



# Large Scale Vermicomposting

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Thomas Herlihy  
Worm Power

US Composting Council  
January 30, 2013



# Differentiate Vermicompost

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## Vermicompost

- Excellent and uniform process control = uniform product
- Fast 75 Days
- Mesophilic process produces “plant-viable” microbial communities
- Earthworm composting truly alter the availability of nutrients
- Vermicompost sold for \$425/cu-yd

## Compost

- Slow 9-12 month
- Inconsistent process controls result in variable quality end product
- Large variations within batches (cross section)
- Variability leads to inconsistent grower results.
- Manure compost sold for \$35/cu-yd



# Background –Waste Issues

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## Economics of manure management (the **CRUCH**)

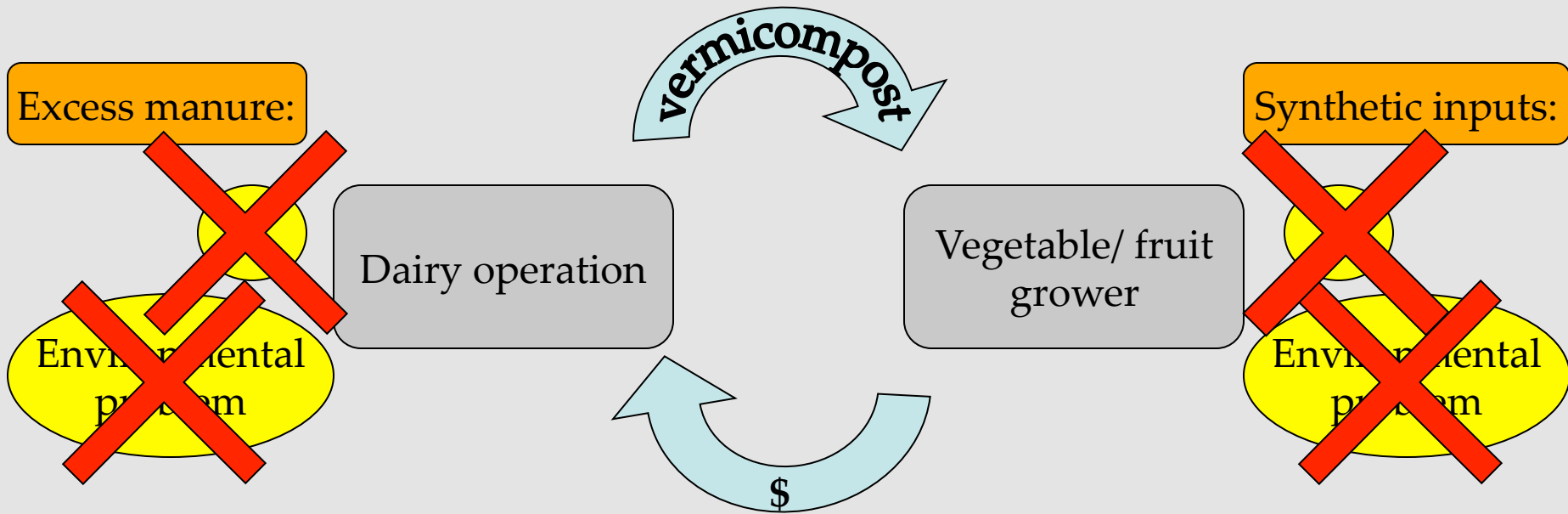
- Larger farms (compensate for lower revenue/animal)
- More animals = more manure
- Regulations limit manure application rates (tons manure/acre)
- Results in more land needed solely for manure (acreage)
- Application costs increase dramatically as distance from farm to field increases

**Excess manure becomes a waste issue,  
as the value of manure can not offset  
handling costs**

(\$/ac spreading costs > \$/ac fertilizer value)



Liability  Asset





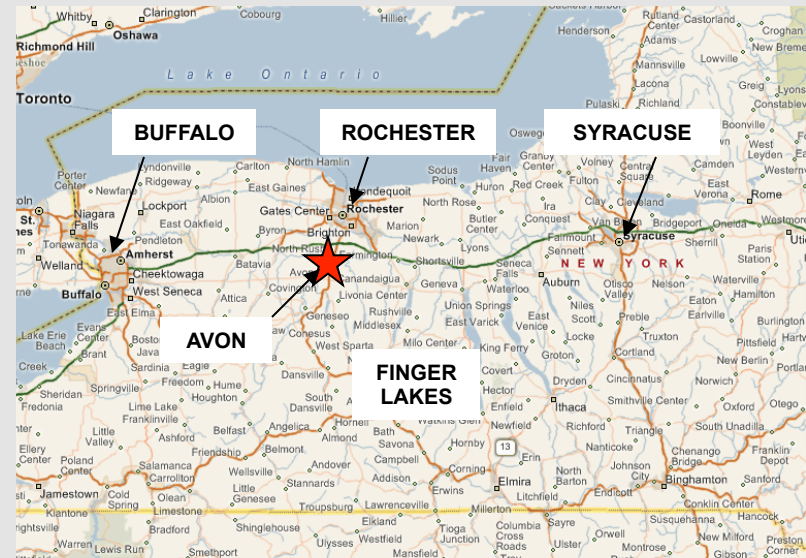


# Single Consistent Feedstock

Vermicompost is not an elemental product – what comes out, depends on what goes in

Decided that sales of end-product is the goal vs. tipping fee from accepting variable materials

Worm Power mantra –  
Consistent...Uniform...  
Repeatable



# Single Source Feedstock - Coyne Farm



Our coworkers

- 1,000 Registered Holstein milkers & 600 heifers.
- 5<sup>th</sup> Generation family owned and operated “Dairy of Distinction” – Not organic certified
- Cows feed very consistent diet
- Holstein’s in NY (avg)
  - Consume 310 lbs/day of feed and water
  - Yield 85 lbs/day of milk
  - Generate 120 lbs/day of manure and urine





