 1.5	-	80
	Buried Cistern	Mae Ai, Thailand	Large glazed ceramic cistern designed for water storage, buried up to the rim in the ground	-	23	20

Table 1. Economic summary of various Seed Bank Cold Room and Seed Storage options used at ECHO's various sites around the world.

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