VERMICULTURE GAINS MOMENTUM

NORTH Carolina State University (NCSU) held its 10th annual Vermiculture Conference in Durham on May 27-28, 2010. Over 100 people from 28 states and five countries gathered to learn and share information about raising worms and using worm castings and extracts to improve soil, increase plant growth and reduce plant pests and diseases.

The conference organizer, Rhonda Sherman, of NCSU's Biological & Agricultural Engineering Department, lined up speakers from the U.S. and other countries to present information on principles, large-scale operations and actual applications in the field and in research. The conference opened with an overview of the basics, provided by Sherman and Dr. Norman Arancon, a leading researcher on the uses and benefits of vermicompost from the College of Agriculture, Forestry and Natural Resource Management at the University of Hawaii at Hilo.

Harris Worm Farm in Mebane, North Carolina hosted a tour for the 10th Annual Vermiculture Conference at North Carolina State University. Owner John Harris used old railroad ties to construct 9-foot by 4.5-foot rectangular worm beds.

This year's 10th annual vermicomposting meeting captured the advances in operations, research and utilization of vermicompost and related products.

Janice Sitton

A FEW BASICS

Vermiculture refers to the practice of raising earthworms and maximizing reproduction rates for the harvest and sale of earthworms, versus vermicomposting, which refers to the process of managing earthworms to convert organic waste products into soil amendments for sale. The end product is typically called either vermicompost or castings.

"Vermicomposting is very different from traditional composting," explains Sherman. "In traditional composting, temperature is the main component, but in earthworm composting, high temperatures are a danger. Vermicomposting is really animal husbandry. We want to use language that denotes this basic and important difference."

Typical vermiculture systems include windrows, batch systems and bins of various sizes, wedge systems and flow-through or continuous flow digesters. Bedding, feeding, watering, pest control and harvesting must all be factored into the set-up of a new or continuing operation. Six species of composting earthworms are available: *Eisenia fetida, Eisenia andrei, Dendrobaena veneta, Lumbricus rubellus, Perionyx excavatus* (Indian Blues) and the *Eudrilus eugenae.* The *E. fetida*, also known as red wigglers, is the most common earthworm used in the U.S. and Canada.

VERMICOMPOSTING ENTREPRENEURS

Presentations were given by owners and managers of a range of vermicomposting enterprises.

The Worm Farm: Mark Purser operates The Worm Farm in Durham, California, a large-scale 40-acre facility that ships 250 to 300 lbs/week of worms throughout the U.S. and Canada and sells over 4,000 tons/year of castings, compost and soil amendments mixes. He utilizes 300-foot and 600-foot long windrows where worms are fed a regular supply of fresh cow manure. Drip irrigation is used to keep the windrows moist.

The castings are harvested once a year in the fall and screened to remove rocks and cow ear tags. Sales of compost mixes and soil amendments comprise over 75 percent of the business. Purser purchases additional castings from four other worm farmers nearby to meet demand, and creates blends mixed with bat guano, perlite and peat moss to expand the castings portion of his business. "If you are just selling worms or castings, it is hard to do," he says. "That is why we have diversified with extra materials, mixes and special blends."

WeCare Organics Vermitech: Jeffrey Budzich, a professional engineer and senior project manager, oversees WeCare Organics' Vermitech composting technology in the United States and Canada. Vermitech is currently the only large-scale vermiculture system operating in the U.S. to process biosolids from wastewater treatment plants to meet Class A pathogen requirements.

A mixture of aerobically digested biosolids and a minimal amount of wood chips (for structure) is fed to the worms from

A mixture of aerobically digested biosolids and a minimal amount of wood chips are added to the top of the continuous flow Vermitech composting system, operated by WeCare Organics. Material is added, and vermicompost is harvested, one to two days/week.

the top, and vermicompost is harvested from the bottom one to two days per week in a continuous flow system. An installation in Granville, Pennsylvania, which was processing 10 wet tons/week of biosolids, has been decommissioned. A second facility in West Hanover, Pennsylvania, which receives 20 wet tons/week, is being expanded. Several additional pilot plants are being planned throughout the U.S.