US Interstate 390.  
Approximately 18  
miles south of  
Rochester, NY

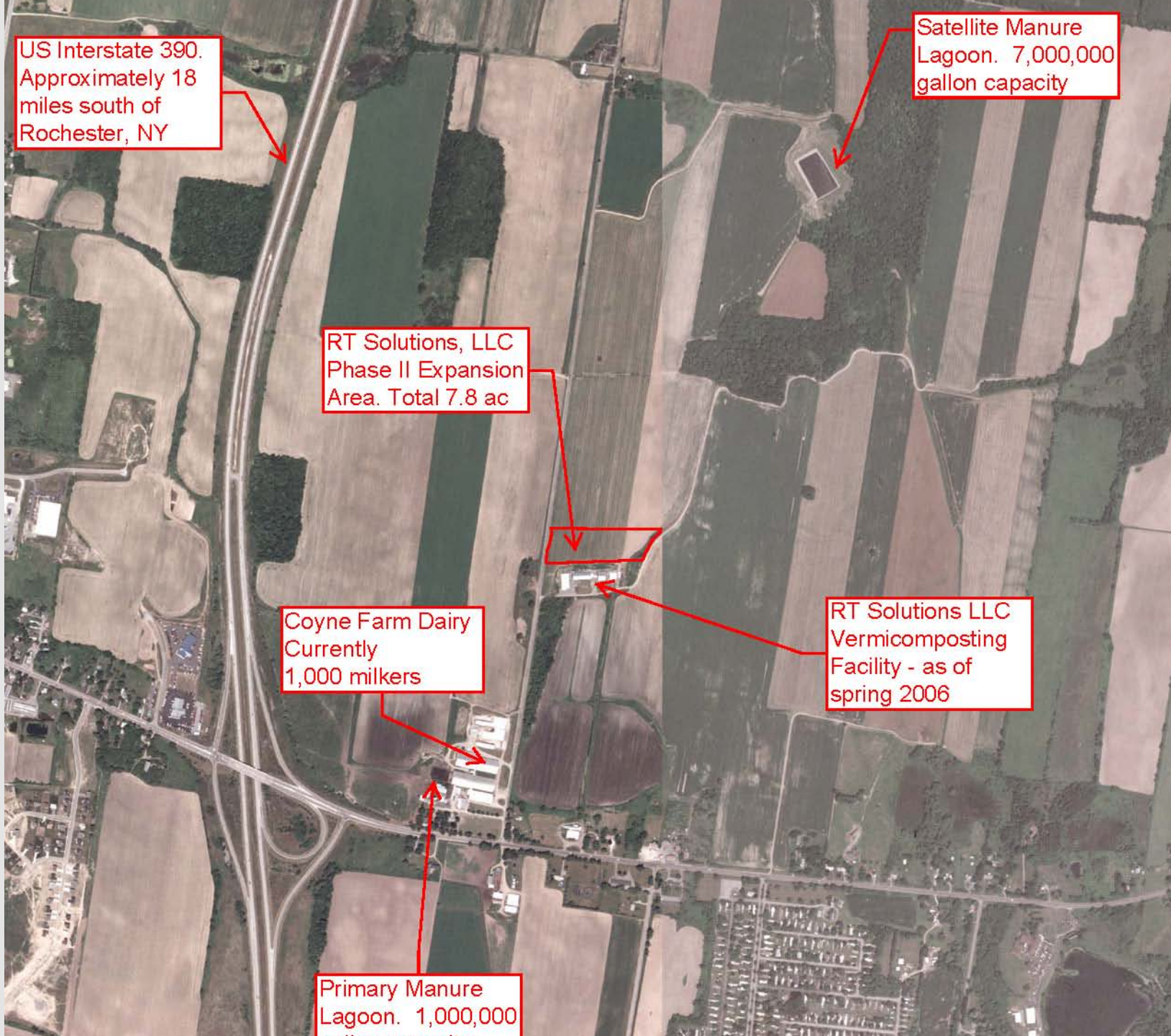
Satellite Manure  
Lagoon. 7,000,000  
gallon capacity

RT Solutions, LLC  
Phase II Expansion  
Area. Total 7.8 ac

Coyne Farm Dairy  
Currently  
1,000 milkers

RT Solutions LLC  
Vermicomposting  
Facility - as of  
spring 2006

Primary Manure  
Lagoon. 1,000,000







# Feedstock Preparation

Very few materials are instantly ready for large scale vermicomposting

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Manure separators – Ver 1.0 & 3.3



# Manure Management

## Integrating Plant and Animal Agriculture

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1,000,000 & 7,000,00 gallon  
manure effluent lagoons







# Manure Management

## Integrating Animal and Plant Agriculture

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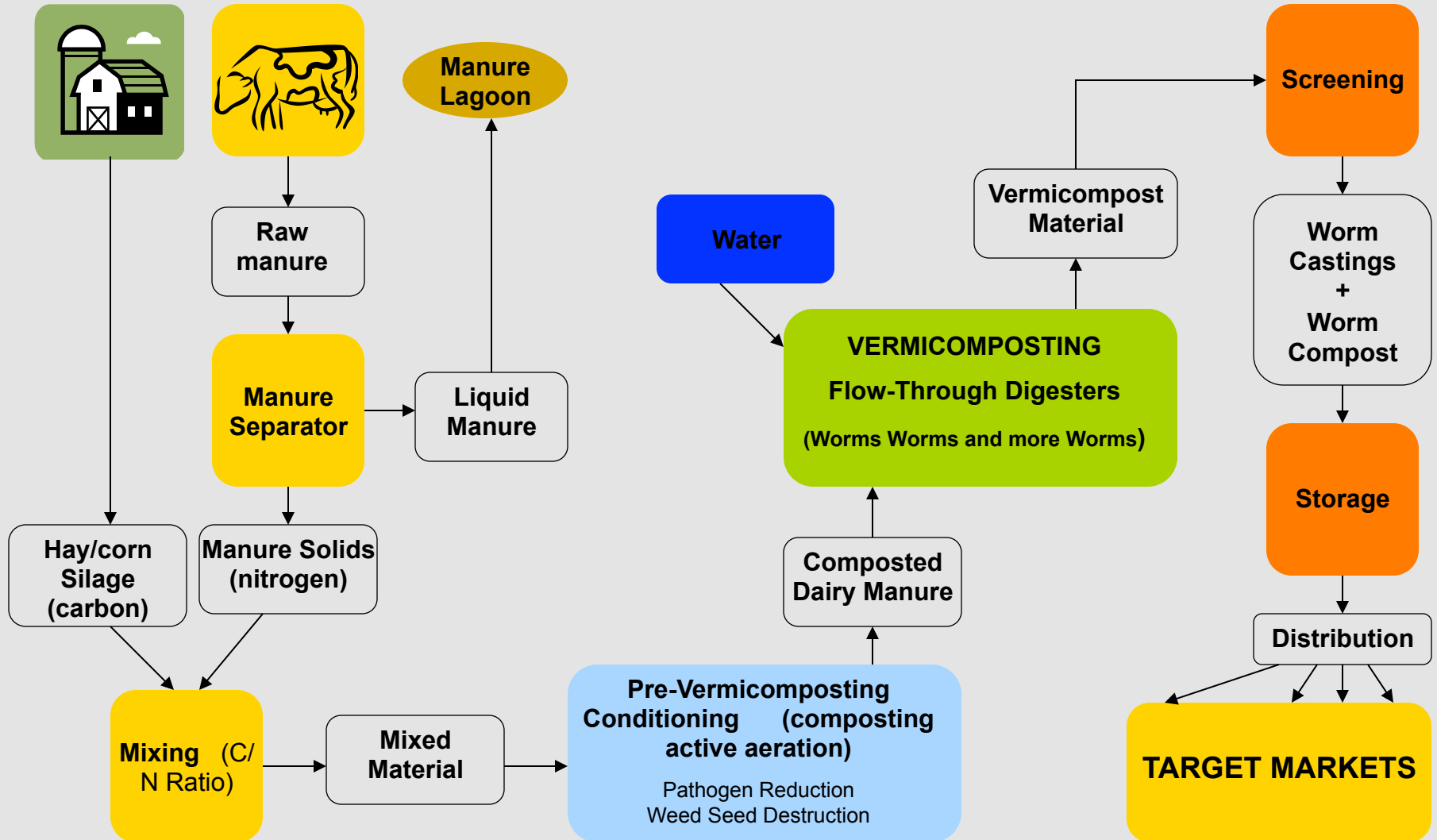
Effluent from separator is pumped from lagoons through 5,000' of drag hose to subsurface injector.



