Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost in the Region of Peel

GMF # 12117

Applied Research • Economics • Market Development

Farmers Feed Cities – Cities Feed Farm Soils

Region of Peel
Working for you

Conseil canadien du
COMPOST
Council of Canada

"If we'd known back then what we know now, we'd have done things differently – put compost in 20 years ago, or doing other things to build organic matter."
Nick Stokman, Strathroy site

"Soil is like a bank account. You need to invest in it for it to pay dividends."
Mike Lishman, Arlington Farms

In the shorter term …"if we see a three- or four-bushel increase in yield, that's better than buying another 100 acres."
Mike Lishman, Arlington Farms

"We need to change the vision of people.
The feedstock is not waste. It's an organic amendment.
All we're doing is putting stuff that came from the field back in the field.
It's a really healthy way to go."
Mike Lishman, Arlington Farms

"It's tough to say what's good and bad.
But if it's a drought year, that's where compost really shines."
Tim Armstrong

"By using it (compost), the farmer is doing a good thing, and helping the environment.
You're putting it back into the soil that you've taken the products from."
Tim Armstrong

"… the reason for putting compost on is that it's adding organic matter to the soil.
The bottom line for growers is that when it comes to yield response,
you're not going to see it in the first few years."
Scott Banks, Winchester Farms

"There are too many variables to reach a quick conclusion."
"Generally most growers understand what compost is; that it's a long-term improvement option, not short-term. It's part of a very long-term strategy."
Scott Banks, Winchester Farms

"If it costs me $20 per tonne to get compost to my field, it's worth $16 to $18 for those nutrients, but I also get better moisture retention and microbial activity.
I'm not sure how you put a value on that."
Wayne Cunningham

"Worm activity is extreme now. There are literally thousands of worms.
Water retention and soil tilth are better. The soil smells better."
Wayne Cunningham

“We’ve got to start rebuilding the soil or it will turn into a desert. Any time you till a field, you start breaking down the carbon base, and eventually, it’s gone.”
Wayne Cunningham

“I farm to build my soil. You only get out of it what you put back into it.”
Wayne Cunningham

“Short-term I’m not going to get a big result. The next generation will, if they keep farming this land.”
Wayne Cunningham

“I want the soil to be better than when I got it. I’m putting in extra effort to make the soil more resilient and healthy than before.”
Scott Mabury

“By and large, in Ontario, there’s very little land being put through rotations aimed at building or even maintaining soil. It’s for quick profit; sustainability is not the goal.”
Bob Misener

“It’s (compost) a valuable public asset that could be a win-win for cities and agriculture. This is a real opportunity for our society to be smart.”
Bob Misener

”Farmers can’t afford to spend upfront for benefits that may not show up for four or five years,” especially when the benefits are difficult to quantify. ”I’d think from my guys’ reaction who used it and didn’t see much initial benefit, it becomes something we’d need to see more immediate benefit than we’re seeing.”
Paul Sullivan

“You invest in it (the soil) now to get a return later.”
Gerry Veldhuizen

“You can’t just apply it one year and say, ‘I’ve got this much production.’ It takes multiple years.”
Gerry Veldhuizen

“I’m looking for an increase in organic matter, which gives you better moisture retention. It’s a project. You’re continually trying to improve the soil. It’s a long-term thing.”
Gerry Veldhuizen

“When I apply the compost I don’t give it any credit for fertility. I put it in the soil bank. I balance what I’m taking up and putting in with commercial fertilizer. Any fertility from the compost goes in the bank. You’re always looking to build soil.”
Gerry Veldhuizen

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The organizational and personal commitment to both undertake and complete this project has been great.

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It is only together that agriculture will come “full circle”, allowing for the existing well-known phrase: “Farmers Feed Cities” to be fully completed so that “Cities Feed Farm Soils”.

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CONCLUSION OVERVIEW

The Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost Trials are demonstrating the benefits of applying compost produced from residential source-separated organic material to agricultural land. The practice converts a major waste stream into a valuable product that improves and maintains soil health.

Across Ontario and elsewhere, soil organic matter has slowly depleted. Less livestock and less forage in rotation, less owned/more rented acres and larger fields and larger equipment have all been contributing factors. In addition, economic pressures — lower prices and profit margins, equipment costs and competition from lower-cost external producers — have led farmers to work their land harder. Heavy and/or frequent tillage often destroys the soil structure and reduces the habitat for the beneficial organisms that create healthy, productive soil.

The Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost Trials are showing that compost is helping to re-build soil structure and is creating healthier soils. Through its addition of natural nutrients and organic matter to farm soils, soils are realizing increased microbial activity, enhanced moisture control and soil structure, helping produce healthier plants more resistant to drought, pests and disease. The benefits of compost use parallels the benefits of solid manure use for soil. Compost's contribution of organic matter is increasingly important as sources of manure decline in Ontario.

The trials, along with interviews with the farmer participants and members of the compost industry in Ontario, also reveal challenges associated with encouraging farmers to use compost to build improved soil health and ensure its sustainability.

The reality is that it takes time to build healthy soil, a multi-year effort in fact, which fundamentally includes the ongoing addition of compost to return organic matter back to the soil. This, in addition to more well-established best management practices such as crop rotations, cover crops and no-to-low tillage, must become more and more essential for long term soil health improvements and sustainability.

This "new reality", however, requires considerable investment with the financial return to be realized involving multiple years of effort and commitment by farmers to their soil.

While the longer term goal and benefits of building healthier soil is gaining ever-greater acceptance, farmers are being asked to pay in advance the entire cost of a product – compost - that likely will not generate results for them for several years. Added to this, some farmers must continue to buy and apply commercial fertilizer along with compost to maintain yields at least until the compost benefits take hold. In addition, compost is more expensive to transport, and time consuming (and therefore expensive) to apply. The fact that approximately 40% of the land farmed in Ontario is through short term leasehold arrangements provides another significant hurdle to long term investment in soil health.

