Seed Storage
&
Appropriate Technologies

ECHO®
ASIA IMPACT CENTER

How do you store your seeds?

3 limiting factors for storing seeds

1. **Temperature**
   - Ideal seed moisture content for storage is 3-8% for orthodox seeds
2. **Moisture**
   - Ideal seed moisture content for storage is 3-8%
   - Stability is better
3. **Oxygen**
   - Low oxygen keeps seed in dormant state
   - Low oxygen will kill off insect pests

Some Appropriate Seed Drying Methods

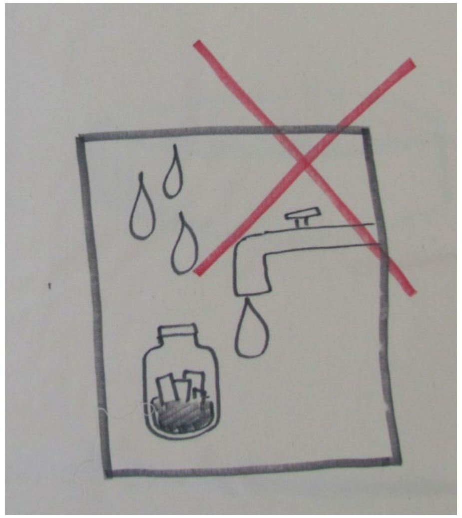
Drying in the Sun

Drying Shelves

Home-Built Seed Dryer

Storing Seeds

- Seed should not be exposed to ambient moisture in storage
  - Don’t let them be exposed to high humidity again!



Rule of 100

The combination of the temperature (F) plus the relative humidity (%) of the ambient environment where seeds are being stored should not be greater than 100

How to overcome?

- ☐ Climate controlled environment
- ☐ Desiccant
- ☐ Airtight containers
- ☐ Vacuum sealing

Cold Room Storage Options

Cold Room Storage Options

	Facility	Location	Details	Size (m)	Avg. Temp. (°C)	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 x2 .5	15	5500
	[1]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

Some Appropriate Storage Methods

Vacuum Sealing

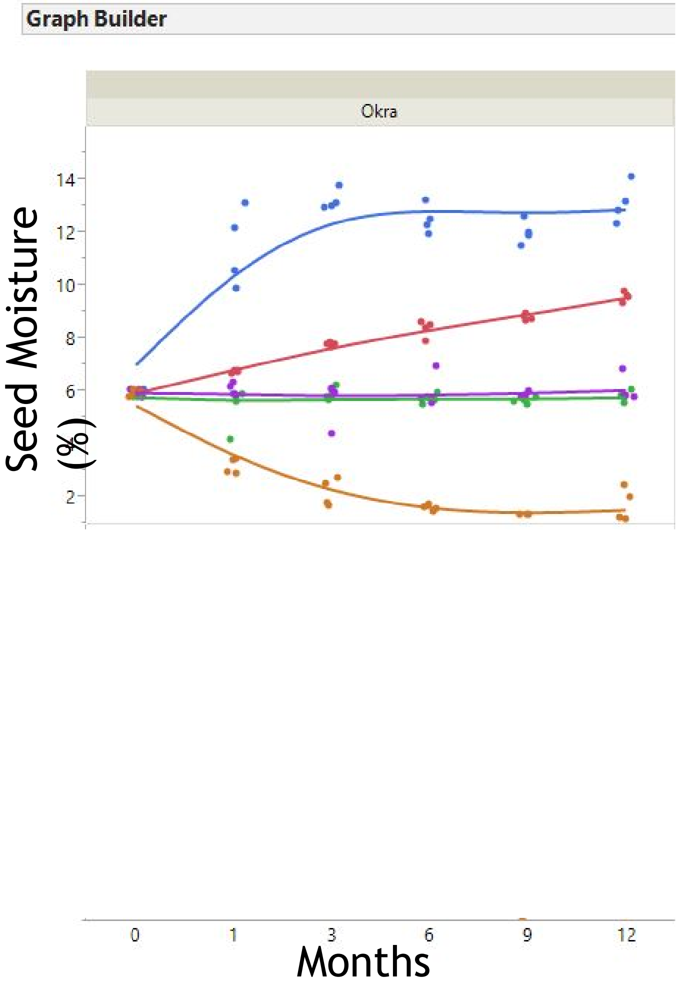
Some Appropriate Storage Methods

Appropriate Seed Storage Methods Experiment

1. Control (Paper bags)
2. Vacuum Sealed with Machine
3. Vacuum sealed with modified bicycle pump
4. Calcium Oxide Powder
5. Zeolite Drying beads