- Conserves nutrients
- Reduces
  - Odors
  - Road traffic
  - Soil compaction
  - Application costs



# Production Process



# Compost Preparation

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All materials stored under cover

Materials are mixed with large agricultural equipment to a specific recipe (16 ton batch)

- Porosity, MC, C:N ratio, bulk density
- Consistent mixes can produce consistent final products







# Composting

Mixed materials loaded into aeration bays

## Thermophillic Composting

- 21 days with one turn
- Min of 3-days @ 55 degree C
- Weed seed deactivation
- Pathogen reduction (PFRP)

Oxygen, temperature, and moisture are monitored -- feedback to metered air flow





# Vermicomposting

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Vermicomposting in large “flow through digesters”

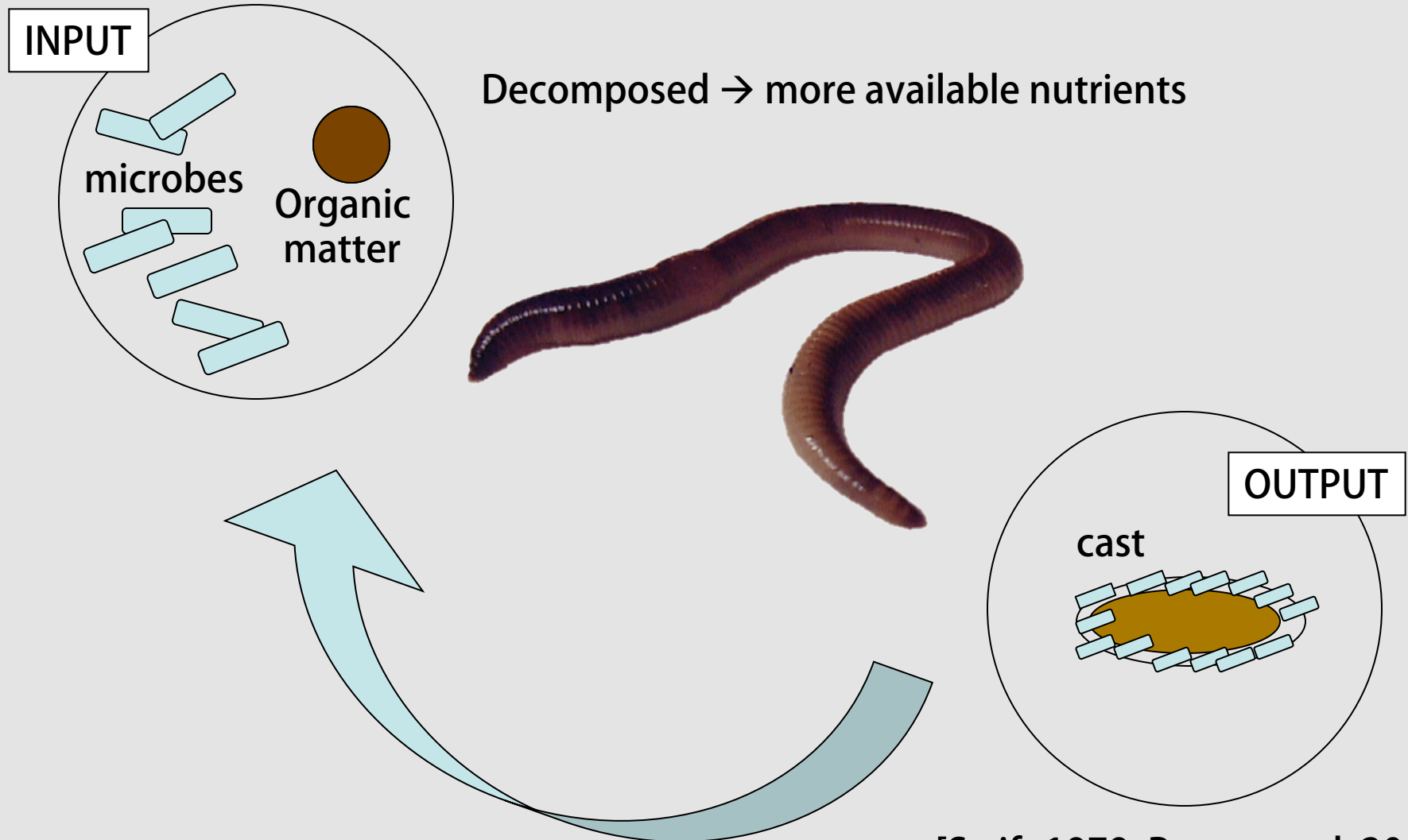
- Designed around the biology of the earthworms
- Green compost is layered on the top
- Finished vermicompost is removed from the bottom
- Worms move upwards towards new food source
- Retention time of ~47 days (worms are never moved)
- Much more than just worms involved - Mesophilic processing.