At the same time, the compost industry must begin to be considered as a fundamental member of the agriculture sector instead of being treated as an outsider, viewed primarily for its waste-diversion attributes. Compost enterprises – both municipal and private sector operations – should be recognized as local agricultural manufacturing operations which are creating soil amendments from under-appreciated resources that otherwise would be discarded. This manufacturing emphasis and the active involvement of agriculture in the advancement of compost markets will help increase the compost industry's ever-greater focus on product quality – both upfront and ongoing consistency. This, in turn, will help influence an ever-greater rethinking of how organics collection and processing are managed and financed.

Significant financial and government policy support will be required to ensure the full availability of sufficient production and adoption of the use of compost in the agricultural soils of Ontario, helping to deliver the environmental and agricultural benefits of sustainable soil health for Ontario.

Next steps for this project include:

- Continuing the in-field research trial – at minimum for ten to fifteen years -- to track soil health changes, crop productivity results as well as carbon sequestration benefits in the long term;
- Addressing the short term economic, policy and regulatory barriers that are impeding compost's fuller market development in agricultural soils;
- Building long term partnerships between the compost industry and agricultural soil health stewards to advance awareness and improve compost's use within agriculture;
- Exploring opportunities to combine technologies such as anaerobic digestion and composting to maximize benefits of each.

INTRODUCTION

At a time when "doom and gloom" is frequently associated with the state of our environment, a compelling opportunity is being presented to two currently mostly-unconnected forces in Ontario - agriculture and waste management; return compost made from the organic residuals being recycled by residents through local municipal greenbin programs to build the health and vitality of Ontario agricultural soils, strengthen soils' resilience against potential erosion and phosphorus loss and use soil as a "carbon bank" for climate change mitigation.

Proven research, in-field observations and yield results all show that this is the right thing to do.

Currently there are considerable obstacles being faced to establish a "full circle" solution to capturing the potential that organic "wastes" offers to address a wide range of environment and sustainability issues. Most of the hurdles can be overcome with a concerted focus by government through policies and programs.

This report looks in detail at the impacts of compost in agricultural use and, most important, steps that would make it practical and acceptable in that market.

Much of it deals with results from Ontario farms, where crop yields from test fields with compost applied were compared with those treated with chemical fertilizers, other organic amendments or nothing at all. It also describes studies of compost on agricultural land across Canada, and what has been learned from them. And it examines the barriers to the agricultural market for compost and how they could be overcome.

Overall, the opportunity future forward must be set in the following context:

- First, while compost clearly offers impressive advantages to agriculture, the detailed cost/benefit analyses on which farmers decide whether to use it vary widely across Canada and even from farm to farm. Thus, much more research will be required into its local costs and impacts.

- Second, the compost industry must be viewed not as a waste-diversion effort but as a manufacturing enterprise primarily focused on manufacturing a quality, practical product, essential for soil health. This, in turn, requires a rethinking of how organics collection and processing are managed and financed.

The Opportunity for Compost in Agricultural Soils

The benefits of adding compost to soil are numerous and well known.

Compost provides the major nutrients plants need — nitrogen, phosphorous and potassium — along with sulphur, magnesium and many other micronutrients; as well as beneficial organisms. And it improves a soil's structure, nutrient cycling and ability to hold moisture.

While compost contains a range of nutrients, compost is widely recognized as an important way to increase organic matter in soils, improving overall soil health, defined by the United States Department of Agriculture (USDA) as "the continued capacity of a soil to function as a vital living ecosystem that sustains plants, animals and humans".

Compost's contributions to soil health reflects its influence on soil's physical, chemical and biological properties; specifically:

i. *Physical Benefits*
- the organic matter in compost improves soil texture and promotes soil aggregation
- reduces susceptibility to soil compaction and improves water-holding capacity

ii. *Chemical Benefits*
- directly provides nutrients in a slow release format, buffers pH, can improve availability of other nutrient sources

iii. *Biological Benefits*
- provides carbon (energy) and nutrients for soil biota, is a source of beneficial organisms, provides habitat for biota

While awareness of compost's benefits and its use continues to grow, there is still opportunity and need to build the overall market category – compost. The compost supply is growing as more municipal and provincial governments introduce programs to divert organic materials from landfill. In most cases, these residues are composted aerobically, but there is a trend toward processing them in anaerobic digesters, then, composting the solid digestate.

Compost is popular in horticulture, landscaping and home gardening and for erosion-control projects. Current markets are not big enough – yet - to consume all of this material. Compost producers are seeking to expand into new markets to build a portfolio of market options and optimize returns on their efforts.

Agriculture seems an obvious new destination: protecting the integrity and building strength (productivity) back into agricultural soils is fundamentally important for ongoing sustainability. Compost can improve soil health and structural integrity which in turn, can increase crop yield and crop quality. Significant volume tonnages of compost can be used within agriculture.

Across Ontario and elsewhere, soil organic matter has been badly depleted. According to an analysis done by the Office of the Environmental Commissioner of Ontario for its report, **SOIL: Our Eroding Asset**, "as of 2001, 44 per cent of our land had the potential to erode at rates greater than six tonnes per hectare per year. Less than 3 tonnes per hectare per year is tolerable to maintain productive soils. To put this into perspective, for almost half of our cropland, we are at risk of losing at least one tonne of soil for every tonne of grain corn produced. For up to 29 per cent of our arable land, the potential loss rate is at least twice that." (Appendix I)

Economic pressures — lower prices and profit margins, equipment costs and competition from lower-cost external producers — have led farmers to work their land harder.

Heavy and frequent tillage often destroys the soil structure, and the beneficial organisms that create healthy, productive soil. Overall, the agricultural industry has not always understood or recognized the importance of healthy levels of micro-organisms. In some areas, including Ontario, a decline in the number of livestock producers means that on many farms manure is no longer available to contribute soil organic matter. Low organic matter reduces water infiltration which in turn increases water runoff and soil erosion and reduces the amount of plant available nutrients which impacts crop production. Instead, farmers apply chemical fertilizers which can deliver precise quantities of nutrients to crops when they are needed but do not provide the other essential benefits that come with organic matter.