Months

Appropriate Seed Storage Methods Experiment



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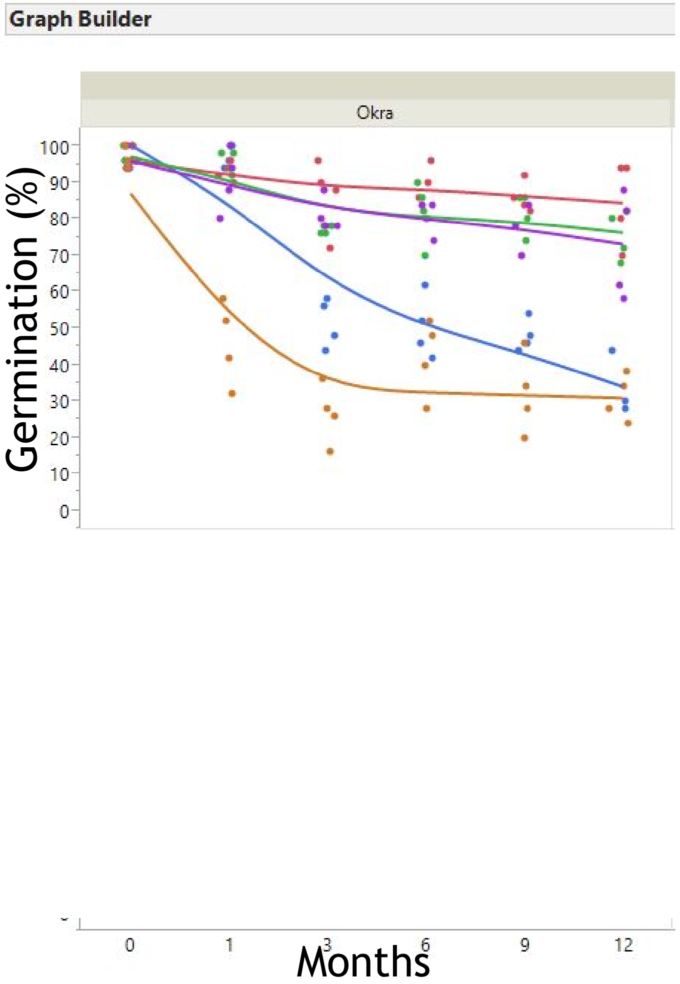
Appropriate Seed Storage Methods Experiment



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ECHO Asia Notes

A Regional Supplement to ECHO Development Notes

Edited by Patrick Trail & Daniela Riley

May 2019 | Issue 38

Refugee Camps as Microcosm: Restoration & Sustainability in an Accidental City

Adapted from article by Gene Fifer (Edited by Gabe LePage[1])

[1]*ECHO Asia Impact Center; Chiang Mai, Thailand*

[Editor's Note: This article seeks to address the broader challenges of food security in refugee camp environments, of which there are many within our Asia region, while offering individual practical options that may be implemented to address the need for nutritional diversity in these challenging settings. For further questions or feedback please feel free to contact the author at etf26@cornell.edu]

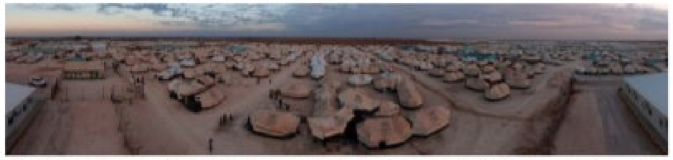

Figure 1: *Za'atari Refugee Camp in Jordon.* (UNHCR Photo Unit, Creative Commons Attribution License)

Refugees, Asylum Seekers, and Internally Displaced People

Forces causing dislocation and flight from danger are on the increase worldwide. On an average day, 44,000 people are displaced and seek refuge within their own country, neighboring countries, or other continents. In 2017 alone, 1.2 million refugees fled Myanmar, 6.3 million fled Syria, and 2.6 million fled Afghanistan. The total number of people displaced due to civil conflicts exceeded 68 million at the end of 2017. This total included 25.4 million refugees (i.e., those crossing national borders), 3 million people seeking official asylum in other countries (also called political refugees), and 40 million internally displaced people Eighty-five percent of these refugees fleeing violence relocate to developing countries or regions with populations struggling with food insecurity and poverty. Over half of the refugees are under 18 years old as well (UNHCR, 2018).

