



Vermicomposting of Campus Food Residuals and Waste

Part 1: Summer 2010 to Fall 2011

Michigan State University

Student Organic Farm:

John Biernbaum, Laurie Thorp, Dan Fillius,
Brendan Sinclair, Kirk Green, Chris Lamkin,
James Manning, Kim Forte, Emily Mckay

Residential and Hospitality Services:

Venie Gore, Diane Barker, Carla Iansiti, Robbia
Pipper, Guy Procopio

University Office of Sustainability:

Jennifer Battle

Land Management:

Ben Darling

University Recycling Center:

Ruth Daoust

SOF Mission

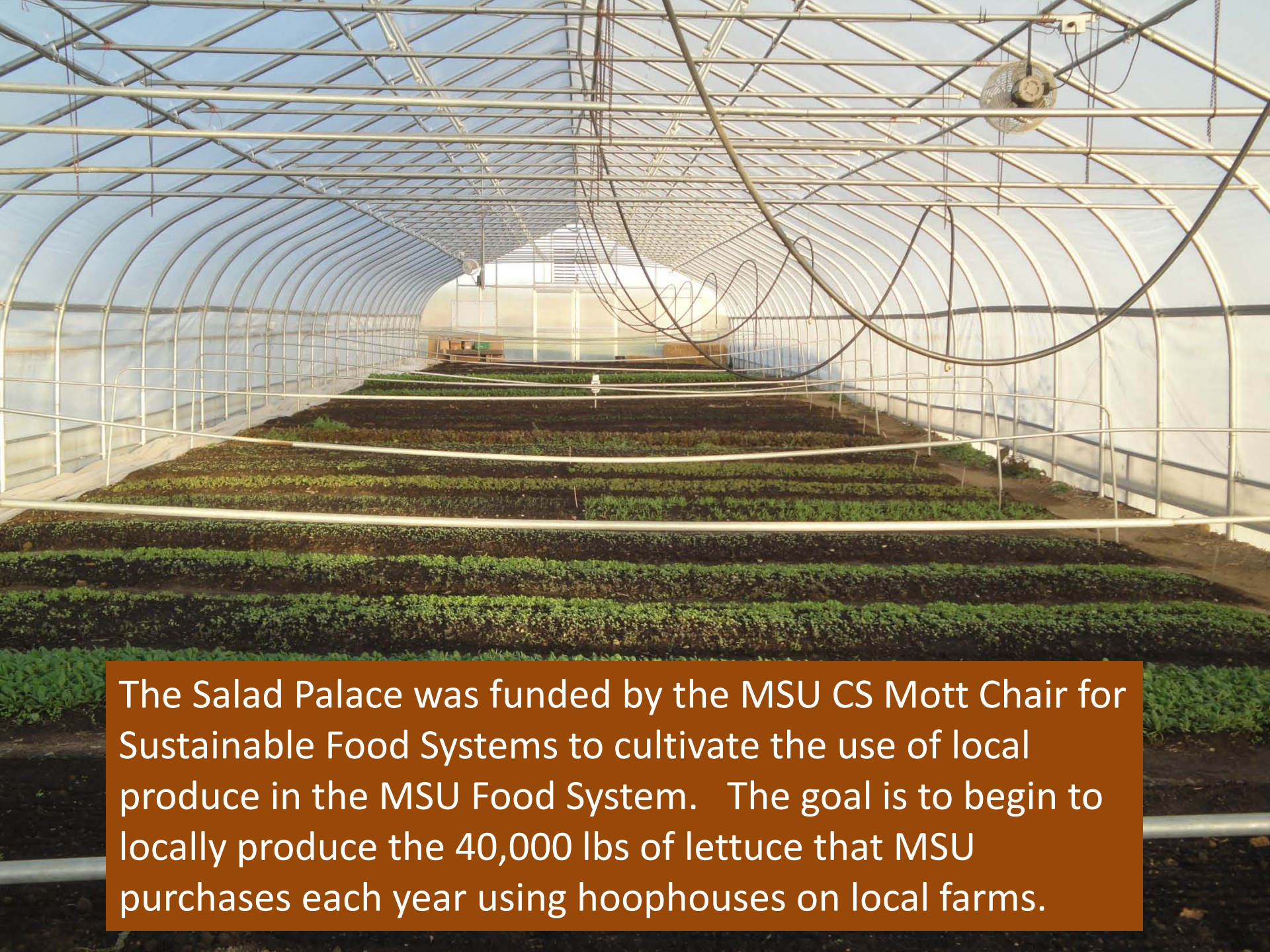
To cultivate knowledge and human capacity in organic and sustainable agriculture for students, farmers and educators.





Michigan State University SOF Activities

- Year-round teaching farm on a 10+ acre site at the Horticulture Farm
- Used by many classes (>15 MSU+LCC) as a laboratory and learning site
- Nine-month full time intensive organic farmer training program
- Hoophouse research and outreach program
- Five acres field and 20,000 sq ft hoophouse organic vegetable production
- Marketing through 48 week CSA, farm stand and University Dining
- Poultry for eggs in mobile hoophouse; bees for honey
- Swine husbandry integrated with vegetable production
- Outreach for organic and year-round urban agriculture
- Over 1500 visitors toured the site in 2010
- Vermicomposting of campus food waste



The Salad Palace was funded by the MSU CS Mott Chair for Sustainable Food Systems to cultivate the use of local produce in the MSU Food System. The goal is to begin to locally produce the 40,000 lbs of lettuce that MSU purchases each year using hoophouses on local farms.



Robbia Pippert at Yakely Dining Hall and later Chef Eric at Snyder Phillips worked with the SOF to develop the necessary methods for a successful relationship. Robbia is now at Brody Market Place and the efforts continue to grow.