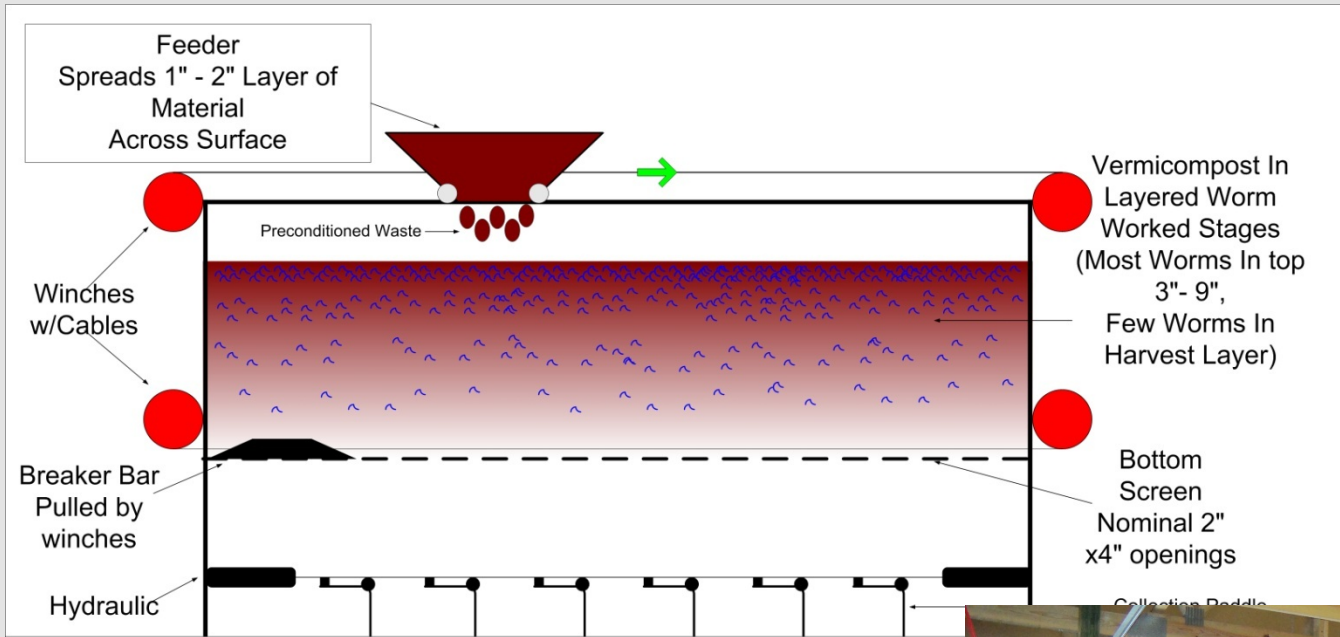


# Earthworms farm microbes

## The 'external rumen' for manure dwellers



# Flow Through Digester Feeding



6" Concrete Floor  
**Continuous-Process, Flow-Through Earthworm Vermicomposting Digester**

Material is spread in a uniform 1" layer across the surface of each digester.





# Process Controls

- Worms are fed the green “uncured” compost
  - Only when ready!!!
- Building engineered with automatic ventilation, watering, heat and directed lighting systems - happy worms = a good night’s sleep.
- Harvested and moved by multiple hydraulic systems





# Process Controls

- Good animal husbandry of worms is **MOST** critical
- Control moisture content of material
- Monitor temperature continuously (tipping point)
- Look for cocoons and reproduction.



# Animal Husbandry

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- Good vermicomposting requires basic animal husbandry
  - If you treat your worms like a garbage disposal don't be surprised by the results
  - Careful feeding, watering and environmental controls lead to healthier and larger worm populations – surprise!
  - Use your nose as part of your monitoring program.