The severity of the migration crisis goes far beyond the 68 million people classified as refugees, asylum seekers, and internally displaced people (IDPs) since this number does not include regional and international migration due to hunger, poverty, and lack of opportunity. It excludes people fleeing crime and gang violence in their home countries, drought and famine, land seizures and forced relocation, and natural and environmental disasters (FAO et al., 2018). Hundreds of millions of people are on the move seeking safety, food, and opportunity. According to the International Organization for Migration, the total number of international migrants was over 257 million by the end of 2017 (International Organization of Migration).

Accidental Cities on the Margin

Refugee camps are almost always located on sparsely populated "waste" land, so the host country does not need to displace a large population. For example, reports suggest that the government of Bangladesh may plan to settle 400,000 Rohingya refugees on Hatiya Island—an uninhabited river island prone to flooding and typhoons (bdnews24.com). This wasteland is usually hot, dry, and dusty, and the addition of thousands of families in high-density housing with inadequate waste disposal creates a harsh environment. The camp environment, or "Accidental City," is a microcosm of the conditions that exist in urban slum areas where non-refugee migrants settle in their own countries and other countries (Figure 1).

Featured in this AN

The ECHO Asia Impact Center operates under ECHO, a non-profit Christian organization that helps you help the poor to produce food in the developing world.

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Low-Cost Natural Building Options for Storing Seed in Tropical Southeast Asia

by [1]Patrick Trail, [1]Yuwadee Danmalidoi, [2]Saw Moo Pler, [1]Abram Bicksler, and [1]Boonsong Thansrithong

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[2]*Kahelu Small Farm Resource Center, Pathein, Myanmar*

[Editor's Note: ECHO's Network of Community Level Seed Banks across Asia leads not only to the sharing of more seeds, but to the sharing of information as well. In 2018 ECHO Asia partnered with the Kahelu Small Farm Resource Center in Myanmar's Irrawaddy Delta to research the practicality of storing seeds in various low-cost earthen structures, with and without vacuum-sealing. We are pleased to engage with partners in the field to test and verify better the practices and technologies we promote, with the goal of sharing this information with the wider ECHO network.]

Figure 1A: *Earth Bag Seed Storage Facility*

Figure 1B: *Hillside Bunker Seed Storage Facility*

Figure 1C: *Buried Clay Cistern Seed Storage Facility*

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 and many existing seed bank and gene bank facility examples do not satisfy the needs of many smaller organizations or communities. Thankfully, many diverse options currently exist, with varying levels of investment for a wide range of facilities, 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, from a high tech, walk-in climate-controlled cold storage room, to a retrofitted refrigerated shipping container, to a low-cost, foam-insulated cold room cooled with a standard split-unit air conditioning system.

While each of these systems has proven to be effective in storing seeds for our needs over time (Motis, 2016), even our lower cost options do not adequately address the very real question of how seed storage facilities may be replicated at a farm or local community level. Though we have learned how to bring down costs considerably to establish low-budget facilities, these options remain out of reach for many communities and smaller organizations, and each example currently relies on the need for an uninterrupted supply of electricity, among other barriers. In an attempt to address these ongoing questions, much of our recent effort at the ECHO Asia Seed Bank has shifted into improving the practicality and cost-effectiveness of seed storage options for small Community Level Seed Banks, and on down to the individual farm level.

Building on ideas observed in the field, and storage ideas passed onto us by ECHO network members (CRS, 2014), we attempted to verify the effectiveness and practicality of various options using natural earth-building techniques. A small research experiment was implemented over the course of 2018 (Jan – Dec) at the ECHO Asia Seed Bank in Chiang Mai, Thailand, and was replicated by one of ECHO's Community Level Seed Bank Network members in Myanmar.

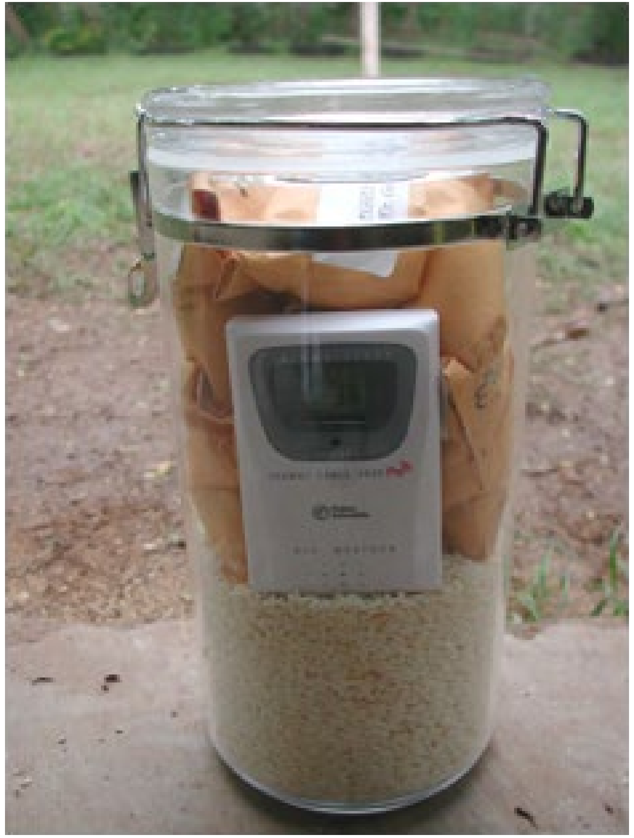
Comparing Earth Bag Houses, Hillside Bunkers, and Buried Cisterns