Project Goals and Funding

- Recycle organic materials from the campus food system; divert materials from the current waste stream. “Close the loop.”
- Demonstrate the importance of bringing nutrients back to the farm to sustain long term soil quality and plant health.
- Make an organic resource for soil and nutrient management and plant health at the SOF.
- Develop a low tech, low cost system that can be replicated on farms and in communities to connect institutional food preparation with farms.
- Project Funded by the Office of Campus Sustainability and Residential and Hospitality Services for \$24,500.

Prior work illustrating effect of compost on transplant growth.

On farm replacement for fish fertilizer.

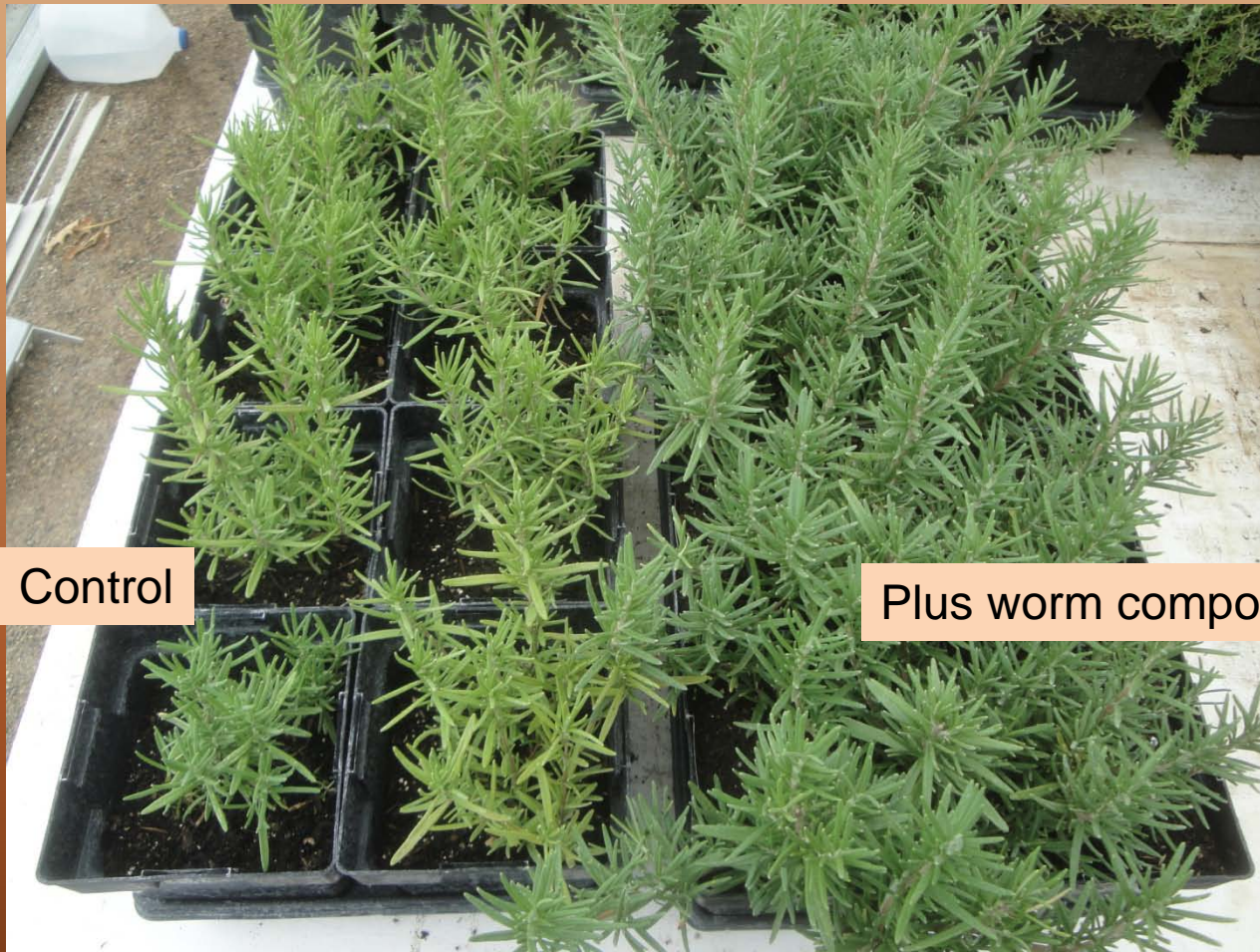


Top dressed worm compost

Starting rate of ~ 1 cup per flat



Vermicompost on Potted Rosemary



Control

Plus worm compost



