



ISU Compost Facility Update

Steve Jonas—compost facility manager

Tim Goode—farms manager

The University Compost Facility has completed 12 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.

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. This year a 75 x 189 ft. mono-slope steel frame building was constructed to store finished and screened compost, topsoil, and amended soil for sale. The facility also has a Mettler-Toledo electronic scale with a 10 ft. x 70 ft. platform to weigh all materials.

1. Key machinery at the compost facility is:
 - a compost turner, a used pull-type Aeromaster PT-170, 14 ft. wide, made by Midwest Biosystems, Tampico, Illinois;
2. a 2017 dump trailer made by Berkelman Welding, Ontario, Canada, used to construct windrows and haul material;
3. a 2019 telehandler, Caterpillar TH408 with a bale spear, pallet forks, 1.25 yd. bucket and 2.75 cubic yard bucket;
4. a tractor, 2003 John Deere 7520 (125 PTO hp) with IVT (Infinitely 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 inaccessible to the wheel loader.

The compost blend targets are a carbon-nitrogen ratio of 25-30:1 and moisture of 45-50%. 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 per week. The composting process takes about 12 to 16 weeks with 25 to 30 turns. Frequency of turning is determined by windrow temperature, moisture content, and weather. Turning provides mixing and aeration. When the oxygen level in the windrow falls below atmospheric oxygen levels, the windrows benefit 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), Poultry Farm, Campus Services (yard and greenhouse waste), ISU Dining (food waste), Hansen Learning Center (arena wood shavings), BioCentury Research Farm, Agricultural Engineering/Agronomy Research and Demonstration Farm, Plant Introduction Station, Reiman Gardens, Horticulture Research Station, and others.

A total of 7,431 tons were received in 2021 (Table 1). This is about 8% less than 2020. Some of the decrease is attributed to drier weather and changes to dairy cattle management. About 75% of the incoming material came from the ISU Dairy Farm.

The facility generated compost and amended soil primarily for campus use. A total of 2,893 tons were outgoing from the facility in 2021, a decrease of 396 tons (12%) compared with 2020 (Table 2). This was due to a decrease in the needs from construction projects on campus. The inventory of finished compost increased significantly with decreased outputs. About 1,180 tons of finished and screened compost were outgoing from the facility. The primary outgoing product was amended soil. Amended soil is a blend of compost and topsoil. Sixty tons of compost was used for several research projects as a soil amendment to plots.

Due to the COVID-19 pandemic and the associated budget constraints, few capital projects were ongoing on campus. New capital projects were delayed or cancelled, thus requiring less amended soil. With lower

demand for amended soil and compost, the decision was made to apply compost to ISU/CAD (Committee for Agricultural Development) farm fields near the facility. Approximately 1,120 tons of compost was hauled to the fields in the fall. This allowed room for storing new finished compost material in the facility.

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 2021. One more cover will be replaced this spring. More covers will continue to be installed until all are replaced.

On December 15, 2021, the compost facility was hit by another derecho. With winds in excess of 75-80 mph for 20-30 minutes, one of the hoop barns was destroyed. Due to budget constraints this hoop may not be replaced until the budget can afford it. Three other hoops had damage to support piers. Staff will try to reinforce the rafters on all the remaining hoops to hopefully prevent other hoops from collapsing.

Table 1. ISU Compost Facility inputs.

Source	2021 tons	2021 % of total	2020 tons	2019 tons	2018 tons	2017 tons
Dairy manure ¹	4,001	53.8	3,975	4,497	4,729	3,722
Dairy solids ²	41	0.6	450	609	688	552
Dairy pack ³	1,699	22.8	1,676	2,190	1,709	1,507
Dairy subtotal	5,741	77.2	6,101	7,296	7,126	5,781
Campus ⁴	337	4.5	441	416	421	649
An Sci manure	737	9.9	729	640	476	458
Dining ⁵	191	2.6	198	295	355	411
Biomass ⁶	86	1.2	14	0	6	481
Stalks ⁷	260	3.5	372	427	275	287
Other ⁸	79	1.1	203	201	201	43
Total	13,172	177.20	14,159	16,571	15,986	13,891

¹Semi-solid dairy barn scrapings.

²Solids from the manure separator.

³Bedded packs from dairy barns.

⁴Consists of campus yard waste (leaves, etc.) and greenhouse waste.

⁵Compostable dining hall and kitchen food wastes.

⁶Biomass research wastes, usually corn stalks, switchgrass, corncobs, or similar waste feedstocks.

⁷Cornstalks as a carbon source.

⁸All other sources.

Table 2. ISU Compost Facility outputs.

Item	2021 tons	2021 % of total	2020 tons	2019 tons	2018 tons	2017 tons
Amended soil	2,893	71	3,289	4,442	4,999	5,637
Compost*	1,180	29	1,225	55	222	291
Stalks	0	0	30	0	0	0
Black dirt	0	0	0	0	92	193
Total	4,073	100	4,544	4,497	5,313	6,121

*Field applied compost included in total.

No concrete aprons were added to the ends of hoop barns last year. More aprons will be added in the coming year.

The new material handling building was completed in spring 2020. It has been an excellent addition. The material handling building stores finished and screened compost, topsoil, and amended soil. With more material coming into the facility to compost, more space was needed for windrows. Thus, the new building allowed a hoop barn previously used for storage of amended soil to be used for composting.

Variable weather made composting at the facility challenging, although the dry year was generally beneficial. The early winter was warmer than average. January and February had average to below average temperatures with little snowfall until late winter/early spring, similar to 2020. The spring was warmer and drier. Composting during the year went well. Staff was able to screen all finished compost in the fall, similar to the previous year. The remainder of the fall was good for composting, thus the windrows were drier going into winter.

The facility continued screening all compost needed for amended soil. A trommel screen is rented one to two times per year. The screen removes the foreign material and rocks. However, the screen does not break up soil chunks or separate wetter material well. The material that does not go through the screen is called overs. This material is put into windrows on an open-air dirt pad to be reclaimed. This material is mostly rock, garbage, and compost that was too chunky to fit through the screen. These windrows, that consist of material that did not go through the screen during the screening process, are turned periodically to aid in drying. The warm and dry conditions of this last summer helped dry out the overs windrows so these would be easy to screen. Therefore, by drying this material in a windrow and rescreening, 80% can be recovered as clean.

During 2021, the hoop barns were used as follows:

1. the central hoop barn was used for receiving, mixing, and storage of raw materials, and
2. the remaining six hoop barns plus the smaller hoop barn were dedicated to general composting.

We commenced the project where the compost facility will start composting the paper towel waste from the bathrooms around campus and vet med. This is being done to reduce the amount of garbage being sent to the landfill.

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

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