Compost's multiple benefits are well-suited to improve agricultural soils. But while there has been some market inroads made by specific compost producers (largely focused within the organic agricultural community and for high value crops), the overall agricultural market for compost and more specifically, greenbin compost, largely remains untapped.

To-date, greenbin compost's limited agricultural market penetration is reflective of:

i. limited awareness of its performance amongst agriculture;

ii. its short—term yield benefits vary widely, depending on its ingredients and maturity, application rates, farm management practices, soil type, weather and the crop being grown;

iii. its most impressive soil benefits — improved structure and moisture retention, enhanced microbial activity, and erosion control — take time to appear and can be difficult to quantify;

iv. it is usually much more expensive and time consuming to buy, transport and spread than manure or chemical fertilizer. Many farmers are reluctant to pay this upfront cost when it might not be immediately recouped by higher crop yields and the main positive impacts, realized through healthier soils in the long term, is an investment whose return will be likely years down the road;

v. the availability of sufficient quantities at specific application times and the considerable variability in processing, ranging from feedstock inputs to length of time involved;

vi. Due to the current nature of greenbin compost, there is a strong potential for physical contaminants (plastics) in the product which can be off-putting to users;

vii. Compost that does not meet maturity standards require NASM (non-agricultural source material) plans and approval which can be expensive and time-consuming.

These issues are not insurmountable. Compost and organic matter are fundamental to soil health. Many farmers who use compost, especially livestock farmers with more land base than available manure, love it. Agriculture has seen and realized compost's benefits, particularly in the longer term.

Overview of the Greenbin and Organics Recycling Programs in Canada

On an annual basis, every Canadian generates approximately one tonne of waste.

In 2012, the most recent survey by Statistics Canada, a total of 33.4 million tonnes of waste was created, with 25.0 million tonnes being sent to private and publicly-owned landfills. The remaining quantities, 8.4 million tonnes, were diverted to recycling and organic processing facilities across the country.

Organics residuals – representing a wide range of materials from both residential and industrial streams – are widely acknowledged to account for more than one-third of total waste. At the residential level – accounting for approximately 38% of total waste for disposal - food waste and leaf & yard trimmings are amongst the largest components of the organic residuals typically discarded.

According to the latest national survey of organics recycling operations as conducted by The Compost Council of Canada, approximately 3.5 million tonnes are being processed annually through the combined forces of composting and anaerobic digestion. This effort produces about 2 million tonnes of soil products mostly in the form of compost, all of which requires markets for use.

While large-scale organics recycling programs and operations have now become established in every province and the territories in the nearly twenty-five years since The Council's original survey which recorded the overall processing of 275,000 tonnes of organic residuals, the current state of production is estimated to be capturing only 25% of the total annual processing potential.

As more municipal and provincial governments increase focus and introduce “greenbin” programs to divert organic materials from landfill, there will be ever greater pressure to expand the current compost markets to effectively “consume” the material produced annually.

Region of Peel Organics Recycling Overview

The Region of Peel is comprised of the Ontario cities of Mississauga, Brampton and the Town of Caledon. Located just west of Toronto, the Region contains 330,000 single family households and 94,000 multi-residential units.

In 2014, the Region of Peel managed 520,000 tonnes of waste, achieving a 46% diversion rate based on an estimated participation rate of approximately 34%.

Of the 239,200 tonnes of waste recycled by the Region of Peel, organics collection totaled 79,289 tonnes, involving 45,877 tonnes of leaf & yard trimmings and 33,412 tonnes of greenbin organics, primarily consisting of food waste and soiled paper products.

The Region of Peel's waste diversion accomplishments to-date reflect primarily a focus on single family households who were provided with weekly curbside collection services for garbage, recycling, and greenbin material and seasonal collection of yard waste. Beginning in 2016, residents will be switching to bi-weekly garbage and recycling collection while organics continue to be collected weekly. This adjustment to collection schedules is part of the Region's overall goal to achieve an overall 3Rs diversion rate of 75% by 2034. This target will require further enhancements to current diversion efforts as well as increased education and promotion of the greenbin program.

The Greenbin Curbside Collection Program in the Region of Peel

The Region of Peel first began to explore the possibility of a greenbin curbside collection in 1994 with a pilot collection program in select neighbourhoods in Caledon. These pilots were then expanded to areas in Brampton and Mississauga before a region-wide program began in 2007. Provided with a 96 L greenbin, residents are allowed to recycle a wide range of organics (Appendix II), with voluntary participation encouraged through extensive advertising and promotion support, focused on overall program dynamics and specifics of what should or should not be included in the organics collection bins.

In recent years, the Region of Peel has conducted several studies to review the composition of residential waste stream as well as contamination issues involved in both recycling and greenbin collections. The waste audits of residential curbside garbage found that 30% of the garbage stream was greenbin-acceptable materials. The 2015 audits showed 45% was greenbin material and an additional 7% was yard waste.

Data from these studies supported decisions to adjust curbside collection from a weekly to bi-weekly collection of garbage and recycling. By shifting garbage collection to a bi-weekly system, it is expected that residents will increase use of their greenbin for organics recycling. This was evident in the pilot areas in the Region of Peel that were studied to gain an understanding of how tonnages and behaviours will change once the Region switches to bi-weekly collection. In the pilot areas, people were forced to use their recycling and greenbin containers more and it was found that more materials were being diverted out of the garbage stream with the biggest gains being in the organics stream.

It is expected that, when residents switch to the new program in January 2016 an additional 15,000 tonnes of organics will be removed from the garbage stream, destined for composting and producing approximately 9000 tonnes of additional compost.

This gain in compostable quantities might be offset somewhat in reductions in avoidable food waste from residential sources. Current audit findings indicate that over half of the material in the greenbin is avoidable food waste. The Region will be pursuing additional education and awareness messages to encourage greater mindfulness in food preparation and usage to avoid wasting food. As well, the education messages will emphasize the acceptability (or not) of materials in the various recycling streams and the role of every resident to recycle materials properly, limiting unnecessary contamination issues.

The Composting Process at the Region of Peel's Organic Recycling Facilities

The collected greenbin material and yard waste are processed by the Region of Peel at three facilities. The first stage of the process is completed either at the Peel Integrated Waste Management Facility or the Caledon Waste Management Facility.