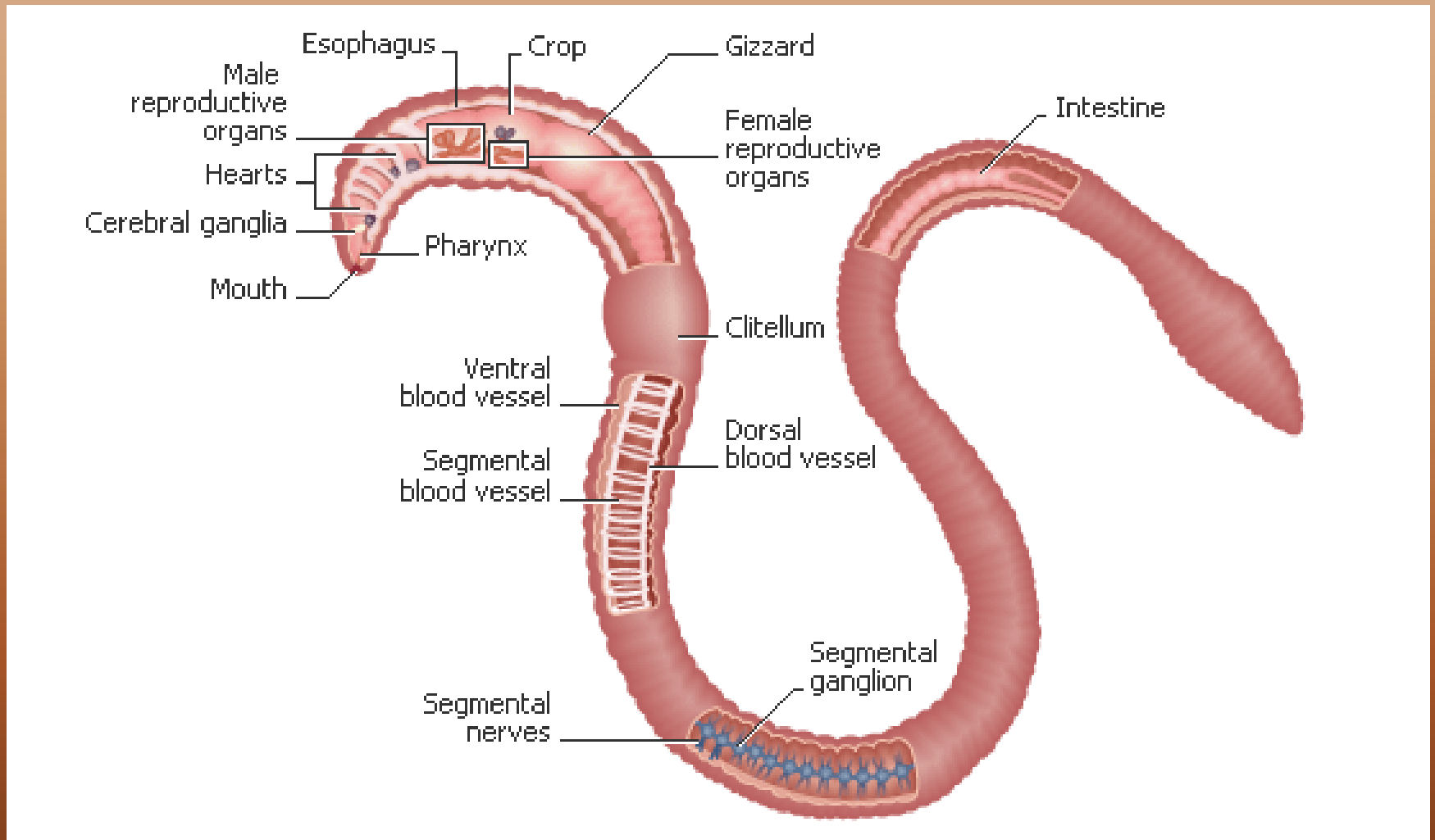
Pear Tree Farm horse manure piles as the source of the worms. At least 40+ lbs at no direct cost. Isolated from composted manure using fresh manure as attractant.

Composting Worms – Red Worms



- Reproduce quickly
- Survive in dense populations
- high moisture environments – near surface
- Can live for years
- Ingest approximately 0.5 to 1.0 times body weight per day

Composting Worm Anatomy





Worms exchanging sperm

<http://northeastparkscience.wordpress.com/page/2/>



Cocoons

Emerging worm



http://www.vermica.com/articles/worm_birth.htm

At the Student Organic Farm, a temporary, mobile structure was constructed to provide shade and protection from wind and rain.



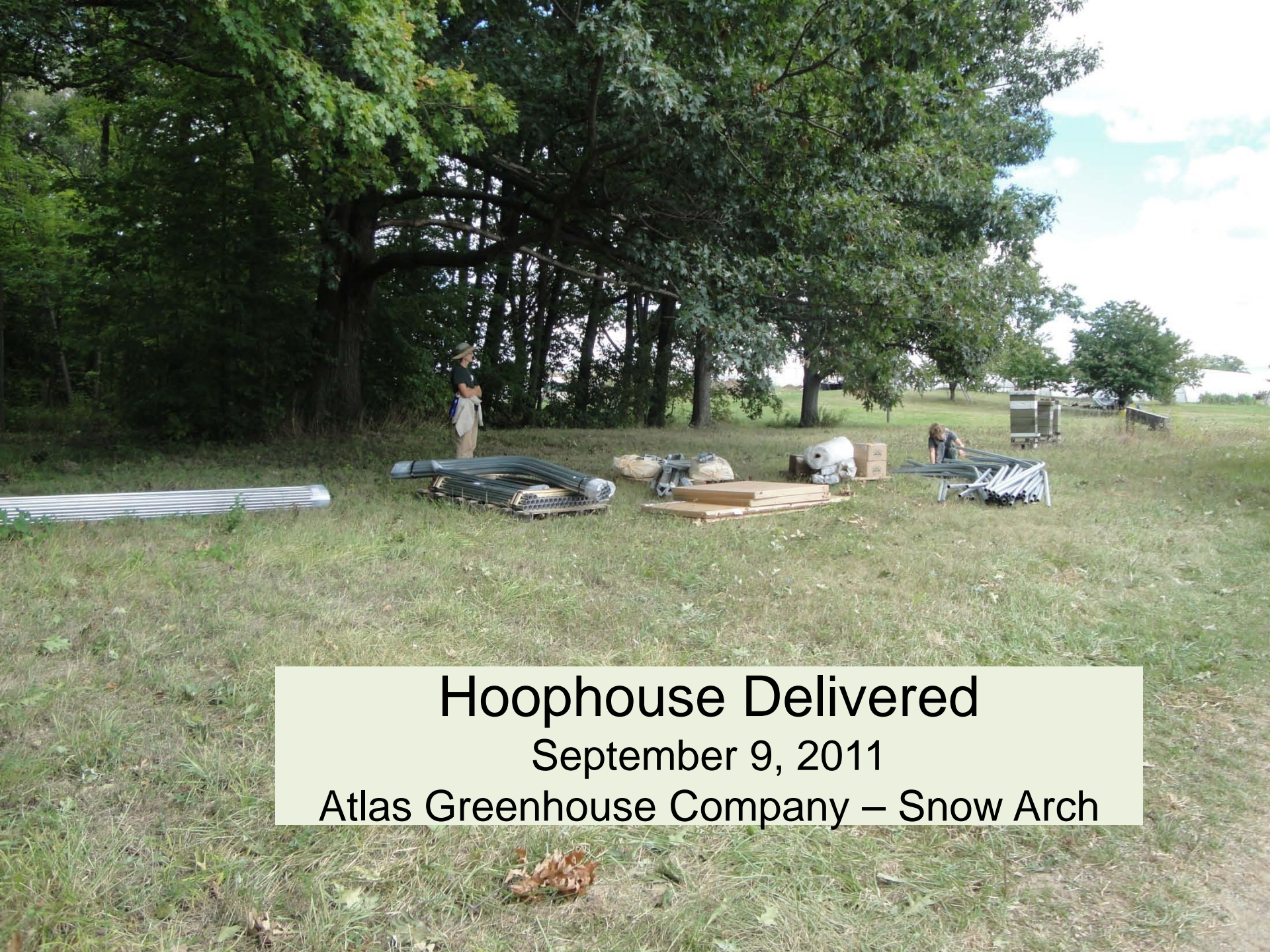
Worms were maintained in wooden “bulk bins” originally used to harvest apples. Protection from sun/heat, wind and rain was necessary as the amount of worms grew.