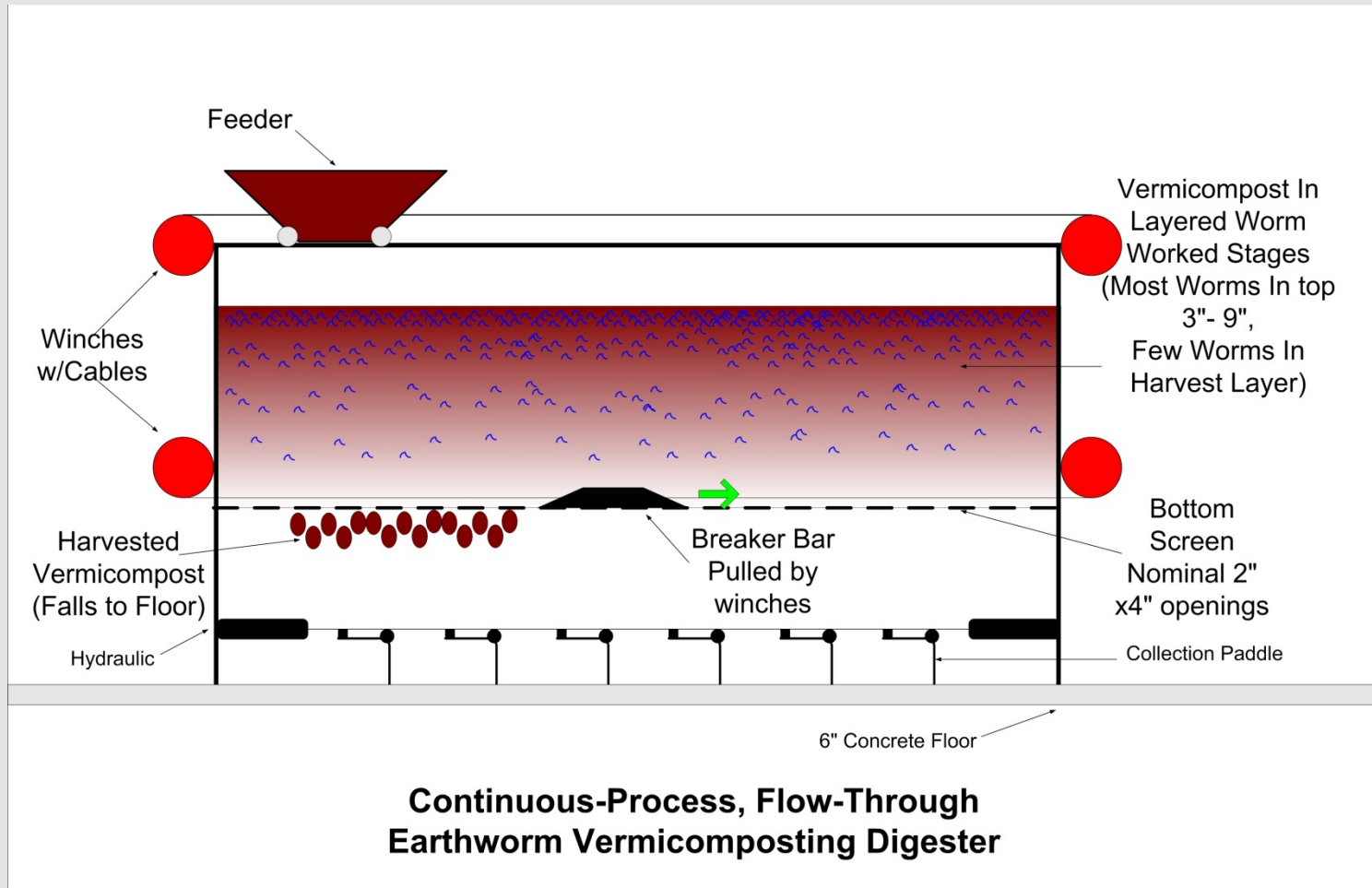






# Harvest

Worm worked material is removed from bottom of each digester



# Screening

- Product is screened into 5 classes based on end-user (shaker deck)
  - Overs, minus - 1", 1/2", 1/4" and 1/10"
- Bulk packaging in 2 cu-yd sacks
- Retail packaging
- All finished product kept in enclosed buildings





# Vermicompost Products

- Solids
  - Bulk in 1 & 2 cu-yd containers (commercial growers)
  - Retail in a variety of small packages
- Liquid extracts
  - Bulk - 275 gal IBC Tote







# Phase II Expansion



RT Solutions, LLC Vermicomposting Facility  
(Left to Right)

- (1) Finished Product Processing Building
- (2) Vermicomposting Building
- (3) Office Trailer
- (4) Composting Building
- (5) Raw Feedstock Storage

## Original Phase I Facility

**Phase II Facility** – 800% increase  
in production (completed  
October 2011)









# Worm Power' s Avon, NY Facility

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- Largest agricultural vermicomposting facility in Western Hemisphere
- Total site ~ 10 acres
- 8 buildings totaling over 89,000 sq-ft under roof
- All process water from rain fed cisterns
- 21 total earthworm digesters
- Process over 10,000,000 lbs/year of dairy manure
- Final product sold at 12X over compost to large growers and Agricultural companies (Syngenta, SunGro Fafard)









# It' s All About The Quality

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To market vermicompost for top value – the product must be uniform, consistent and reproducible

“Vermicompost“ is not an end product – it' s a component in the end-user' s growing system

Truly understand the targeted growers' expectations, production methods and its associated costs.





# Vermicompost better than fertilizer

## Key Points

- Fraser achieved 25% higher garlic yields with vermicompost.
- Derived from dairy manure, this biofertilizer has organic potential.
- Enhanced resistance to disease is a substantiated benefit of compost.

By KARA LYNN DUNN

**A** 25% gain in garlic weight gain was nothing Ed Fraser could turn up his nose at. In fact, the Churchville, N.Y., certified organic producer is intent on strifing out more benefits of using "made in New York" vermicomposted dairy manure to amend his soil and suppress disease.

High tunnels, quick hoops, storage and mail order allow Fraser to have almost year-round sales of table and seed stock garlic and other vegetables. Just 20 miles southwest of Rochester, he's one of eight growers supplying the 400-plus member Good Root Collective CSA, or Community Supported Agriculture. And, he sells at the new Highland Park Winter Farmers Market.

In 2008, Fraser began applying Worm Power, a vermicompost made by 20 million red earthworms working across the road from Coyne Dairy in Avon, N.Y. There, worms convert 10 million pounds of manure into 2.5 million pounds of nutrient-rich compost over 75 days at North America's largest vermicomposting facility.



PHOTO BY GOODROOTCSA

**WORM POWER:** Compost from dairy manure is further processed by worms to make a better-than-fertilizer soil amendment.

New York Farm Viability Institute, or NYFVI, funding supported greenhouse and field evaluation of the vermicompost as a replacement for synthetic soil amendments. It also funded lab experiments aimed at better understanding how vermicompost suppresses *Fythium*.

"Our interest is in the potential for vermicomposting to reduce the dairy waste stream, convert raw manure into a product valuable for growers and gardeners, and reduce growers' use of crop pesticides,"

says David Grusecmeier, NYFVI managing director.

Fraser field-applied the vermicompost at fresh-weight rates of 2, 4 and 8 tons per acre to the planter furrows. Then he hilled each row, covering the vermicompost and garlic sets with soil.

He was more than pleased. Garlic treated with vermicompost was 25% heavier than the untreated garlic at harvest.

Disease resistance is a plus. Cornell University lab trials have shown promise for applying the solid vermicompost and its non-aerated extract as a control for *Fythium ophiodiomyces*, a disease common to many vegetable crops.

"Garlic doesn't tend to have *Fythium* problems," points out Fraser. "So I was looking for how well the compost would support plant growth. We saw a definite impact on leaf growth and weight gain."

"The healthier and more vigorous plants are with the microbiology in their root zone, the more the plants are able to thwart attacks from destructive crop pathogens and insect pests," he elaborates.

Recent Ohio State University studies also concluded that crops fed with vermicompost are also more resistant to blight, bacterial wilt, parasitic nematode attacks and powdery mildew than those on synthetic fertilizers.

Still more organic potential?

In 2011, Fraser expects to test a vermicompost extract. Worm Power has submitted its extract to the Organic Materials Review Institute, or OMRI, for listing as an approved organic input.

"OMRI lists the extract by spring, then I'm interested in applying it as a drench to some of my garlic to evaluate its potential to increase bulb size and control *Axizium*, a common disease in garlic," says Fraser.

"If it works, vermicompost extract is an attractive product," he adds. "It's less bulky, would store easier and go farther on the fields than the solid compost, and be an input with hopefully at least the same results."

Vermicomposting project manager Allison Jackin Cornell's Department of Plant Pathology and Plant-Micro Biology, says, "Vermicompost [is] an effective addition to

transplant media for greenhouse production in trials with tomatoes, cabbage and cauliflower. We need more research, however, into its potential for field application."

Cornell is also testing vermicompost's impact on other pathogens affecting garlic, strawberries, grapes, cabbage, cauliflower and tomatoes. An educational video and project reports are online at [www.nyfvi.org/research/vermicompost.htm](http://www.nyfvi.org/research/vermicompost.htm). For more details contact Allison Jackin at 607-255-7842 or [allj54@cornell.edu](mailto:allj54@cornell.edu).

