BEAM Composting and Models of Climate and Resilience for Food Security

Agenda for this meeting

1. Introduction to BEAM composting – background, formulation, optimal conditions, carbon sequestration etc potential for co-composting with Biochar for sequestering ammonia and nitrogen
2. **How to use BEAM compost (amount, what crops etc)** -Seed coating, foliar spray, top dress, direct application to root zone during transplant, compost tea.
3. **Construction and different configurations —settling and breakdown shrinkage - challenges**
4. Building BEAM composting systems with particular focus on low cost reusable materials
5. Lessons Learned - more observations needed on response of specific fruits and veggies to BEAM i.e brassicas.
6. Build a BEAM System

Background

- Developed by a husband and wife team David Johnson (a career molecular biologist) and his wife Hui-Chun Su

- Similar to other forms of compost – ideally need wood chips, green/brown waste such as leaves, and a manure or nitrogen source

- Utilizes an aerobic process and is similar to most other composting but does not turn the biomass, preserving the fungal hyphae; resulting in a much more diverse compost.

- BEAM – Increases soil fertility, soil carbon, seed germination, soil water infiltration and retention

- A relatively easy effective way to manage manure on small farms. If manure is not available or an entirely plant based compost is desired, a variety of nitrogen sources can be used.

Benefits - Why use this method ?

- Easy – Set it and forget it- Passive Aeration ensures low maintenance (but have to leave for a year for good BEAM)
- Higher Yields- Improved Fertilizer Efficiency- Reduced Fert. Requirements **
- Does not produce much in the way of greenhouse gas emissions because it is aerobic
- Excellent fertilizer that focuses on having the mycorrhizal fungi provide access to nutrients, minerals and trace elements (fungi perform this service in nature)
- High Fungal to Bacterial ratio

Table 1. Types of fertilizer and carbon footprint

Type of fertilizer	Lbs of CO2 Equivalent (per lb)	With farming and transportation CO2 equivalent per lb	CO2 Equivalent (lbs of CO2e/acre)	Application Rate Assumption	Overall impact on CO2 emissions
Ammonium nitrate	0.5	0.575	86.25	150 lbs./acre	3 to 10x more per lb of CO2 equivalent emissions; loss of organic matter; increases dependency on exports
Urea	0.5 – 1	0.575 - 1.15	115 lbs.- 230 lbs. CO2e/ acre	200 lbs./acre	5 to 20x more per lb CO2 equivalent emissions; loss of organic matter; increases dependency on exports
Compost	0.1 -0.3	0.115- 0.345	230lbs.- 690 lbs. Co2e/acre	2 cubic yards/acre. BD @ 1,000lbs/ yard =2,000lbs/ acre	same or more CO2, plus increases soil organic matter 22 to 33% but dependant on the quality of compost and existing levels
BEAM Compost	0.1 -0.3	0.115- 0.345	0.23lbs - 0.69 lbs	2lbs / acre when applying as compost tea	125 - 375x less carbon footprint than commercial fertilizers
Fish Hydrolysate	0.05 - 0.1	0.0575 - 0.115	1.5 lbs- 3.0 lbs.	3 gallons (26.25lbs) /per acre -	30 -150x less carbon footprint, increases organic matter; creates circular economies

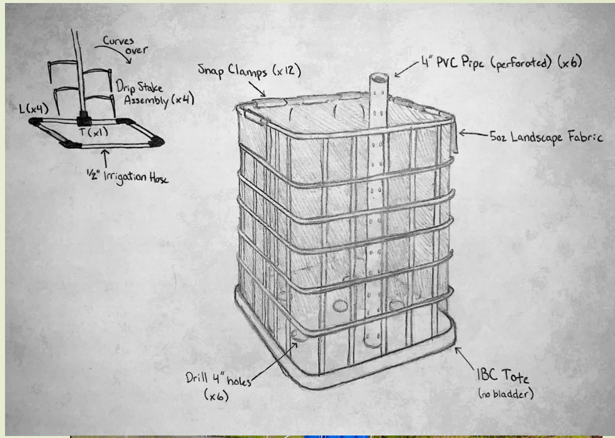
Data Sources

"Greenhouse gas emissions from the life cycle of fertilizers" by the Food and Agriculture Organization of the United Nations
"Carbon footprint of fertilizers: A review" by the Journal of Cleaner Production
"Composting to avoid methane production" Western Australia Agriculture and Food www.agric.wa.gov.