Greenbin material and yard waste are mixed together along with amendment material, shredded and put in concrete vessels for 7 days to ensure weed seed and pathogen kill.

Following 7 days, the material is removed from the in-vessel system and transferred by tractor trailer to the Peel Curing Facility. Material is offloaded directly onto the aerated footprint of the windrow, where it is formed into windrows and covered with GORE covers. The material is left undisturbed for 2 weeks while being monitored for temperature and oxygen. After two weeks, the cover is removed and the material is turned with or without water depending on the temperature and oxygen measurements. The material is re-covered and left for another two weeks. At Week 4, the process is repeated and again at Week 6.

In total, the composted material remains under the GORE cover for 6-8 weeks. Once it has completed this cycle, it is moved from the windrow to the screening building where it is screened based on particle size. Material is stockpiled on site until it is ready to be shipped out to commercial and agricultural clients.

The compost produced by the Region of Peel consistently meets Ontario's Category AA regulatory standards for trace elements, pathogen, moisture content and maturity. At times, the strict standards for foreign matter content are exceeded, caused by residents having placed non-compostable materials in their greenbin collection cart and these items not being able to be fully removed through the processing's screening system.

The Region of Peel actively participates in the voluntary "over and above government regulations" agronomic testing program operated through The Compost Council of Canada and the Compost Quality Alliance (CQA), consistently testing the finished compost for its agronomic properties and directing its usage appropriately (Appendix III). Based on the evaluations pursued through the CQA program, the compost produced by the Region of Peel is considered appropriate for a wide range of soil applications including landscaping, soil blending and agriculture.

The creation of different grades of compost, appropriate for specific end markets, has been a strong internal focus of the Peel composting team in recent years. In addition to residential use, the Region is working to develop strong usage amongst commercial landscapers, soil rehabilitation connected to a mine tailing project as well as agriculture.

Building an Agricultural Market for Compost

To more fully expand the market for greenbin compost in agriculture, the *Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost Trials* were established. Combining multi-year in-field research using compost produced from current residential organics recycling programs in Ontario, the trials also extended beyond product performance to reviewing the economics of applying greenbin compost on farm soils as well as to identifying marketing mix parameters needed to building awareness and sales in the agricultural market in the long term.

OBJECTIVES of the *Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost Trials*

i. OVERALL:

To help establish a sustainable market for greenbin-derived compost within the agricultural community

ii. SPECIFICS:

- To conduct applied research to assess the value (yield, soil health, environment and economics) of greenbin-derived compost for crop production
- To determine the how-to's of application logistics and current costs to deliver and incorporate greenbin compost into agricultural soils
- To build communication networks and potential partnerships to increase awareness, acceptance and use of compost in agricultural soils

Partnership Dynamics

With financial support from the Green Municipal Fund and the Federation of Canadian Municipalities, the four-year research project (2012 – 2015 inclusive) was spearheaded by the Region of Peel, Ontario Ministry of Agriculture, Food & Rural Affairs, the Ontario Soil & Crop Improvement Association and The Compost Council of Canada.

The multi-year applied research was made possible through the voluntary partnership between Ontario-based compost producers whose feedstock included organics from residential source-separated organics collection programs (including leaf & yard trimmings) and Ontario-based farmers who contributed time and effort to incorporate greenbin compost into their croplands and allow ongoing soil testing and yield assessments. Soil and compost testing was spearheaded through the involvement of A&L Canada Laboratories.

During the years that the applied research was taking place, additional work was spearheaded to learn about various networks linked to the agricultural community and important aspects to be considered in the development and implementation of an effective marketing plan targeted to the farm community. Through various meetings and attendance at agricultural-focused events, information about the *Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost Trials* was communicated in presentation, display and article format, helping to build awareness about the trials, the overall initiative and the parties involved.

The seven municipal compost producers included:

	Compost Producers	Compost Produced from Greenbin Collections of:
1.	Region of Peel	Mississauga, Brampton, Caledon
2.	AIM Environmental	Hamilton
3.	All Treat Farms	Toronto
4.	Miller Compost	Region of Durham
5.	OrgaWorld	Ottawa, St. Thomas, Toronto, York
6.	TRY Recycling	Leaf & Yard Collections of London
7.	Walker Environmental	Region of Niagara

The participating farms involved side-by-side comparisons with additional information collected at some of the sites.

Site (county)	Crops Grown
• Strathroy site (Middlesex)	Corn, Soybeans
• Parkland Farms (Lambton)	Corn, Soybeans, Wheat
• Winchester site (Dundas)	Corn, Soybeans, Wheat
• Castleton site (Northumberland)	Alfalfa, Corn, Soybeans, Winter Wheat
• Acton site (Wellington)	Alfalfa, Barley, Soybeans, Corn
• Woodstock - Outdoor Farm Show	Corn, Soybeans, Cereals
• Plattsville site (Oxford)	Hay
• Jarvis site (Haldimand)	Corn, Soybeans
• Inglewood site (Caledon)	Corn, Soybeans
• Orton site (Wellington)	Corn, Soybeans, Winter Wheat
• Thorndale site (Middlesex)	Strawberries
• Oakland site (Norfolk)	Corn, Soybeans, Wheat
• Byng site (Haldimand)	Corn, Soybeans, Wheat
• Simcoe site (Town of Norfolk)	Apple & Cherry Orchards, Corn, Soybeans
• Paul Sullivan	Corn
• Belfountain site (Caledon)	Corn, Soybeans, Wheat, Hay
• Wainfleet site (Niagara)	Corn, Soybeans, Wheat
• Ridgetown site (Kent)	Corn, Soybeans, Wheat, Canola

I. THE APPLIED RESEARCH

i. Approach

At each participating farm, greenbin compost was incorporated into specific field-scale plots. Side-by-side comparisons (treatment size approximately 12 m x 350 m [40 ft x 1,200 ft]) were set up with municipal compost compared to commercial fertilizer and/or other organic amendments (ie. biosolids, manure). Depending on the source of the compost, municipal compost included combinations of leaf & yard waste and food waste materials.