Hoophouse Site Preparation

August 24, 2010

Site was fill dirt and heavily compacted. A subsoiler was used to break up the soil prior to dragging and tilling to kill and remove grass and weeds and provide drainage.





Hoophouse Delivered
September 9, 2011
Atlas Greenhouse Company – Snow Arch

Hoophouse Construction

September 17 – October 7



Students at the SOF and participants of the Organic Farmer Training Program assisted with construction of the hoophouse.

The Compost Commons

30' x 72' structure
extended side walls
drop down sides
all metal – no wood
thermostatic ventilation
single layer cover;
approximately \$10,000.



No More Parts

Long awaited worm move in
was on October 8, 2010.





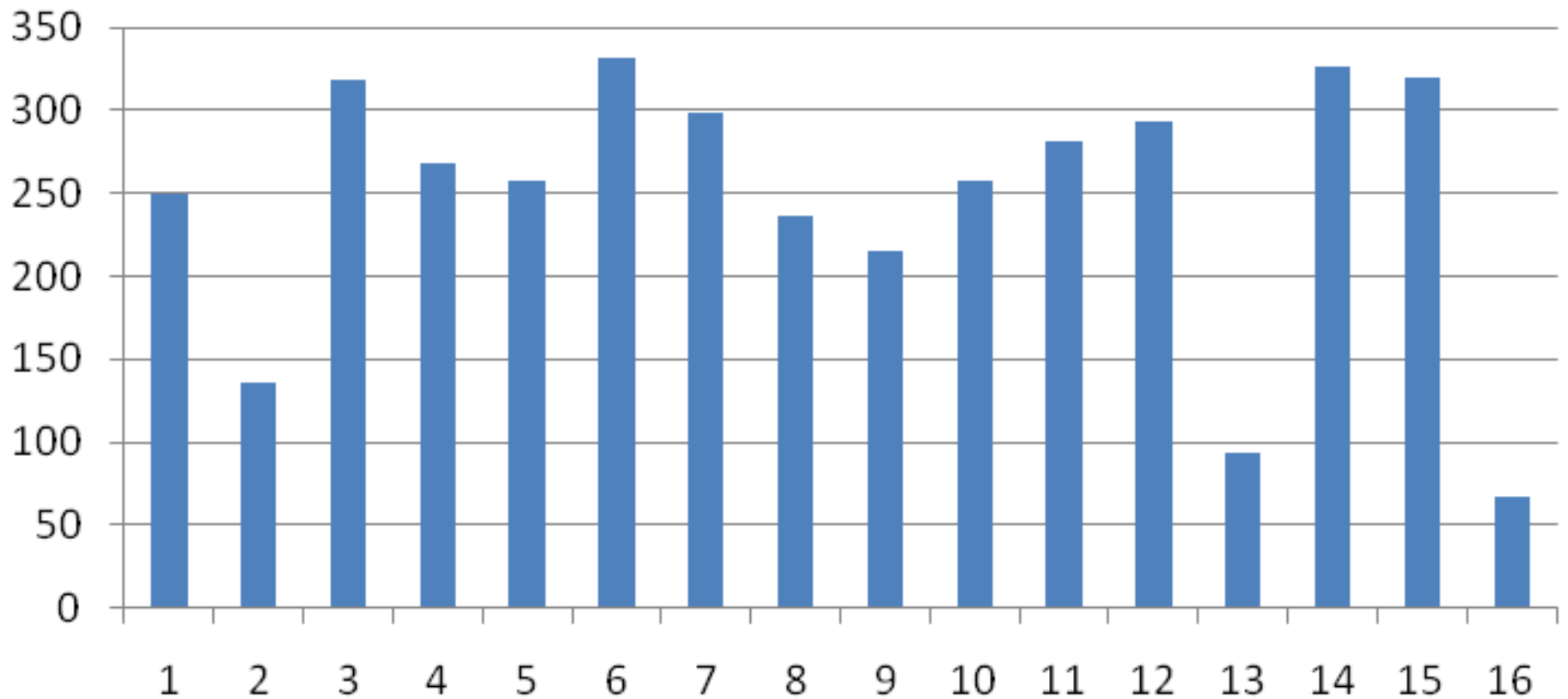
All the containers below were used to move worms from Pear Tree Farm to the SOF.





Example of preconsumer kitchen residue collected twice per week from dining areas that were also using salad greens from the SOF. Each collection was weighed.

Weekly Kitchen Scrap Weight in Pounds for Fall 2010 - Total ~4000 lbs




Yakely 250 lbs weekly average

Fresh kitchen residue mixed with straw and provided to the worms. This was not the best strategy due to development of fruit flies and excessive heat due to composting.