Dunn writes from her farm in Mansville, N.Y.

*Editor's note: Funding for all NYFVI projects is at risk of cancellation due to Gov. Andrew Cuomo's proposed 2012 budget.*



**BOUNTIFUL BULBS:** Ed Fraser found that vermicompost boosted garlic yields and improved plant health.

## OWNER DRIVEN

When our equipment owners said they wanted more capacity without sacrificing size, the V330 vertical lift skid loader answered the call. This loader, manufactured in Madison, South Dakota, pushes fit to the vertical limit with a lift height of 131 inches and a rated operating capacity of 3,000 pounds.

SEE THE ALL-NEW V330 VERTICAL LIFT SKID LOADER AT [www.gehl.com/enr1101](http://www.gehl.com/enr1101)

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**NY farm viability INSTITUTE**

NYFVI is a farmer-led nonprofit that invests in innovative projects to increase the success of ag production enterprises, protect farm-based natural resources and produce measurable farm-level results. For more information, visit the Web site, [www.nyfvi.org](http://www.nyfvi.org).





Elzinga & Hoeksema Greenhouses

# Grower Of The Year

Labor Savers  
Seamless Software  
Variety Central:  
University Trials



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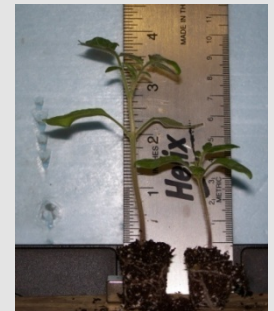
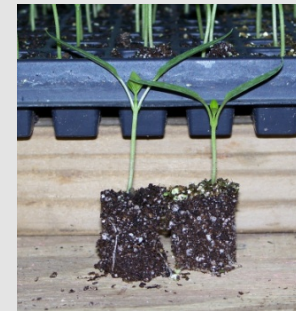






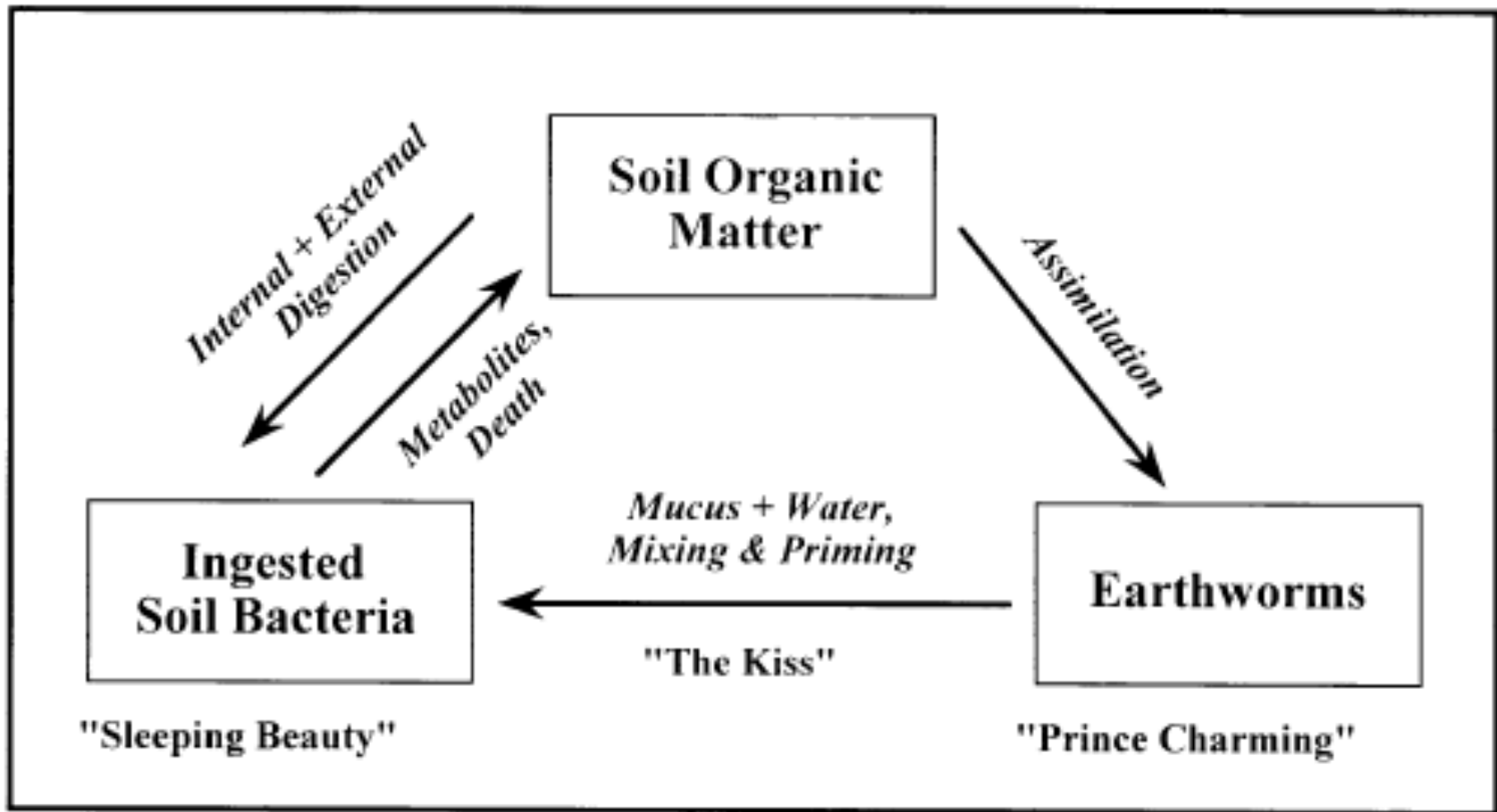
# Research and Development

- Awarded sixteen peer-reviewed research grants from Federal and State Agriculture Agencies.
- To characterize our material, Worm Power has invested seven-years and over \$2,000,000 in R&D
- Long standing research collaboration with multiple Departments at Cornell University and a new arrangement with Cal Poly.