The treatment application at each specific farm reflected the following approach:

- municipal compost (greenbin) was applied at a "once in the rotation" rate (with the target rate being 5 to 10 tons/acre)
- replicated treatments included:
    - normal fertility program
    - regular rate of compost
    - regular rate compost with additional N to meet corn crop needs or regular rate and half or double rate compost when applied to soybeans
    - horticulture (site specific)
- At the time of application, each compost applied was analyzed to determine: (i) the value of available nutrients, (ii) bulk density; (iii) organic matter (OM). (The analysis and estimate of available nutrients of the materials used are shown in Appendix IV).
- The receiving soil was analyzed for existing nutrients and soil health. Soil organic matter and bulk density measurements were taken as part of the soil quality measurement.
- Yield data at harvest was collected for year of application and year(s) after application.
- Crop input data, economics of compost use and observations/suggestions were also collected.
- During the growing season, soil fertility, soil nitrogen and plant tissue samples were taken to determine differences in uptake for plant nutrition.
- Each site was monitored to observe differences. Some sites were sampled more intensively than others based on location, field consistency, replicated treatments and time.

Figure 1. A silo view of the plot layout. Each treatment is the length of the field. This photo shows some of the field variability that can occur from topography and past field history and management.

ii. Results

In general, the addition of municipal compost increased the crop yield in the fields where they were applied, both in the year of application and in subsequent years. Testimonial observations confirmed improvements in the resiliency of the soil in dry periods and wet periods with the addition of compost but measured soil quality improvements will take longer than the 4-year-study to document. A soil health lab analysis is in the development for Ontario that should help to evaluate the impact of various organic amendments.

Table 1 provides an overview of the yield comparison for the treatments with compost compared to the treatments without compost. Many of the sites included treatments with different rates or combinations; that show other advantages or disadvantages. The average yield advantage for the side-by-side comparisons was an increased yield of +7.5% with the municipal compost application. The economic value of the yield increase varies with crop value (field crops vs. more valuable horticultural crops), however there is no dollar value set for organic matter yet.

Location	Crop	With Compost (bu/ac)	Without Compost (bu/ac)	% Change
Oakland (2011)	Corn	212.3	203	4.4
Winchester (2012)	Corn	191.3	191.5	(0.1)
Winchester (2013)	Corn	219.3	207.0	5.5
Winchester (2013)	Soybeans	48.5	50.1	(3.2)
Winchester (2014)	Corn	137.3	141	(2.6)
Jarvis (2013)	Corn	119.4	115.5	3.3
Jarvis (2014)	Corn	203	167	17.7
Jarvis (2015)	Soybeans	44.7	39.0	12.7
Jarvis (2013)	Corn	119.4	115.5	3.3
Plattsville (2013)	Corn	186.7	171.3	8.2
Strathroy 1 (2013)	Corn	152.8	145.3	4.9
Strathroy 1 (2014)	Soybeans	43.8	39.3	10.3
Strathroy 1 (2015)	Corn	143.5	132.7	7.6
Strathroy 2 (2014)	Corn	181.7	164.4	12.4
Strathroy 2 (2015)	Soybeans	42.9	43.5	(1.4)
Castleton (2012)	Soybeans	33.5	31.0	7.5
Castleton (2013)	Wheat	78	72	7.7
Castleton (2014)	Corn	154.5	150	3
Castleton (2015)	Soybeans	36.7	30	18.3
Orton (2012)	Corn	104.9	96	8.4
Wainfleet (2012)	Corn	139	147	(5.4)
Wainfleet (2013)	Soybeans	60.2	58.3	3.1
Belfountain (2012)	Corn	96.7	90.4	6.5
Belfountain (2013)	Soybeans	56	53	5.3
Belfountain (2014)	Wheat	74	68	8.7
Ridgetown (2011)	Canola	47	34	27.6
Acton Field 1 (2013)	Forage	1.59 (ton/ac) 1,344 (lbs milk/ac)	1.59 (ton/ac) 991 (lbs milk/ac)	0 26.3
Acton Field 2 (2013)	Forage	1.76 (ton/ac)	1.63 (ton/ac)	7.8
Thorndale (2013)	Strawberries	2.42 (kg)	2.08 (kg)	13.9

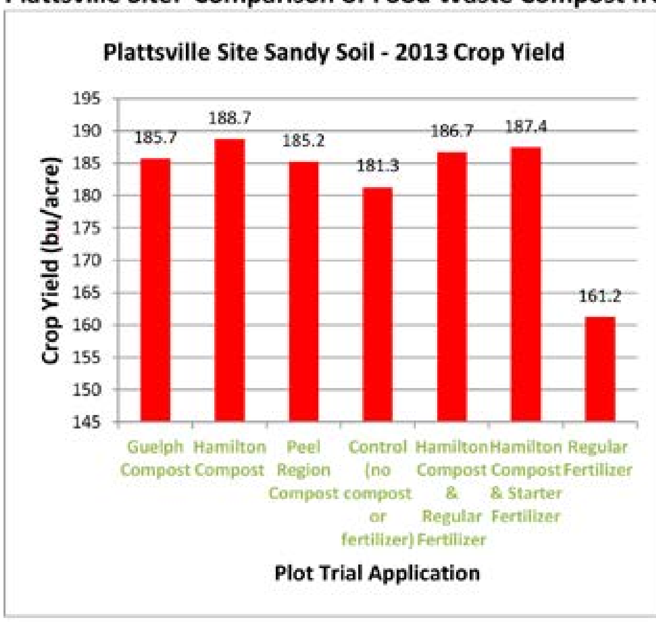
Table 1: Yield Summarized by Location – With and Without Compost and % Yield Advantage from Compost (Compost Project Yield/Quality Results 2011 - 2015)