As an alternative, the kitchen residue was precomposted prior to feeding to the worms. This worked, but also was not the best strategy because much of the food value for the worms was lost. We did not have enough worms to consume the amount of material collected.



Worm compost collected during the summer. Piled for removing any remaining worms.

We started with two smaller beds for containing worms, in part so as to not have all our “eggs in one basket”.

As we gained more confidence and experience, we decided that one larger bed was a better strategy for heat retention for the winter.



We constructed an interior frame from 0.75 inch electrical metal tubing (EMT) to provide the “Tunnel in a Tunnel Technology” necessary to trap the heat and keep the worms warm.



The plastic cover traps moisture and acts like a cloud on a cold winter night to reflect radiant energy from the worm beds back into the structure to keep the beds warm. This same method allows us to harvest vegetables all winter long.

The worm bed maintained 50°F through the winter and the worms remained active.



Isolating worms



Several students requested the opportunity to work with the worms as part of a class project. We designed a feeding experiment to compare how the worms did on horse manure compared to pulped post consumer food residue from the Brody Market Place. The first step was to get a know quantity of worms in each of 12 composting containers.

Feeding Trial

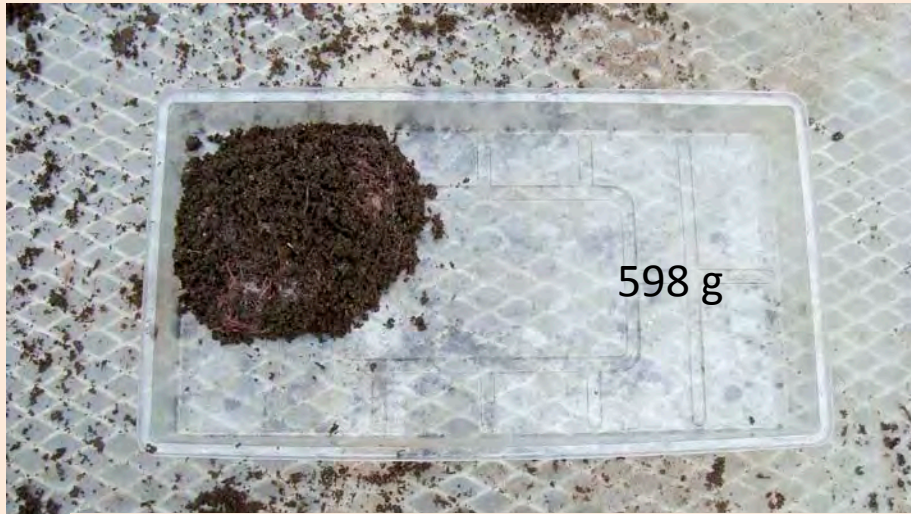


Approximately one pound of worms (400 grams) was placed in each of the 12 boxes. This project was done in a heated greenhouse at the Plant and Soil Sciences Building from November through February.

After 5 additions of food and eight weeks later, the worms were isolated from each composting container.



Horse Manure 0.5 body weight/day



Horse Manure 1.0 body weight/day



The mass of the worms was much larger with the pulped post consumer plate scrapings.

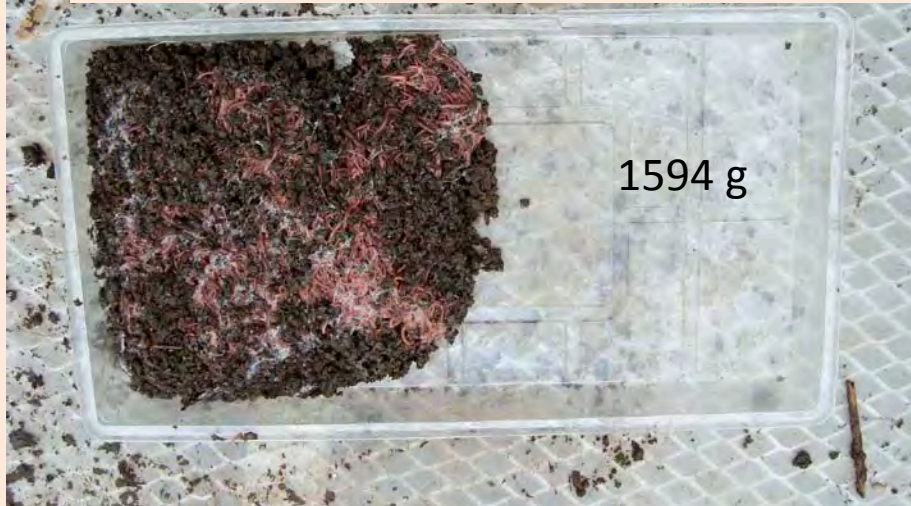
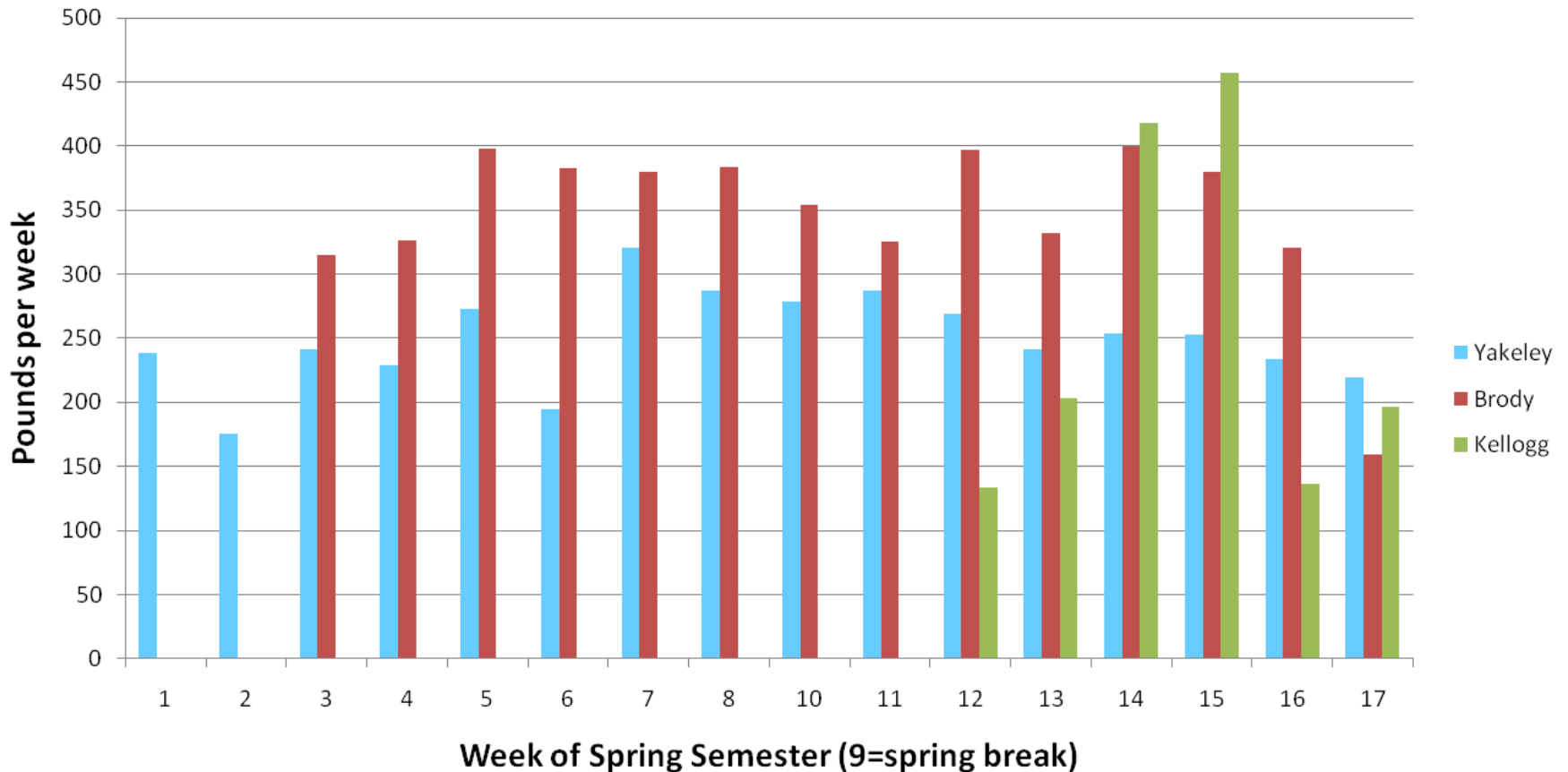


