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On-Farm Composting of Fishery By-Products

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Being surrounded by water in a province which has the fishery as an important contributor to its economic base, it is only natural that Island farmers have long recognized fish and fishery by-products as valuable nutrient sources. Fishery by-products are available annually and are rich in nitrogen (N), phosphorous (P), potassium (K) and calcium (Ca) and can contribute to environmentally sustainable agricultural production.

However, with the growth of rural non-farm residents, the tolerance for the odours generated during the storage and spreading of these fishery by-products has decreased. Composting is one way to minimize or eliminate odours from fishery by-products. During the summer and fall of 2000, a demonstration project was conducted on two Island farms to develop successful composting techniques for lobster/crab waste and whole fish. Cooperating farmers were Joe Dorgan from Seacow Pond and Gerry Richard from St. Nicholas.

A good compost puts a smile on anyone!
Left to right: Joe Dorgan and Roger Henry

The Composting Process as It Pertains to Fishery By-products.

A pile of fishery by-products will not compost properly unless it is mixed with other ingredients. Left alone, the pile will heat up, become anaerobic and generate strong odours. If combined with other ingredients and supplied with air and water for eight to ten weeks, by-products will be converted into a compost without the creation of odours.

Trenched sawdust with whole fish added.

Proper composting requires air, water and a food source for the microbes. The food or compostable material is changed into compost by the microorganisms in the presence of water and oxygen. This process produces carbon dioxide, water and heat. When composting fishery by-products, usually there is water in the by-product materials, and the air is provided by turning the material periodically or by using coarse materials which allows for air to flow through the pile. The micro-organisms which convert raw organic matter to compost require specific amounts of carbon (C) and nitrogen (N) to work effectively without odours. Good composting requires approximately 30 parts C to every part N. Fishery by-products are a high N source; so to compost properly, they have to be mixed with a C source. Local C sources (sometimes called bulking agents) are straw, sawdust, leaves and manure where plenty of straw and or sawdust was used as bedding.

Physical Effects of Fishery By-products on a Compost Pile

The lobster/crab (LC) material used in this project consisted of almost entirely shell with a very small amount of tissue and liquid. The shell provided a readily available source of N and when mixed with other ingredients caused the compost pile to heat up very quickly. The shell gave the pile structure and allowed for good air flow through the pile. This is beneficial; but because the pile has good air movement, it can dry out very quickly. If a pile becomes too dry, it will shut down the composting process. This will also stop any odour generation but it does not produce the desired end product. The LC by-products should be combined with a high moisture carbon type material such as wet straw or sawdust or a wet manure in the following ratios:

1 : 1 — LC : manure (requires manure with plenty of straw/sawdust)
2 : 1 — LC : wet manure (requires manure with plenty of straw/sawdust)
2 : 2 : 1 — LC : manure : sawdust

The whole fish (WF) contain essentially N and water. As the fish tissue breaks down it releases the water and N. This material makes an excellent compost when combined with a high C source such as sawdust, shavings and/or straw. It does not give the pile structure; rather it tends to increase the density of the compost which will reduce air flow and thus will require more turning and aeration. The recommended ratio is 1 : 3 — WF : sawdust. Three parts sawdust to one part WF is the minimum required to cover the WF and thus prevent odour and scavenger problems at the site. When the WF is sufficiently broken down, at approximately eight weeks, and if the C : N ratio is 25 or above, more WF could be added. The amount added would depend on the amount of C in the mix; the higher the C is above 25, the more WF which can be added. WF will compost well with any carbon source provided there is good air flow through the pile.

Sawdust and whole fish compost pile made and ready for composting.

Making the Compost Pile

The site chosen for building the compost piles or windrows should not be near a waterway or tile drains. Ideally there should be a way to retain the liquids that may leach out of the pile and seep into the soil if the pile gets too wet when rainfall is high. This can be done if the site selected is on a slight slope. Otherwise, use level land and do not use the same place each year. Heavy clay soil is ideal because it prevents any leachate from reaching the water table.