RT Solutions: Tom Herlihy is the president of RT Solutions located in Avon, New York, the largest process controlled vermicomposting facility in the U.S. Herlihy's focus is on earthworm husbandry; castings processed at his facility are marketed under the brand Worm Power. He currently sells over 400,000 lbs/year of castings in bulk, retail packaging and liquid extracts for a price that denotes the value of his product. Worm Power is currently undergoing a major expansion that will be completed during the fourth quarter of 2010.

Raw cow manure solids are mixed with chopped silage (for use as a carbon source and as a bulking agent) and then precomposted indoors before being fed to the worms. The precomposting, thermophilic process utilizes active aeration. Feedstocks are composted for a minimum of 14 days with one turn, with a minimum of three days at 55°C to stabilize the materials, increase pathogen reduction and destroy weed seeds.

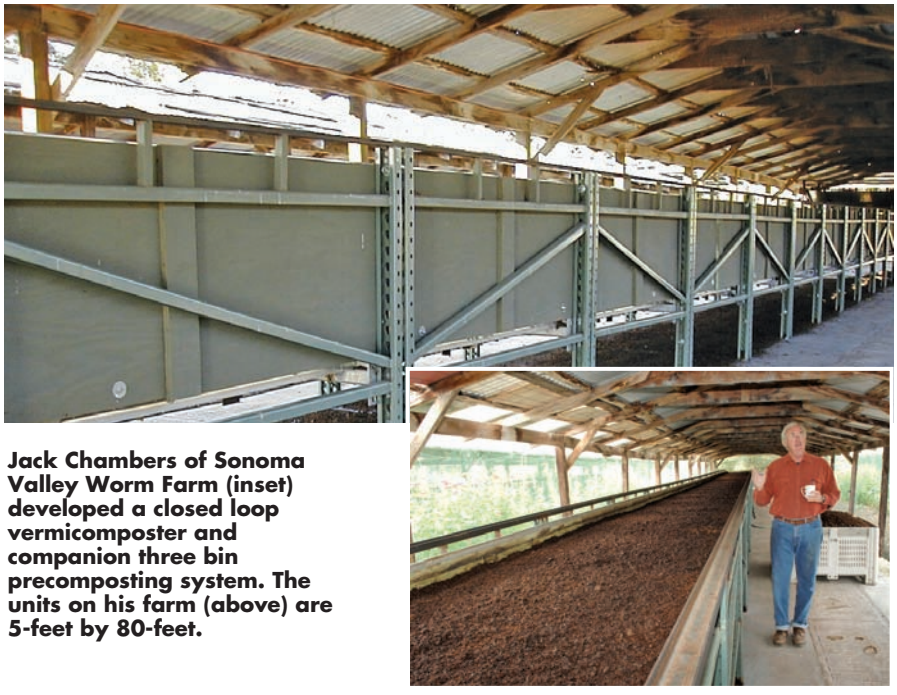
Precomposted materials are fed to the worms via a continuous-process, flow-through digester. A 1- to 2-inch layer of feed is spread along the top of the digester, and castings are harvested from the bottom. The bed/digester depth is sufficient to allow enough time for the worm's gestation cycle, so "workers" are replenished on an ongoing basis. Herlihy and his team monitor reproduction carefully. "If worms aren't reproducing, they aren't happy, and when worms aren't happy it can lead to a total system crash," says Herlihy. "The biological process can't be pushed without losses."

Sonoma Valley Worm Farm: Jack Chambers developed a medium closed loop vermicomposter and a companion three-bin precomposting system used at the Sonoma Valley Worm Farm in California that has been in operation for nine years. A local biodynamic winery contacted Chambers to develop a smaller scale system for their ranch, as they wanted to source all nutrients needed on property. The smaller vermicomposting systems — one 5-feet by 20-feet and another 5-feet by 40-feet — with a three-bin precomposting companion system, were developed and are now available for other small and medium-scale operations that want to close the organics loop. The 20-foot vermicompost system has a capacity of 7.4 cubic yards (cy) with an annual output of 12 cy, or one yard per month. The companion three-bin precomposting system utilizes forced air and holds approximately 43 cubic feet per bin.