Plate Scrapings Pulper 0.5 body weight/day

Plate Scrapings Pulper 1.0 body weight/day

Starting weight 400 g Nov 13; finish ~600 g (1.5 x) to over 2000 g (5X) Jan 13 or ~ 8 weeks.

Weekly Kitchen Prep Residue for SOF Vermicomposting Spring 2011 - 10,393 pounds total



Residue collection and composting continued through the spring semester and included coffee grounds from the Kellogg Conference Center.

Yakely 250 lbs per week average
 Brody 350 lbs per week average
 Total 600 lbs per week average

Summer 2011 the emphasis was on keeping the worms shaded and cool. Bed temperature increased to over 80°F which was too hot. Internal shade and spray on shade on greenhouse roof was effective.

First year vermicompost moved from short wall to long wall.



Food waste precomposted outside was added to the side of the worm bed using the wedge system to attract the worms out of the finished compost.



Precomposted food residue fed to the worms. This method was effective for collecting the worms into fresh material.



A new taller structure was constructed in October 2011.

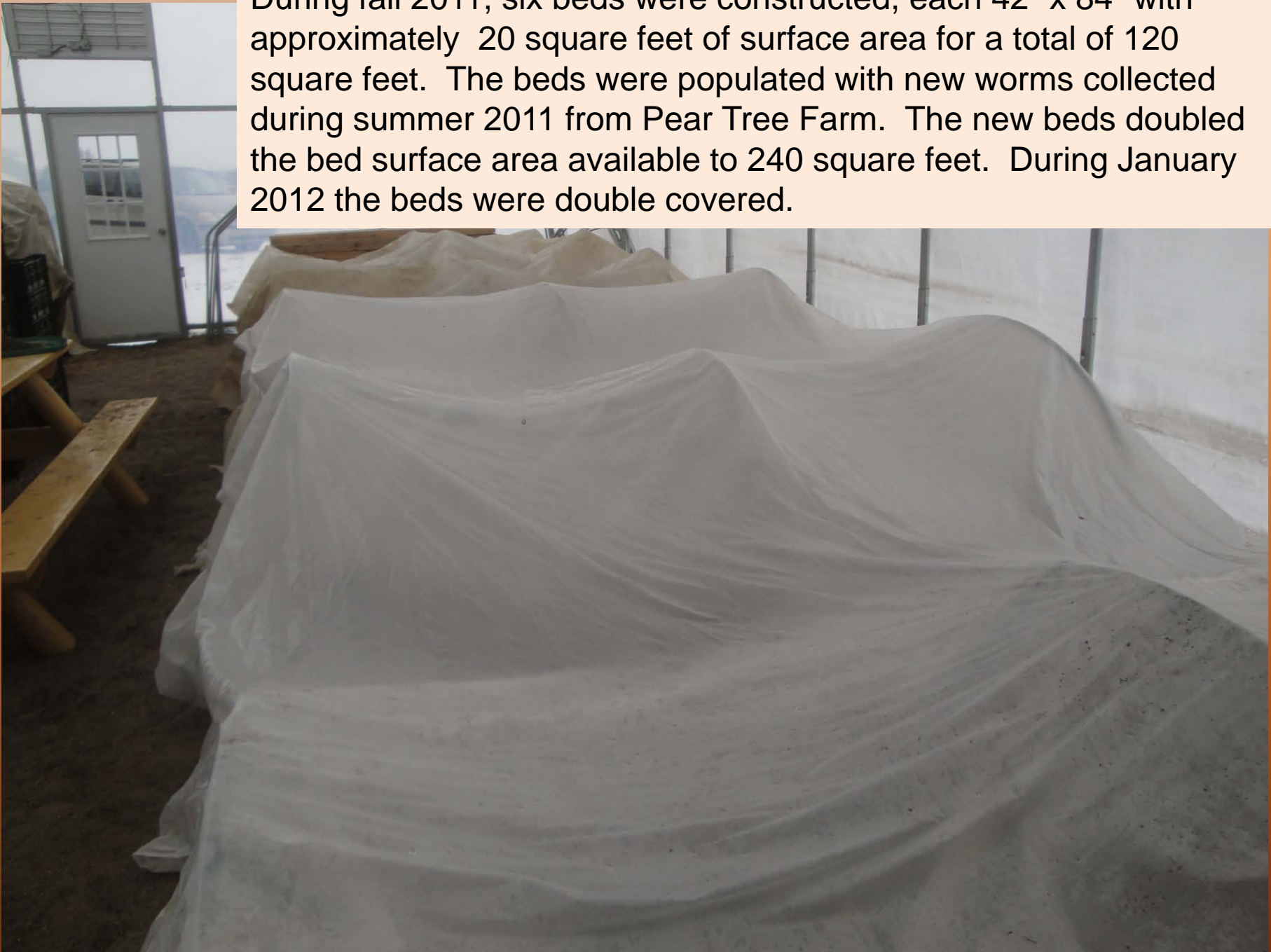
First year vermicompost.