# 'Sleeping Beauty' Paradox

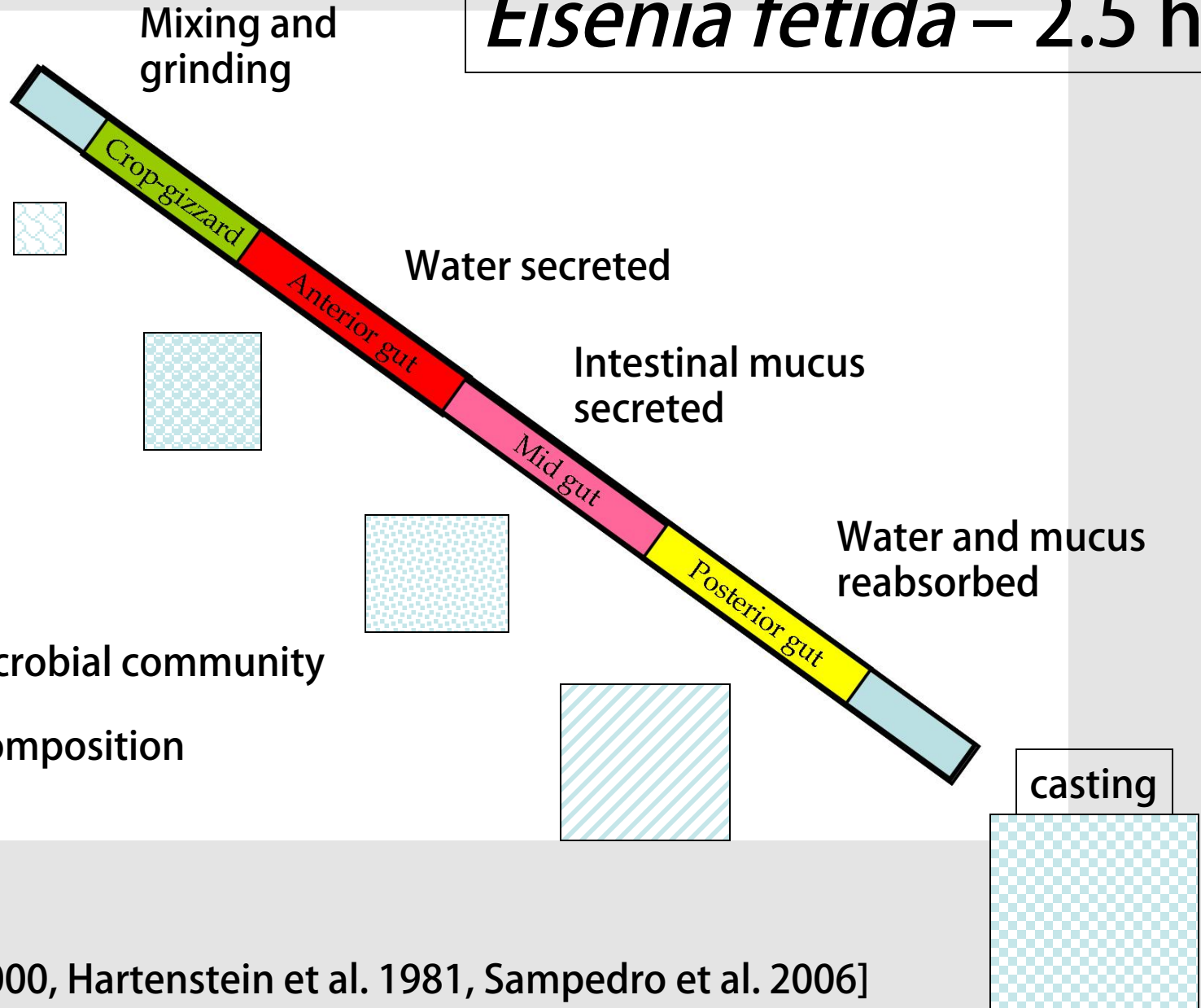




# Earthworm gut *Eisenia fetida* – 2.5 hr

food

Viable microbes



[Brown et al. 2000, Hartenstein et al. 1981, Sampedro et al. 2006]





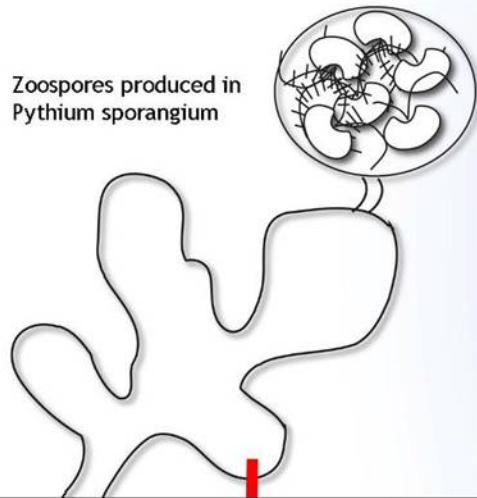
## 2. Vermicompost suppression of Pythium damping off

Allison Jack, Plant Pathology, Cornell University

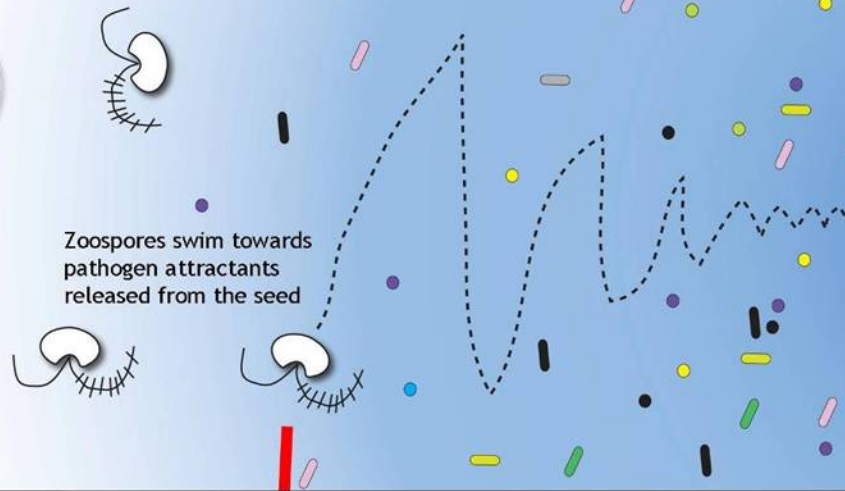
# The Spermosphere

## ZOOSPORE INFECTION STAGES WHERE DISEASE PROTECTION COULD OCCUR

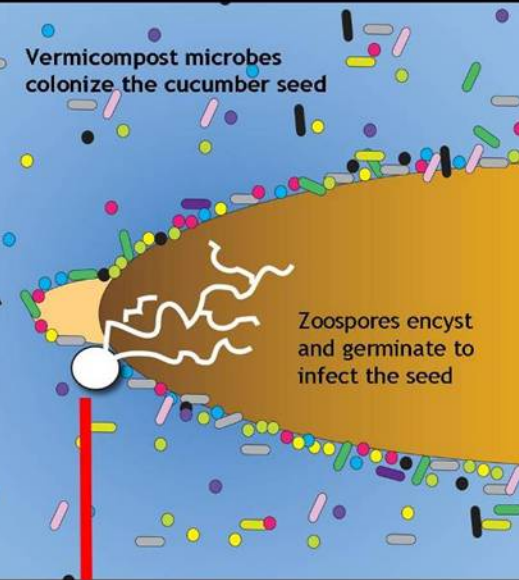
Zoospores produced in  
Pythium sporangium