It has been suggested for many years now that various natural building facilities such as earth bag and rammed earth houses may serve as ideal sites for storing seeds, while in other places it has been suggested that storing seeds underground may be effective as well. Keeping in mind the insulating qualities and low-cost of construction of natural building techniques (Build Abroad), we began testing different methods at the Asia Impact. In 2018, ECHO conducted a small experiment in Thailand and Myanmar to test these hypotheses, specifically within the Southeast Asian context, where temperature and humidity are higher than the climates in which these facilities have previously been implemented.

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 1). 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 (°C) and relative humidity (%) every hour.

Climate Controlled Room



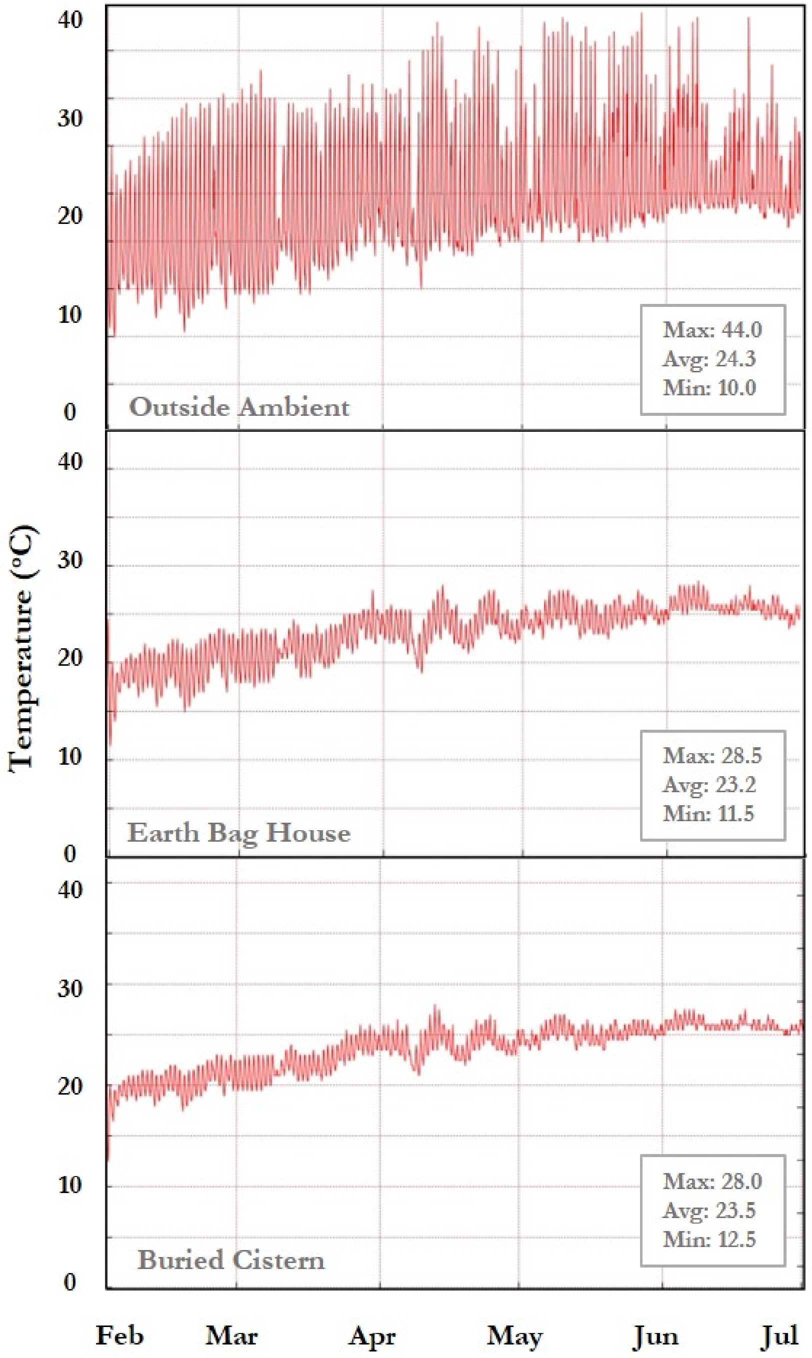

EARTHBAG
VACUUM - SEALED
150g SEEDS
ZEOLITE BALLS
EVERY 5 MIN

Seed Storage Options

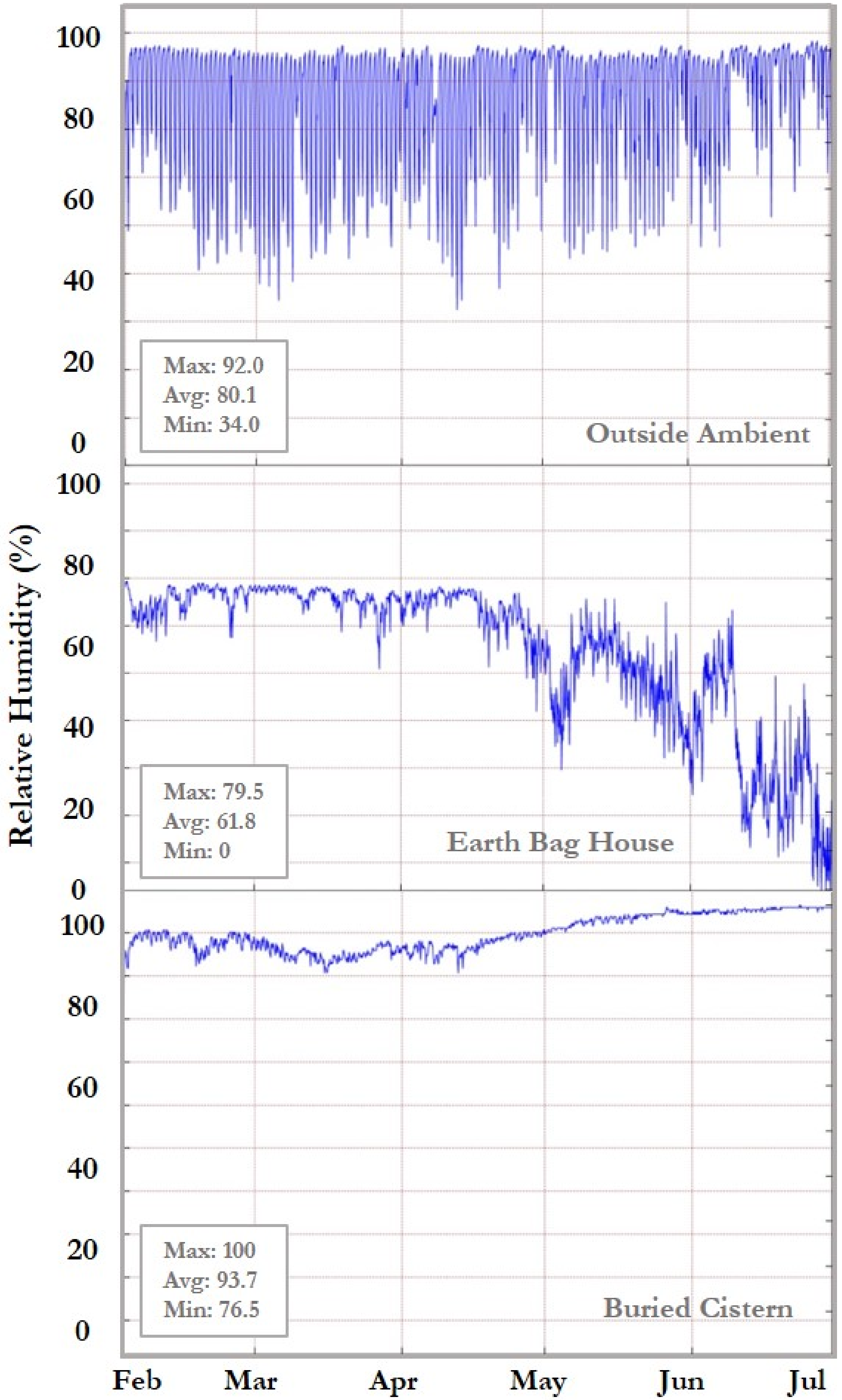
Demonstrated at Kahelu Small Farm Resource Center, Pathein, Myanmar

Seed must be sealed!

Temperature Stability



Temperature Stability



THANK YOU!

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