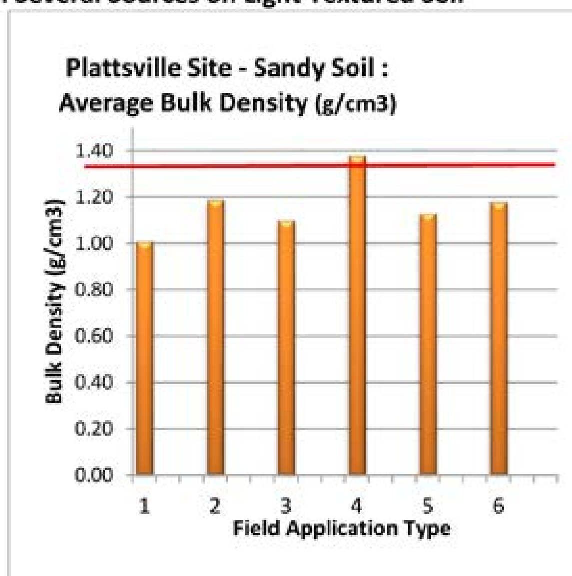
Measuring the Impact of Soil Organic Matter from Organic Amendment Additions

Improvements in soil quality take time and are difficult to measure. Ideally the fertilizer benefit and the yield difference between the treatment for each crop in the rotation between applications will show the organic matter benefit from the organic amendment. A rotation that includes a forage-based rotation and/or cover crops in combination with organic amendments will likely show the soil quality advantage more quickly.

To try and show changes in moisture-holding capacity, several different methods were experimented, however bulk density was chosen to determine if there were consistent differences. The graphs below show bulk density measurements for a Haldimand clay and a Burford sandy loam where the control treatments generally are denser (more compact) than for the treatments where compost was applied. This is more evident in the sandy loam than the clay soil. The higher the reading, the higher the bulk density. Lower numbers indicate more airspace and water-holding capacity.

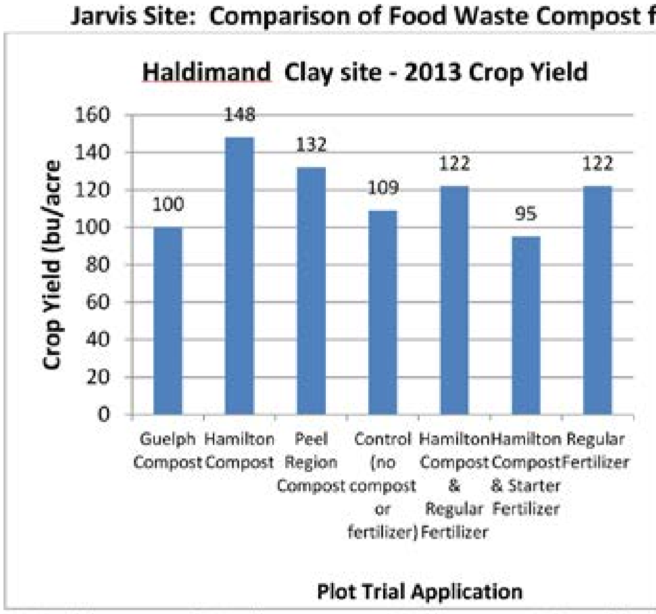
Plattsville Site: Comparison of Food Waste Compost from Several Sources on Light Textured Soil



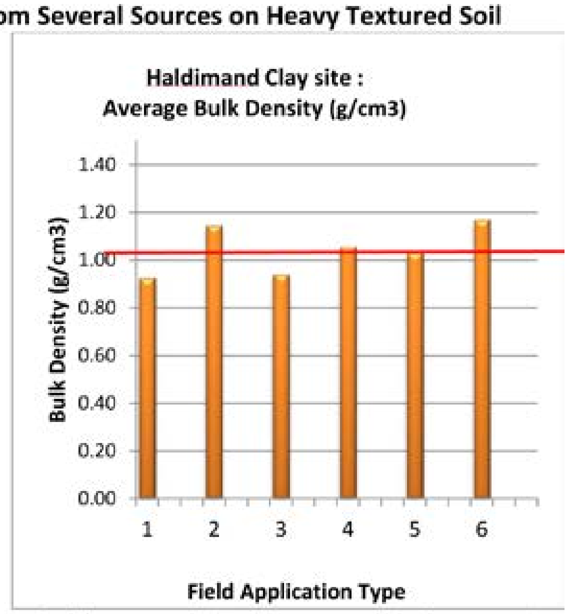


1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4.

Jarvis Site: Comparison of Food Waste Compost from Several Sources on Heavy Textured Soil



1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4. Control (no compost or fertilizer), 5. Hamilton compost + fertilizer, 6. Hamilton compost + starter only, 7. Regular fertilizer only



1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4. Control (no compost or fertilizer), 5. Hamilton compost + fertilizer, 6. Hamilton compost + starter only

Observations

While the overall average yield increased with the addition of greenbin compost amendments, from farm-to-farm, though, the results varied. These outcomes appear to have depended on several factors:

- Field variability and past management were often reflected in yields: for example, variable drainage, compaction or previous fertility management. Higher-rate applications of compost, and the use of less mature compost, were often connected to higher yield gains;
- Some crops responded better than others to compost, relative to other soil amendments;
- Compost had the biggest impact in sandy or gravelly soils with low organic matter;
- The yield differences between compost and chemical fertilizer tended to be greater in dry weather, when crops could take advantage of compost's ability to retain moisture;
- The outcomes using compost were similar to those seen with solid manure application. If manure is applied regularly, combined with an extensive crop rotation and/or cover crops, the benefits are more significant than when manure (or compost) is applied once-in-a-while.

Details by Farm

The overall crop research has been championed by OMAFRA through the leadership of Christine Brown, Nutrient Management Lead, Field Crops. A&L Canada Laboratories Ltd. was commissioned to manage the analysis of soil tests.

The following provides various aspects of the applied research at individual farm locations as contributed by Christine Brown, OMAFRA. Significant testing has been conducted, the details requiring additional review longer term by the applied research team at OMAFRA. Depending on the farm, crops and applications varied.

Great thanks are extended to Peter Gorrie and participating farmers for the excellent interviews and write-ups.

