The ISU Compost Facility after 11 Years

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Introduction

The University Compost Facility has completed 11 full years of operation. The facility is managed by the ISU Research Farms and has a separate revolving account that receives fees and sales and pays expenses. The facility is designed to be self-supporting, i.e. not receive allocations for its operations. It is located at 52274 260th Street, Ames, Iowa.

Materials and Methods

The ISU Compost Facility consists of seven, 80 x 140 ft hoop barns and a 55 x 120 ft hoop barn, all with paved floors. The facility also has a Mettler-Toledo electronic scale with a 10 ft x 70 ft platform to weigh all materials.

Key machinery at the Compost Facility is 1) compost turner, a used pull-type Aeromaster PT-170, 14 ft wide, made by Midwest Biosystems, Tampico, IL; 2) a 2017 dump trailer made by Berkelman Welding, ON, Canada, used to construct windrows and haul material; 3) a telehandler, Caterpillar TH407 with cab and 2.75 cubic yard bucket; 4) a tractor, John Deere 7520 (125 PTO hp) with IVT (Infinite Variable Transmission) and front-wheel assist used to pull the turner and dump trailer; and 5) a used wheel loader, 2013 John Deere 624K high lift. The wheel loader is the main loader used and the telehandler provides backup and operates in areas the wheel loader cannot get into. It also reduces the load on the telehandler, potentially extending its life.

The compost blend targets are a carbon-nitrogen ratio of 25-30:1 and moisture of 45-50 percent. Porosity and structure affect how well oxygen flows into the pile and its availability to the microbes.

After a windrow is made with the dump trailer, the windrow is turned to mix all materials thoroughly. Within three to four days the windrow heats to 140-160°F. Later, it is turned one to two times a week. The composting process takes about 12 to 16 weeks with 25 to 30 turns. Frequency of turning is determined by windrow temperature and moisture content. Turning provides mixing and aeration. When the oxygen level in the windrow falls below atmospheric oxygen levels, the windrow benefits from turning. The porosity of the windrows is related to moisture content and structure from particles like cornstalks.

Results and Discussion

The facility receives manure and biomass from several ISU facilities: Dairy Farm, Animal Science Teaching Farms (including the equine barns), Campus Services (yard and greenhouse waste), ISU Dining (food waste), Hansen Learning Center (arena wood shavings), Ag Engineering/Agronomy Farm, BioCentury Research Farm, Plant Introduction Station, Reiman Gardens, Horticulture Station, and others. Manure and bedding from the newly opened Animal Science Poultry Farm will be composted by the facility beginning in April 2020. A total of 9,275 tons were received in 2019 (Table 1). This is slightly more than 2018. About 80 percent of the incoming material came from the ISU Dairy Farm.

The facility generated compost and amended soil primarily for campus use. A total of 3,970 tons were outgoing from the facility in 2019, a decrease of 1,340 tons (25 percent) compared with 2018 (Table 2). This was due to a

decrease in the needs from construction projects on campus. The inventory of finished compost increased slightly with increased inputs and decreased outputs. About 40 tons of compost and 3,930 tons of amended soil were outgoing. The primary outgoing product was amended soil. Amended soil is a blend of compost and topsoil. Compost was used for several research projects as a soil amendment to plots.

The covers on some of the hoops that haven't been replaced are showing significant wear, mostly along creases. The hoop covers that cover the entire hoop structure from concrete wall to concrete wall work well and appear to be fairly durable. One cover was replaced in 2019. One more cover will be replaced this summer. More covers will continue to be installed until all are replaced.

No concrete aprons were added to the ends of hoop barns last year. However, a concrete pad was poured for the storage of rock, sand, and loess soil for some engineering labs. More aprons will be added this year.

Construction started for a new building to store finished compost, topsoil, and amended soil. With more material coming into the facility to compost, more space was needed to compost windrows. Therefore, with the new construction, a hoop previously used for storage of amended soil will be used for composting again.

Composting at the facility was challenging again. The winter had average/below average temperatures with little snowfall until late winter/early spring, similar to 2018. Cool temperatures and above average rainfall/snow during the spring slowed composting. The summer had a lot of rain, which had little effect on composting under the hoops. The exterior windrows that are overruns from screening, did not dry out because of the excess rainfall and were not screened in the fall. A wet and cool fall slowed composting considerably. It offered no opportunity to screen the finished compost. In December, the oversized particles from the screening process were cleaned to create space. The wet unscreened compost was placed on the outside storage pad to hopefully dry out to be screened the next year.The difficulties of composting without covers are a reason why the hoop barns or some other roof are so critical for successful composting in Iowa.

The facility continued screening all compost at the facility. The screener removes the foreign material and rocks. However, the screener does not break up soil chunks or screen wetter material well. Therefore, by drying this material in a windrow and re-screening, 80 percent can be recovered as clean.

During 2019, the hoop barns were used as follows: 1) the central hoop barn was used for receiving, mixing, and storage of raw materials; 2) one hoop barn was used for storing finished compost, topsoil, and mixing/storage of amended soil (this hoop barn will be switched to general composting when the materials building is complete); and 3) the remaining five hoop barns, plus the smaller hoop barn, were dedicated to general composting.

The ISU Compost Facility continues to serve a unique and vital role in assisting ISU be "greener" and more sustainable. The staff continues to improve the management of the compost to benefit the university.

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Table 1. ISU Compost Facility inputs.

	2019 tons	2019 % of total	2018 tons	2017 tons	2016 tons	2015 tons
Source						
Dairy manure[1]	4497	48.5	4,729	3722	3,901	3,642
Dairy solids[2]	609	6.6	688	552	846	1,404
Dairy pack[3]	2190	23.6	1,709	1,507	1,728	1,683
Dairy subtotal	7,296	78.7	7,126	5,781	6,475	6,729
Campus[4]	416	4.5	421	649	466	672
An Sci manure	640	6.9	476	458	579	461
Dining[5]	295	3.2	355	411	292	340
Biomass[6]	0	0.0	6	481	365	292
Stalks[7]	427	4.6	275	287	189	165
Other[8]	201	2.1	201	43	58	29
Total	9,275	100.0	8,860	8,110	8,424	8,688

[1]Semi-solid dairy barn scrapings.
[2]Solids from the manure separator.
[3]Bedded packs from dairy barns.
[4]Consists of campus yard waste (leaves, etc.) and greenhouse waste.
[5]Compostable dining hall and kitchen food wastes.
[6]Biomass research wastes, usually corn stalks, switchgrass, corncobs, or similar waste feedstocks.
[7]Cornstalks as a carbon source.
[8]All other sources.

Table 2. ISU Compost Facility outputs.

	2019 tons	2019 % of total	2018 tons	2017 tons	2016 tons	2015 tons
Amended soil	3,930	99.0	4,996	5,637	7,389	3,381
Compost	40	1.0	222	291	29	26
Stalks	0	0	0	0	0	22
Black dirt	0	0	92	193	276	246
Total	3,970	100.0	5,310	6,121	7,694	3,675