Verde Base:
Automated Lunar Greenhouse Concept Development and
Simulated Lunar Derived Soil Vegetative Growth Experiment

Report for the Student Visions of the Future Program
NASA Institute for Advanced Concepts
March 23, 2004

Kam Yee
University of Washington, Bothell
Underground location - Lava tubes

Advantages:

• Radiation protection
• Meteoroid shielding
• Natural thermal insulator
Semi-direct solar heating and lighting system

• Heating and lighting system
• Efficient energy usage

• No cosmic radiation!
Semi-direct solar heating and lighting system
Alpha reflector and tower

Alpha reflector/tower at 30 meters high
Seen 10 km away

\[ P_{\text{tot}} (1.05)^{nr} \]

Reflector Size = \[ \frac{L_{\text{sun}}}{\text{Reflector size}} \] \geq 4.56 \text{ m}^2

a) 2.14 m x 2.14 m
b) diameter of 2.4 m
SAM

Systematic Agricultural Machine
WASAP

Water and Soil Acquisition Probe
Starchy Food Requirement

- 6-11 servings of bread group per day/per adult
- 15 grams per serving = 170 grams per person/per day

Grain $\sim 1000 - 1500 \text{ g/m}^2$

Space of 1 module = 30 m$^2$
## Food supply duration

<table>
<thead>
<tr>
<th>Crew Size</th>
<th>1 Cycle’s Yield</th>
<th>1 Year’s Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 person crew</td>
<td>4 Modules</td>
<td>3 ½ months</td>
</tr>
<tr>
<td>12 person crew</td>
<td>6 Modules</td>
<td>5 ½ months</td>
</tr>
<tr>
<td>8 person crew</td>
<td>6 Modules</td>
<td>3 ½ months</td>
</tr>
<tr>
<td>12 person crew</td>
<td>8 Modules</td>
<td>5 months</td>
</tr>
</tbody>
</table>
Lunar-derived soil

Composting:
- Recycles scarce organic material (waste management)
- Produces carbon dioxide
- Gives off heat during decomposition
Radishes at one week
Radishes at one month
Causes?

- Insufficient watering
- Spacing
- High temperature
Future Work

Undergraduate research

Better simulated lunar-derived soil

Change crop
Special thanks to:

NASA Institute for Advanced Concepts
University of Washington, Bothell
The Museum of Flight
South Seattle Community College
Paul Unwin, Gus Posey, Meredith Hale,
Dr. Colin Danby, Marjie Vittum-Jones,
Marty Hale-Evans, Jay Unwin, and my family.

**3-D Rendering:** Gus Posey