1. Strathroy Site - Middlesex County

i. Research Conducted during the Years of / with Crops of:

2013: Corn
2014: Soybeans; Corn
2015: Corn; Soybeans

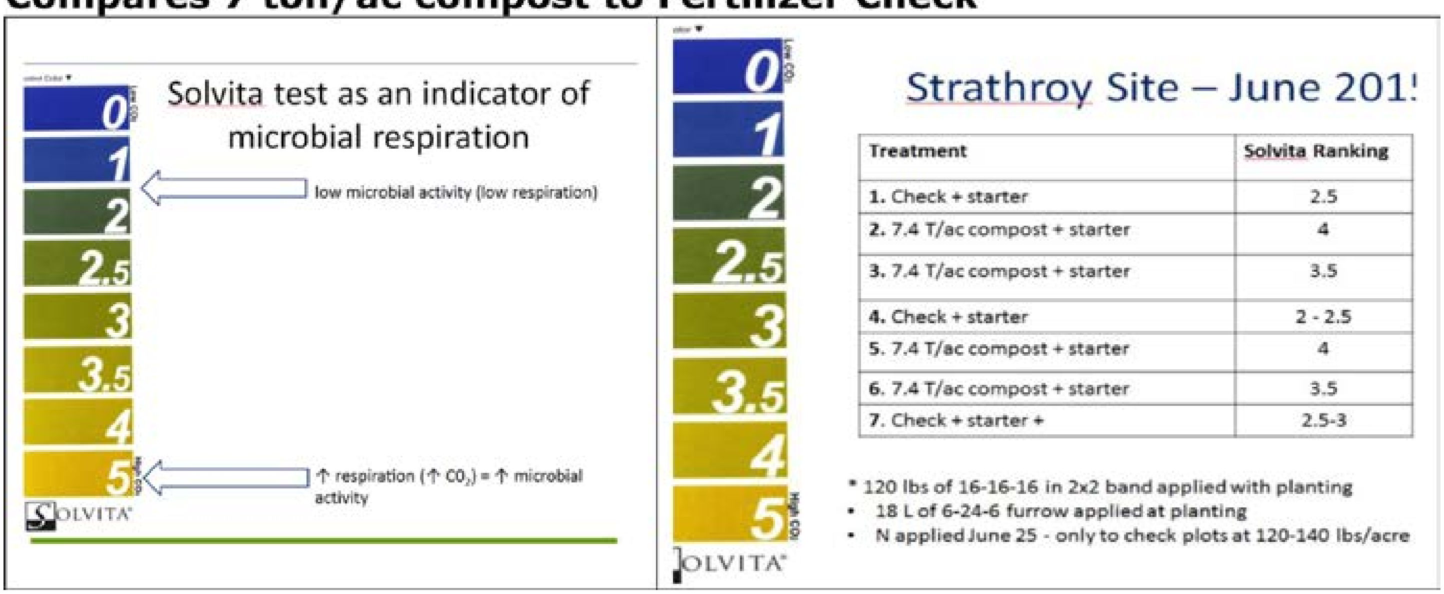
ii. Compost Analysis

Feedstock: Source-Separated Residential Organics
Feedstock: Leaf & Yard Residuals

Key Findings

Below are the results of the Solvita test done to measure soil biological activity in mid-June 2015. Solvita test measures soil respiration from biological activity and is an indicator of nitrogen mineralization.

Solvita Test Results (Strathroy Site – June 2015)
Compares 7 ton/ac compost to Fertilizer Check



iii. Overview of Research Approach, Observations & Results

The Strathroy site (Middlesex Soil & Crop demonstration farm) allowed in-depth evaluation of food waste compost at two different rates in 2013. A high and low rate of compost application compared with commercial fertilizer resulted in nearly identical yields for both rates – an indication that the immature compost had higher available nitrogen than expected and that the nitrogen needs of the crop could be met with a rate that would closely meet phosphorus fertility needs over the crop rotation.

Compost Application Demonstration – Strathroy site

Compost Delivery – Transport with walker unloading system

Loading compost into G.T. Bunning Low-body spreader

Calibration using plastic 41"x 50" feedbags

Plot application – target 5 and 10 ton/ac rate

Incorporation with Turbo 330 vertical tillage

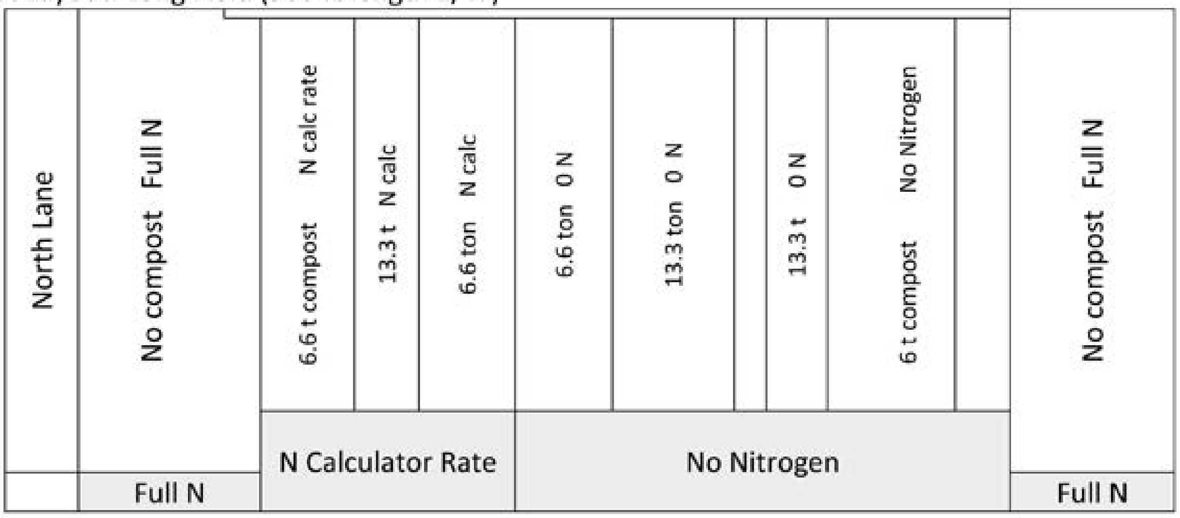
10.4 ton/acre (~34 lbs/ft^3)