Adding lobster/crab to a trenched row of manure.

Once the raw materials and the bulking agents have been obtained, the next step is to mix the ingredients and form a windrow. The windrow should be approximately five-feet high and 10- feet wide. The most readily available equipment for on-farm composting is the manure spreader and front-end loader. Make sure the material is free of larger stones and any objects which could damage the equipment. Non-compostable material such as rubber or plastic is often a contaminant of fishery by-products and should be removed as well. Outdoor composting works best from May to October; and while it is possible to compost earlier and later in the season, the colder and wetter the weather gets, the more difficult the task. When dealing with ingredients with high odour potential such as fish, it is important that the site be kept clean and that any fish offal is mixed daily into a windrow. Poor or careless work with such materials will often result in significant odour release from the site.

Front-end Loader Method

The front-end loader can be used to measure, mix and pile the ingredients. This method works very well for WF because it ensures that the fish is covered when the pile is formed. It also works well for LC. When using WF, begin by laying down a bed of bulking agent about three-feet deep and then open up a V trench in the bed of material; place the WF in the trench using the loader, then cover it with more bulking agent. WF tends to flow and does not pile well and this method will contain the fish until it starts to decompose, preventing odour and scavenger problems at the site. Once the pile is assembled, it is best to leave it alone for three weeks to allow the fish to breakdown, and then turn it.

This method does not mix the ingredients as well as the manure spreader. To provide better mixing and aeration, the windrow or pile should be turned three or four times during the composting. This will significantly enhance the composting of the material and produce a better end product.

Manure Spreader Method

Using the front-end loader to measure, load the spreader with the ingredients in the ratio required. Move the loaded spreader to the area where the windrow is to be formed. Engage the PTO and allow the spreader to unload enough material to form a windrow before moving it forward a few feet. Continue until all the fishery by-product is used. Most manure spreaders designed for solid manure will form a windrow five-feet high and 10-feet wide at the base which is a good size windrow. If loaded as required by the recipe, the spreader will mix things very well and make a uniform windrow.

Loading the manure spreader.

Pile of lobster and manure made by using a manure spreader.

Compost Turner Method

A compost turner will also work. Form the materials in a windrow in the correct ratio and run the turner through the windrow. The turner will mix, chop and aerate the material. A fish by-product compost should only need to be turned two to three times with such a machine. Excess turning will reduce the quality of the end product.

Heating Phase

A fish-based compost should heat up quickly (within 36 hours) and can easily reach temperatures of 50ºC and higher. The periodic turning will add air and keep the composting going. The pile should stay above 40ºC for a month, at which point pile temperatures will drop off.

Turning heating a windrow with front-end loader.

When It Is Done

Generally, for on-farm use, any material which has composted for eight weeks will be sufficiently composted to prevent significant odour release at field application and will have the nutrients in a readily available form for field crops.

If the material is intended for horticultural or landscape use, then it should be turned more often and left to compost for a minimum of six months. Any compost should be spread within one year of production, or covered, as the rain will leach the nutrients out of the compost. The compost can be spread with a manure spreader.

Neat, organized compost piles.

Nutrient Value of Fish Based Composts

The nutrient content of a compost will depend on the nutrient levels of the raw ingredients and the composting process. A compost made with fish by-products and animal manures will normally contain more nutrients than compost made from materials with less nutrients.

It is important to test the compost at the Prince Edward Island Soil and Feed Lab and know your application rate so the amount of nutrients being applied to the crop/land can be determined. A modest application of such compost will provide significant amounts of some nutrients (see Table 1 below).

Table 1 — Nutrients in Fish Compost

Nutrient	Range of Percentages	Average Application Rate in Tons per Acre	Pounds of Nutrient Applied per Acre
Calcium (Ca)	2.0-5.0	30	1,200-3,000
Nitrogen (N)	0.4-1.0	30	240-600
Phosphorous (P)	0.25-0.5	30	150-500
Potassium (K)	0.20-0.4	30	120-240

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