Zoospores swim towards  
pathogen attractants  
released from the seed



Vermicompost microbes  
colonize the cucumber seed



Zoospores encyst and germinate to  
infect the seed

NON INOCULATED

INOCULATED

SOIL



VERMICOMPOST



, 50 mL  $3 \times 10^5$  zoospore mL<sup>-1</sup>, bar is 3 cm





**Non-inoculated**

**Inoculated**

**Sand**



**Sterile  
Batch 3**



**Batch 1  
2006**



**Batch 2  
2007**

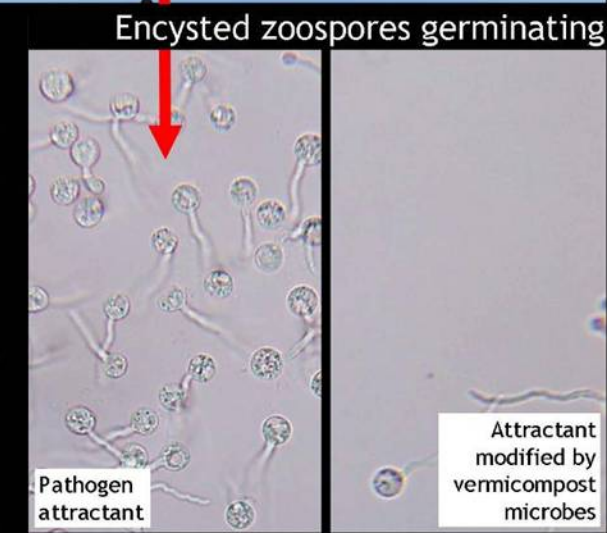
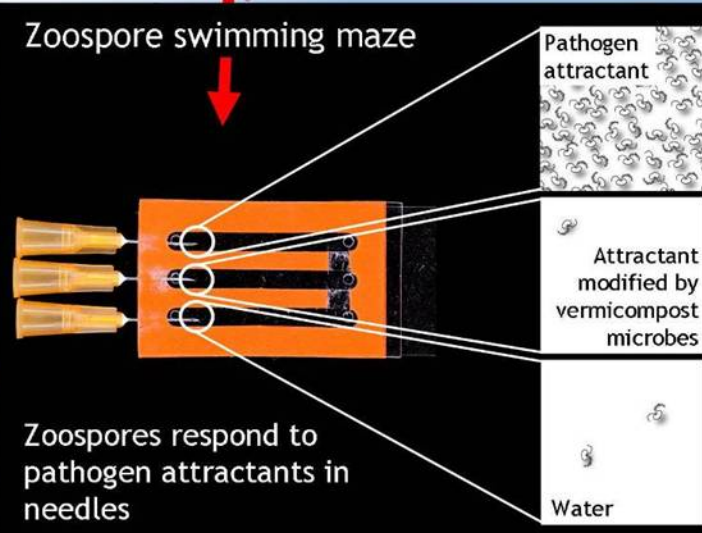
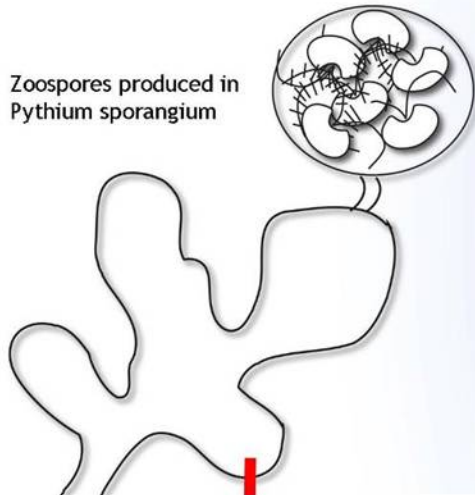


**Batch 3  
2008**



Allison Jack, Plant Pathology, Cornell University

# ZOOSPORE INFECTION STAGES WHERE DISEASE PROTECTION COULD OCCUR








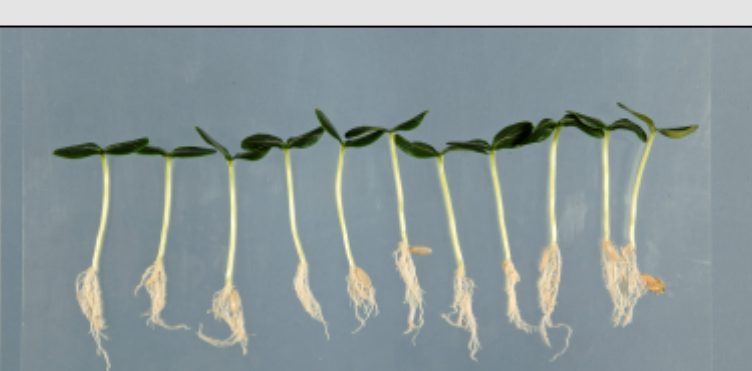


# Liquid Worm Power Extract



**Non-inoculated**

**Inoculated**

<b>Sand</b>	 A row of ten healthy, green seedlings with well-developed root systems, representing the non-inoculated control for the Sand treatment.	 A row of ten seedlings in the Sand treatment. The first four are healthy, but the remaining six are severely stunted, yellowed, and have very small or no roots, indicating a pathogen effect.
<b>Sterile VC Extract</b>	 A row of ten healthy, green seedlings with well-developed root systems, representing the non-inoculated control for the Sterile VC Extract treatment.	 A row of ten seedlings in the Sterile VC Extract treatment. The first four are healthy, but the remaining six are severely stunted, yellowed, and have very small or no roots, indicating a pathogen effect.
<b>VC Extract</b>	 A row of ten healthy, green seedlings with well-developed root systems, representing the non-inoculated control for the VC Extract treatment.	 A row of ten healthy, green seedlings with well-developed root systems, representing the inoculated control for the VC Extract treatment.