How to use BEAM?

- Compost Tea (2 pounds per 20 gallons) – earlier in the planting process the better
- Seed coating
- Foliar spray
- Top dressing (though getting it in the root zone is critical) – direct application at bottom of hole at transplanting
- Potential to use with cover crop and then transplant into the cover, clover, vetch, buckwheat, oats, rye, wheat (multispecies blends preferred) peas/oats, field peas, hairy vetch, oats – spring - early summer
- CROPS – vegetables, fruit trees etc – not necessarily that beneficial with Brassicas as they don't form strong mycorrhizal associations

Many materials could be upcycled into a BEAM composter



1) Trash Can/Recycling Can
2) 60 Gal Pickle Barrell (Food Grade)
3) 275/330 Gallon IBC Tote Container (Food Grade)
4) Plastic Pallets (Preferred) or Wood Pallets
5) T- Posts and Cattle Panel or Wire
6) One of the benefits of the BEAM is that almost any container can be set up to facilitate passive, low-maintenance composting.

Feedstocks

1) Leaf Bank
2) Woodchips (maybe delivered)
3) Safe manure storage

Materials Needed (this simplified approach using plastic pallets)

1) plastic pallets (will last longer than wooden pallets (can often be sourced cheaply) $5-$10 a pallet (5 pallets for a single cube 8 for a double system)
2) hardware cloth (¼ inch) to cover each of the pallets
3) cutter for hardware cloth (tin snips – see picture or angle grinder)(wear eye protection and heavy duty gloves)
4) deck screws with washers, 2- 2.5 inch
5) 2x4s or 2x3's for corners/ seams also can use hardware
6) strong tarp for cover with addition deck screws and washers to have the cover
7) Hose, hose water timer, (what are the little emitter/sprinklers called) irrigation supplies to go from

Lesson Learned/ Mid-Atlantic/ East of the Mississippi

1. Watering even 1-2 minutes per day can be too much in a temperate environment with high humidity and rainfall --especially when a porous top is used on the system

2. Watering in the summer should be perhaps driven by a moisture sensor and days should be skipped around rainfall events and high humidity

3. Or to have the most control over the process it may be important to have a cover over the system that keeps rain off of the system (this would insure a relatively equal volume of water each day and avoid oversaturation) that leads to a higher bacterial density vs fungi

4. Stop watering when freezing start occurring – occasionally in the winter to make sure the system stays moist (thermometers and moisture sensors – smart thermometers – reoltemp.com/compost) (using your senses and also warm temperature days in the winter - check the system) (laminated tip sheet)

Lesson Learned/ Mid-Atlantic/ East of the Mississippi (con't)

4. The ideal plastic pallets are difficult to find and normal plastic pallets might require fine dexterity (Bolts and nuts vs electric drills) as well as long drill bits etc

5. Tall skinny BEAM systems are difficult to load and unload and re-using plastic pallets is faster, more durable and likely would last through multiple uses

6. Winter two options (areas with cold winter) 1) take out the watering system before the first frost – place back into service after last frost; 2) or have the system indoors or within a greenhouse

Example Manure Management Approach

1. Estimate Based on actual conditions: Monthly Volume of Manure produced

2. Build system/s that will hold that 6 or 12 months of volume plus 20-30% (to account for woodchips/leaves to be added plus shrinkage)

3. Stockpile wood chips and leaves in adjacent areas to the BEAM system so that they can be mixed in as with the manure as it is placed in the BEAM Bioreactor (1-1-1 ratio)

4. As the system becomes full build a second BEAM Bioreactor; allow the other to age (for 12 months) while the 2nd one fills up - then rotate between them allowing the compost age for a year for high quality BEAM

