Reducing costs, improving nutrient value

by Chantal Foulds

Advocates of composting believe in the process for many reasons. The principal ones include: producing a humus rich material for the purposes of improving soil quality, providing a form of fertilization that does not encourage weeds and reducing the total volume of material that must be handled in the field. As beneficial as these points are in developing a sustainable farm management program, many farmers encounter problems during the composting process.

Maurice l'Heureux, of l'lnstitut Agro-Alimentaire de La Pocatiere (an agricultural school located northeast of Quebec city) has tried to address some of the major drawbacks of composting. He and his colleagues have evaluated different aeration systems as a means of reducing nutrient losses from the manure, as well as reducing labour and storage requirements. On a more theoretical level, the collection of heat generated during the composting process, to meet on-farm heating requirements, were evaluated in monetary terms.

Different treatments

Manure with two different levels of straw added (2 and 4 kg per animal per day) were each composted in three different ways. No satisfactory results were obtained in any of the treatments using 2 kg per animal because the material was not porous enough to allow air circulation.

In the aeration treatments, manure was overlaid on ventilator pipes to a depth of 2 m. Aeration systems consisted of either a large ventilator with a capacity to push 1.4 cu.m of air per second, or a smaller one discharging 0.6 cu.m of air per second. Manure composted using these aeration systems was compared to manure composted in windrows and turned once during the season.

Nutrient losses

The nitrogen and potassium losses measured at two different stages during the composting process are shown in Table 1. The first measurements were taken as the temperature in the pile fell to 45°C, the temperature at which the thermophile (or initial heating) phase is considered to be over. The second measurements were taken when the compost was well decomposed, 5 months after the process started.

Table 1. Loss or Gain of Macronutrients in the Compost

Composting Stage	Nutrient	Absolute Loss (or Gain) %		
		Large Ventilator	Small Ventilator	Windrow
Thermophile	N	6	14	36
	K	19	23	29
Mature	N	36	37	52
	K	34	52	54

* Phosphorus losses were not included due to uneven addition of rock-P to the manure in the barn.

Conservation of nitrogen was better with both of the aeration systems. This was evident at both the thermophile and mature compost stages. Nitrogen loss is closely associated with temperature, ie. N losses are higher when manure is spread in mid-day than other parts of the day. The same is true for composting.

The temperature was monitored and for both the aeration systems, temperatures stabilized under 45°C within 30 days. In the windrow treatment, it took 45 days for temperatures to fall below this level. The large ventilators were the most effective at lowering the temperature quickly

Potassium losses, however, were reduced only with the large ventilator and observed only at the mature stage. Potassium losses, unlike nitrogen, are not associated with high temperatures, but rather the degree to which the liquid portion of the manure is conserved.

Storage requirements

In general, farmers are most concerned about nitrogen losses from compost, and for this, aeration appears to reduce losses. Potassium losses, on the other hand, can only be overcome by adding absorbents to the manure (ie. straw, sawdust, etc.) and installing some type of liquid manure system. This, in combination with a solid manure and composting facility, could be a sizable investment for many farmers.

However, L'Heureux foresees that this type of continuous composting operation would only need 3,000 cu.m of storage capacity for the liquid runoff because the liquid would be re-circulated continuously onto the compost pile to maintain appropriate conditions for decomposition.

As well, the storage and composting facility are designed for continuous composting. As a result, more manure could be handled on a smaller surface area. Table 2 illustrates the increase in manure treatment capacity of the ventilator systems in comparison to the windrow system.

With the large ventilators, the manure was stabilized at, or under, 45°C within 18 days. Theoretically this means the menu re nutrients are stabilized and the material could be handled in the field with less nutrient losses than if the manure composted using small ventilators or windrows was applied at this time.

Evidently, transporting compost to the field eve ry 18 days increases the handling workload. But L, Heureux estimates that the increased number of trips to the field is balanced by the reduced volume of manure that needs to be transported over the entire season.

Note as well the greater amount of manure that can be processed using a smaller surface area withthe aeration systems. Annually, a large ventilator could process 2700 cu.m of manure on 50 sq.m. The other two systems do not even come close in terms of space efficiency.

Crop outlets

One of the obvious Questions that arises is what do you do with manure that is ready to be spread every 3 weeks in the case of the large ventilator systems? The finished product could be placed in a field for further maturation until that field was ready to receive an application. A stabilized product would be less prone to leaching losses. Applications could be made in the spring before seeding, on forage stands after each cut, post emergence in many crops or on a cover crop/green manure in the late summer/early fall.

Energy recovery

An attempt was made to integrate energy recovery (heat) from the composting process and use it on the farm (Table 3). The equipment was not actually set up, but calculations were made of the amount of heat that could be recovered in 3 different systems using the large ventilators.

The calculations demonstrate how efficient storage and composting facilities can reduce compost production costs, especially if added value, in the form of heat recovery, is taken into consideration.

Table 2. Treatment Capacity of the 3 Manure Composting Systems.

Technique	Surface Area Occupied (sq.m)	Duration of Composting (days till the end of thermophile phase)	Volume of Manure Treated (cu.m)	Ratio during the actual experiment (nov.'89-march'90) (cu.m/sq.m)	Annually (calculated)
Large ventilator	50	18	135	2700	54
Small ventilator	48	30	72	864	18
Windrows	100	120	80	240	2.4

Table 3. Net Amount of Air and Energy Recovered in Dollar Terms.

Scenario	Volume of Warm Air Recovered (%)	Net Amount of Energy Recovered from the Manure (kWh/cu.m)	Value* ($/cu.m of manure)
1. Open System (actually tested in 89/90)	33	34.1	1.76
2. Partially Closed System (preliminary data in 90/91)	66	68.2	3.52
3. Completely Close System (not tested)	100	102.3	5.28

* Based on electrical costs of $0.516/kWh

Table 4. Investment Costs, Manure Volume Treated Annually and Operation Costs for Each of the Techniques on a Surface Area of 50 cu.m.

Technique	Investment ($)	Volume Treated Annually (cu.m)	Operation Costs ($/cu.m of manure)	Production Costs ($/cu.m of manure)
Large Ventilator	16,300	2,700	5.07	Scen 1' - 4.04 Scen 2 - 3.01 Scen 3 - 2.26
Small Ventilator	3,350	900	5.62	5.62
Windrow	200	120	8.29	8.28

' Scenarios 1,2, and 3 are those described in Table 3.