The Sonoma Valley Worm Farm receives 8 cy/ week of organic cow manure from the Strauss Family dairy farm located nearby, which is precomposted and then fed to worms in four 5-feet by 80-feet continuous flow vermicomposters from the top. The vermicompost is harvested from the bottom and dried for one to two days. Approximately 2 cy of material go in, and 1 cy comes out per week. "When the worms have processed everything and are ready for more, the top of the bed looks like a pool table," notes Chambers.

Some wineries in the area use the vermicompost directly in the soil for new plantings and/or to produce an extract applied to existing grape vines to reduce powdery mildew. The typical loss rate in the early 2000s for grape vine plantings was 25 percent, but with a trial application rate of one cup of vermicompost per plant, only two of 400 plants were lost at the vineyard located on the Worm Farm. A famous Napa vineyard using vermicompost planted two acres of vines, and had no vine loss whatsoever.

Harris Worm Farm: John Harris with the Harris Worm Farm located in nearby



Jack Chambers of Sonoma Valley Worm Farm (inset) developed a closed loop vermicomposter and companion three bin precomposting system. The units on his farm (above) are 5-feet by 80-feet.

Mebane, North Carolina hosted a tour for the conference on the first afternoon. Attendees were able to see a small-scale vermiculture operation first hand (one that Harris manages in addition to a full-time job).

Harris used old railroad ties to construct 9-foot by 4.5-foot rectangular beds about 9-inches deep, which he covered with 90 percent shade cloth secured with bungee cords to keep out pests and light. Cloth on the bottom prevents moles and voles from disturbing the worms. The beds are located outside under several large canopy trees, which help keep the temperature down as well.

RT Solutions in Avon, New York recently expanded its vermicomposting capacity (above). Raw cow manure solids are mixed with chopped silage and precomposted prior to being fed to the worms in a 1- to 2-inch layer on the top of the beds.

The earthworms are fed precomposted horse manure, sawdust and food scraps. Harris starts a new bed with 3- to 4-inches of aged manure, then adds 1- to 2-inches of manure on top for food. Although he has harvested some castings, his main focus is raising earthworms to satisfy orders received on his website. Since starting the operation in 2008, he has expanded to 18 beds and ships several pounds of worms on a weekly basis. His worms were obviously thriving, as new worm pods could be found throughout the beds.

MARKETING INSIGHTS

Tom Herlihy with Worm Power sells both castings and casting extracts in bulk and through retail lawn and garden centers in over 12 states. His company's focus is on high-end horticulture, for which consistent, repeatable results are critical. Through several collaborative projects with Cornell University, the consistent quality and value of Worm Power castings and extracts have been proven; third party research data is available for new customers upon request.

Herlihy sells bulk castings for $400/cy, almost 10 times as much as typical compost. Worm Power entered the retail market in 2008, which came with a steep learning curve and a new set of issues to be dealt with — packaging, distribution, product support, displays and financing. "In retail, packaging is king," notes Herlihy. "We hired a graphic design team to come up with a new logo and look for our packaging to increase shelf appeal." He also described the difficulty complying with the labeling requirements from different states, but so far has been able to meet them with only one label. He also produces vermicompost extract.

For Mark Purser of The Worm Farm, TV advertising is less expensive and more effective than advertising through newspapers, shows and fairs. He usually takes out four to five TV spots per day. Aside from bulk sales, the majority of his orders for worms come in via his website. In his presentation, Purser provided a great overview of the steps needed to harvest, bag and ship worms on a large-scale to fill these orders.

GLOBAL EXPERIENCES

Maria Rodriguez, founder and managing director of Byoearth, saw a need and an opportunity for worm composting in Guatemala. The country has no waste diversion practices in place, so all materials are taken to a city dump where approximately 2,000 low income families live and scavenge materials for their livelihood. Rodriguez introduced vermiculture practices to 20 women living in or near the city dump under a program called "Fertilize Your Future" or "Abona Tu Futuro." Through this program, Rodriguez has created transferable skills in vermiculture, recycling and creative cooking, a reuse for valuable organic resources that make up 50 percent of the Guatemalan waste stream, and a mechanism for social change in her country.