5. Use a thermometer to ensure compost temperatures >150 degrees Fahrenheit for 3 days

6. Consider using a soil microbiometer for testing the fungal to bacteria ratio – to ensure good results

seed meals

What's needed to finish-

Example Sequence of Construction- (Case Study) – maybe add short video (Paul)
Manure Management Small Farm (Paul)
Adding Schematic made by Emma

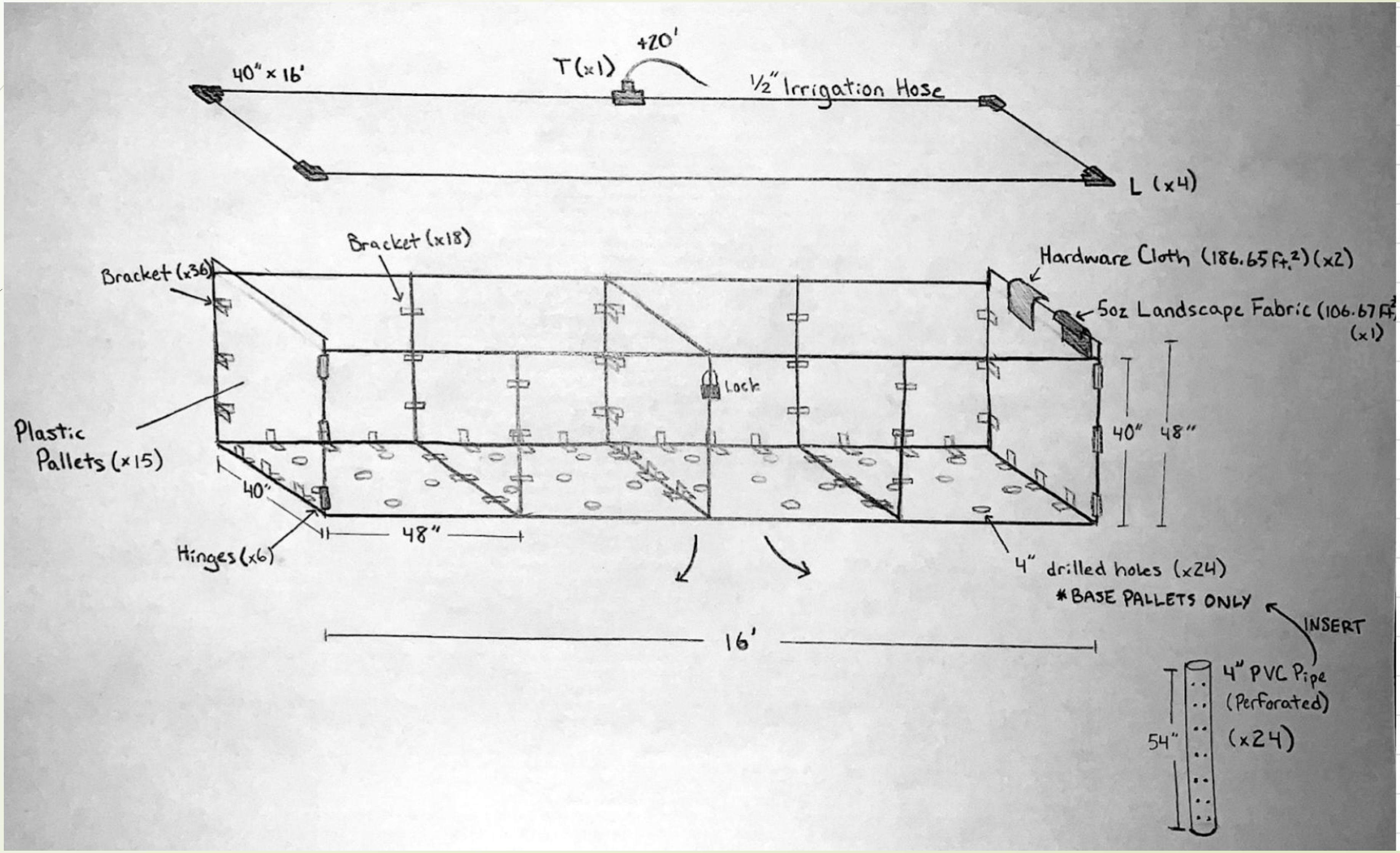
Review key principles for enabling successful passive composting

- Importance of maintaining consistency in composting rector- can use a cheap soil moisture probe (~$10) to make sure the compost is consistently hydrated. Even a pump sprayer can be enough to maintain conditions.