Fresh compost with worms – double the bed area.
Each bed approximately 3' x 20' or 60 square feet.
Total surface area 120 sq feet.

January 2012 – preconsumer kitchen residue is added and covered with precomposted post consumer residue.



During fall 2011, six beds were constructed, each 42" x 84" with approximately 20 square feet of surface area for a total of 120 square feet. The beds were populated with new worms collected during summer 2011 from Pear Tree Farm. The new beds doubled the bed surface area available to 240 square feet. During January 2012 the beds were double covered.





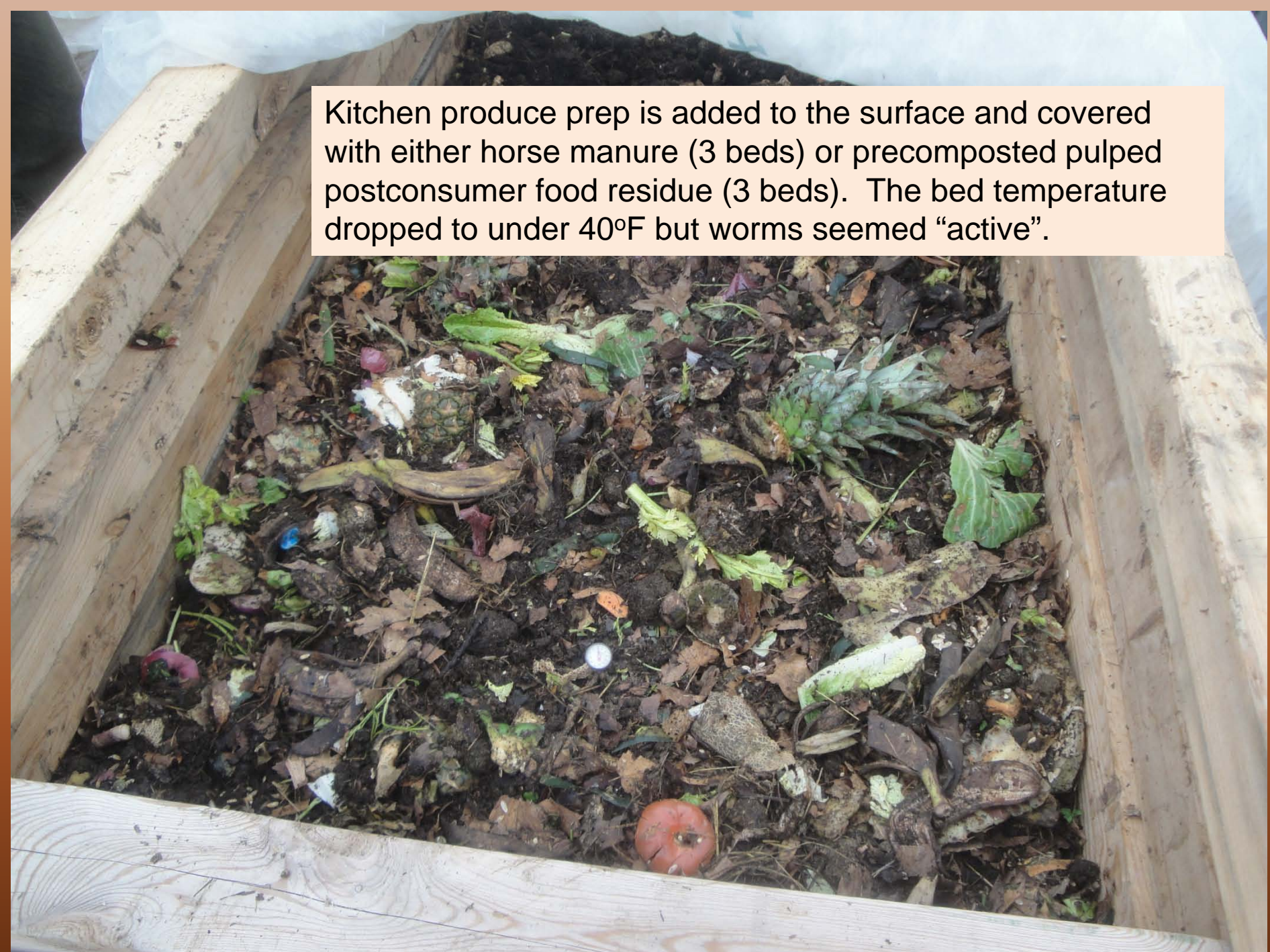
One bed with remay cover over quick hoops.