Rodriguez also uses worms to compost coffee pulp at a family owned coffee farm where she breeds worms and produces vermicompost for the national market. She has a worm population of about 10 million.

Dr. Sarah Sathyavathi, assistant professor with the Department of Zoology at Lady Doak College in Madurai, South India, has focused her research and projects on using vermicomposting to process sewage sludge, thus addressing two challenges at once: management of biosolids and lack of fertilizers for soils. Her research includes precomposting biosolids with either cow dung or leaf litter, and then feeding the materials to *Perionyx excavatus* (Indian Blue worms) and evaluating physiochemical characteristics, heavy metals, pathogens and plant growth between the control groups.

The highest percentage reduction in volatile solids was observed in vermicomposts compared to controls and in those derived from biosolids/cow manure combinations (81.44%) compared to biosolids/leaf litter mixtures (45.16%). Oxidized nitrogen ($NO_3 + NO_2$) values were higher in cow manure derived vermicomposts than in those derived from leaf litter. The biosolids substrate ratio of 1:3 supported the highest earthworm population. Total and fecal coliforms were present in all vermicomposts and controls while *Salmonella* spp. and *Shigella* spp. were absent.

Germination studies with *Celosia argentea* exhibited significantly more chlorophyll and biomass and longer shoot length than controls. Diameter and number of flowers were more in *Tagetes erecta* when grown in soil amended with vermicomposts than in controls as well.

Dr. Suneet Dabke is the proprietor of Concept Biotech, a consulting firm in India, which utilizes composting worms to remediate toxic industrial disposal sites. Dabke presented a vermi remediation case study. The initial analysis showed extremely high levels of contamination in land located adjacent to a village with a toxic dumpsite. The groundwater was severely contaminated with chromium, lead, iron and zinc.

It was not feasible to remove all the contaminated soil and send it to the landfill, so only the top meter of soil from the hazardous waste dump was removed before the vermi remediation project began. Dabke then added compost and vermicompost, a microbial solution, a vermiaccelerator (a consortium of beneficial bacteria with nutrients to support microbial life) and composting worms. The site was tilled every two months. A crop of maize was introduced to measure contamination in the plants and then tilled into the soil to further improve soil health. Once the bioremediation was complete, analysis revealed that only traces of heavy metals remained in the soil. Groundwater contamination had been reduced as well.

PLANT GROWTH RESEARCH

Norman Arancon of the University of Hawaii has been involved in vermicompost utilization research for over 10 years. He started his work at The Ohio State University under the direction of Dr. Clive Edwards, and continues to lead research efforts on plant growth and disease suppression through the use of vermicompost. Arancon's research includes various feedstocks (paper waste, food scraps, cow manure) and vermicompost application rates of 0, 20 and 40 percent. Results show significant and repeatable suppression of *pythium*, verticillium wilt, *rhizoctonia solani*, powdery mildew, plant parasitic nematodes, cabbage white caterpillars, cucumber beetles, tomato hornworms, mealy bugs, aphids and two-spotted spider mites' damage to a wide range of food crops.

Vermicompost harvested from the Vermitech system was studied to understand the effect on plant size and crop yields. According to Jeffrey Budzich, in a case study with 20 percent treatment of vermicompost to potting soil by volume, tomato plants were 57 percent taller than untreated plants after 17 days. An application of 1 ton/acre of vermicompost also showed increased yields of potatoes from 14 to 22 tons/acre.

Maria Rodriguez introduced vermiculture practices to 20 women living in or near a city dump in Guatemala under a program called "Fertilize Your Future."

Herlihy and Worm Power's research at Cornell includes work with Dr. Anu Rangarajan in the Department of Horticulture, who has developed mixtures of transplant media amendments that include vermicompost for nutrient management in organic vegetable transplant production. Dr. Eric Nelson's research group in the Department of Plant Pathology has helped develop a nonaerated vermicompost extract and is currently investigating the microbial mechanisms behind Worm Power's ability to suppress Pythium damping off.

For more information, contact Rhonda Sherman at rhonda_sherman@ncsu.edu or visit www.bae.ncsu.edu/people/faculty/sherman. For information on an upcoming international vermiculture conference, please visit http://isee9.info/. ■

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