Using the BEAM application – compost tea, coat seeds, foliar application shake up – compost sock

Example Design for a little larger system

Larger BEAM System- Schematic

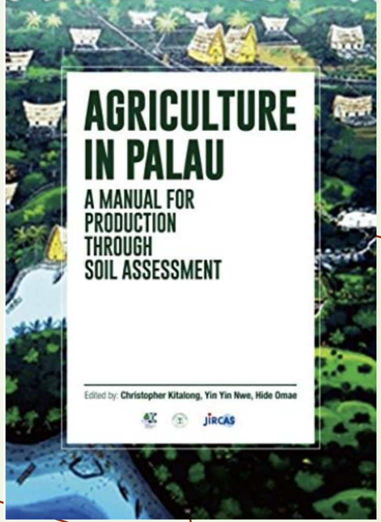


Larger BEAM System

AGRICULTURE IN PALAU

A MANUAL FOR PRODUCTION THROUGH SOIL ASSESSMENT

Edited by: Christopher Kitalong, Yin Yin Nwe, Hide Omae



CHAPTER 11

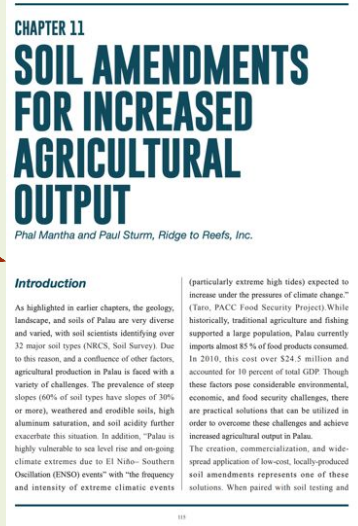
SOIL AMENDMENTS FOR INCREASED AGRICULTURAL OUTPUT

Phal Mantha and Paul Sturm, Ridge to Reefs, Inc.

Introduction

As highlighted in earlier chapters, the geology, landscape, and soils of Palau are very diverse and varied, with soil scientists identifying over 32 major soil types (NRCS, Soil Survey). Due to this reason, and a confluence of other factors, agricultural production in Palau is faced with a variety of challenges. The prevalence of steep slopes (60% of soil types have slopes of 30% or more), weathered and erodible soils, high aluminum saturation, and soil acidity further exacerbate this situation. In addition, "Palau is highly vulnerable to sea level rise and on-going climate extremes due to El Niño– Southern Oscillation (ENSO) events" with "the frequency and intensity of extreme climatic events (particularly extreme high tides) expected to increase under the pressures of climate change." (Taro, PACC Food Security Project). While historically, traditional agriculture and fishing supported a large population, Palau currently imports almost 85 % of food products consumed. In 2010, this cost over $24.5 million and accounted for 10 percent of total GDP. Though these factors pose considerable environmental, economic, and food security challenges, there are practical solutions that can be utilized in order to overcome these challenges and achieve increased agricultural output in Palau.

The creation, commercialization, and wide-spread application of low-cost, locally-produced soil amendments represents one of these solutions. When paired with soil testing and



Part of a Regenerative – Low Carbon, Agricultural Model

Figures 1-6 . (Counterclockwise from bottom left) Images showing the process of converting fish waste into valuable hydrolysate fertilizer. Figure 7. (Top Left) Process chart illustrating hydrolysate production.

ridge to reefs

Resources

Videos

BEAM approach and many others by Dr. Johnson

https://www.youtube.com/watch?v=79qpP0m7SaY

Schematics and parts list for larger system and Tote container

https://docs.google.com/spreadsheets/d/10vmhb8YWaHQRoy7uoAjioTaxFr9UhleJbwtEL72xwgc/edit?usp=sharing

NORTHEAST SARE Sustainable Agriculture Research & Education

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