A small bed system might work for a farm that only needs to produce a limited amount of vermicompost inside a hoop house used primarily for vegetable production.

Beds were constructed of recycled 4x4 lumber from the MSU dormitories (student bed lofts). Cost per bed was \$30 of materials. Beds can be easily moved if needed.



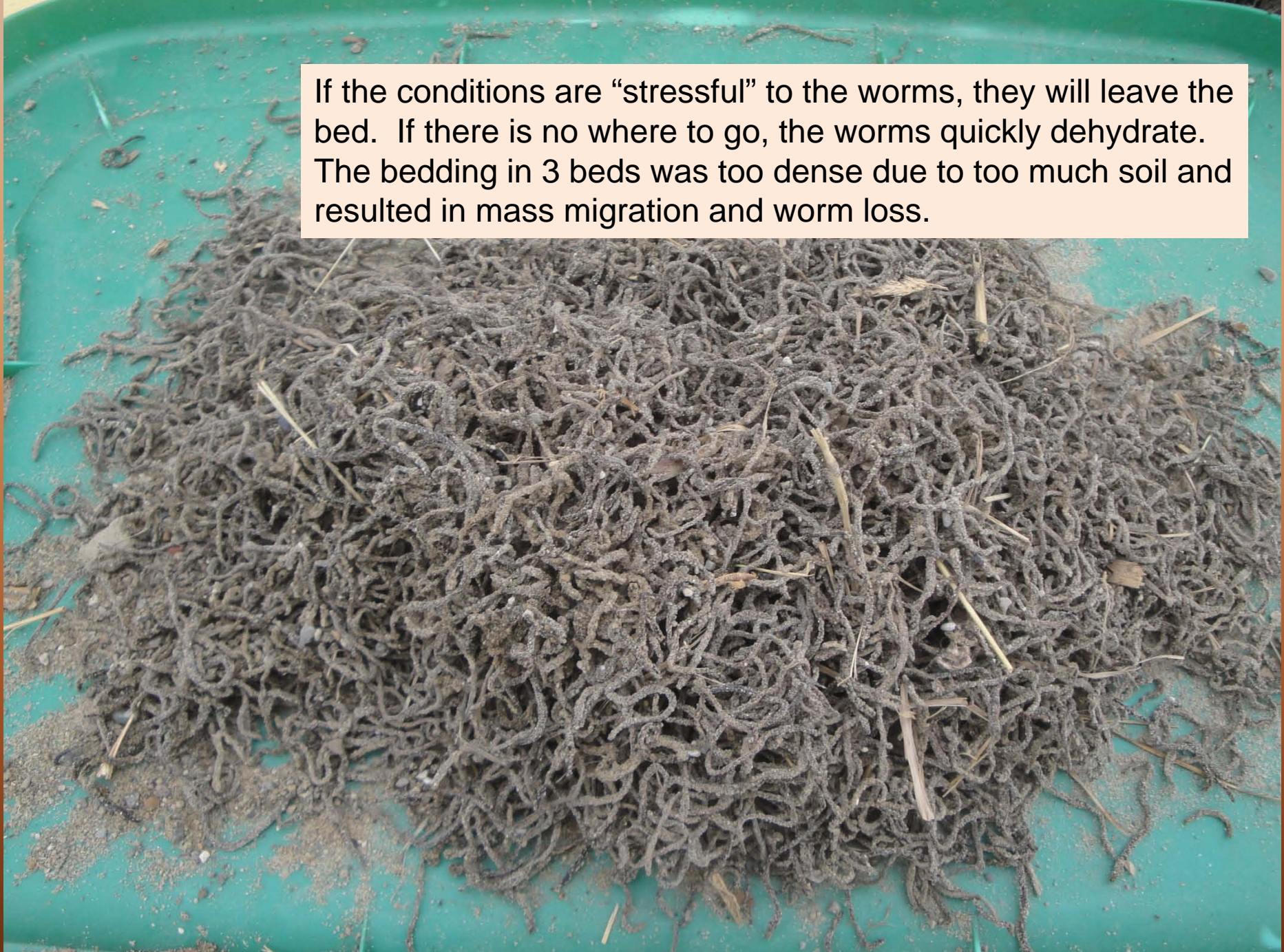
Kitchen produce prep is added to the surface and covered with either horse manure (3 beds) or precomposted pulped postconsumer food residue (3 beds). The bed temperature dropped to under 40°F but worms seemed “active”.



Worms were 3 to 4 inches below the surface on a cold day.



If the conditions are “stressful” to the worms, they will leave the bed. If there is no where to go, the worms quickly dehydrate. The bedding in 3 beds was too dense due to too much soil and resulted in mass migration and worm loss.



2010-2011 Summary

- Established passive solar greenhouse as “laboratory” and compost site.
- Developed worm populations.
- Developed feeding methods.
- Established two types of bed systems that worked through the winter in an unheated passive solar greenhouse.
- Diverted over 7 tons of food residue from the landfill.

Future Research:

Scaling up methods;

Vermicompost for growing plants;

Top dressing transplants;

Raised beds for urban agriculture;

Vermicompost for plant health and pest management.



A Local Food Cycle

*The path to prosperity, peace, parity and partnership
is the passionate perennial progression from
planting,
producing,
protecting,
processing,
preserving,
purchasing,
preparing,
partaking
and passing pooh to
renew the soil and begin anew.*

*Promote positive personal, public and planetary perspectives
and programs with your food practices and purchasing power.*

John Biernbaum