Compost – surface applied

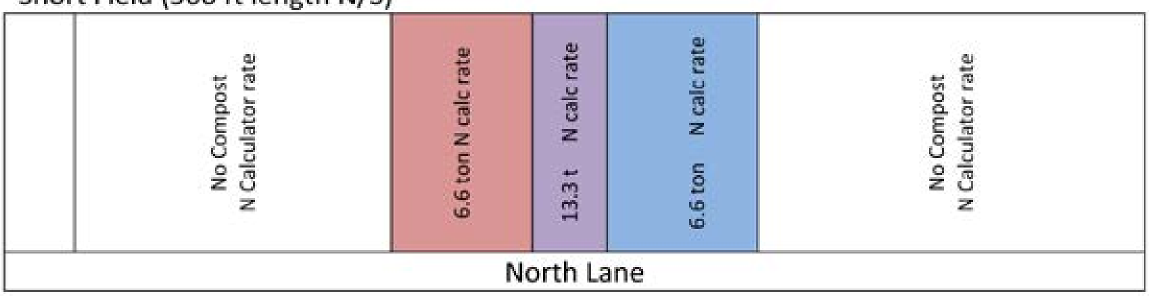
Compost incorporated (vertical tillage)

Strathroy site Greenbin Application - April 23, 2013
Sunny in morning; clouded over after noon – high of 13°C – wind SE ~ 30 km/hr with higher gusts

Plot Layout: Long Field (900 ft length E/W)



Short Field (500 ft length N/S)



Material – Greenbin

			Approximate Available Nutrients (lbs/ton)	Available lbs/ac @ 6.6 ton/ac	Available lb/ac @ 13.3 ton/ac
Dry Matter	75	%	---		
Total Nitrogen	2.52	%	50.5 x 30%		
NH4-N	2384	ppm	5 x 75%		
Available Nitrogen	---		15.12 + 3.6 = **18.75**	124	249
Phosphorus (80%)	0.53	%	19.5	129	259
Potassium	0.55	%	11.9	79	158
Aluminum	1735	ppm	3.5	24	47
Boron	16.9	ppm	0.03	0.2	0.4
Calcium	3.29	%	65.8	434	875
Copper	36.4	ppm	0.07	0.5	0.9
Iron	4469	ppm	8.9	59	118
Magnesium	5600	ppm	11.2	74	149
Manganese	90.4	ppm	0.18	1.2	2.4
Sodium	8100	ppm	16.2	107	215
Sulphur	2633	ppm	5.3	35	70
Total Salts (EC)	15.07	ms/cm	19.3	127	257
Zinc	130.9	ppm	0.26	1.7	3.5
pH	6.10		---		
Bulk Density	488	kg/m^3	30.5		
Organic Matter (as is)	49.7	%	746	4,924	9,922
Carbon:Nitrogen Ratio	11 : 1	C:N	~ 500 carbon	~3,300	~6,650

In 2014, the treatments grew soybeans with the yield realizing up to +5.5 bu/ac increase over the commercial fertilizer treatments.

Compost was re-applied to this field in April 2015 and corn planted May 2015.

In 2014, on a different field, treatments compared an immature (ie. not fully cured to meet compost maturity standards) food waste compost with a cured leaf & yard residuals-based compost. Additional microbial testing was done on this site with the anticipation that the cured compost would increase microbial diversity. Results of the testing would suggest that there is a balance between the microbial populations compost can add to soil versus the nutrients contained in compost that can feed the microbial populations already in the soil. (G. Lazarovits – A&L Biologicals) The food-waste compost had a significantly higher nutrient content and higher level of ammonium nitrogen and appeared to have a higher amount of nutrients available when the crop needed them. With the leaf & yard residuals-based compost, even when the carbon to nitrogen ratio is below 20:1, yield results indicated that some additional commercial nitrogen is required.

During the mid-June and July rapid corn growth period, many organic amendments cannot release nutrients quickly enough to meet the crop needs. Where the leaf & yard residuals-based compost was supplemented with half the nitrogen needs, the yield was similar to the check plots. The food-waste compost with the higher nutrient (available nitrogen) content resulted in less-to-no advantage to additional commercial nitrogen.

2013 Strathroy Site Compost Plot Yield Results

Treatment	2013 Corn Yield (bu/ac)	2014 Soybean Yield (bu/ac)
Corn - Planted May 3rd; re-planted June 15th after frost		
No Compost - Full N (135 lbs)	145.3	39.3
6.6 ton/ac rate of compost	152.5	44.8
13.3/ac ton rate of compost	153.1	42.7

2014 Strathroy Site Compost Plots – Harvest Data

Treatment No additional N	Moisture %	**Test Weight** lbs/bushel	**Protein** % DM	**Yield** bu/acre	**Yield Δ**
Check with 0 N (starter only)	19.9	53.4	6.14	146.2	---
TRY Recycling + 0 N	19.7	53.6	6.07	145.3	**-1**
Orgaworld compost + 0 N	19.4	55.8	7.26	198.3	**52.1**

Treatment with Recommended N	Moisture %	**Test Weight** lbs/bushel	**Protein** % DM	**Yield** bu/acre	**Yield Δ**
Check with 130 lbs N	19.4	53.9	7.42	182.5	---
TRY Recycling + 72 lbs N	18.8	54.8	7.38	185.8	3.3
Orgaworld compost + 36 N	19.5	55.6	7.72	197.2	14.7

Compost applied: May 7, 2014

Orgaworld (London) @ 6.5 t/ac Greenbin (N - P_2O_5 - K_2O =~ 126 – 148 – 108 lbs/acre)
TRY Recycling @ 9.2 t/ac (mainly leaf-yard waste) (N - P_2O_5 - K_2O =~ 55 – 71 – 105 lbs/ac)

Planted: May 19, 2014

- variety DKC 50-78 RIB (30,100 seeds put down set @ 1.75"depth)
- 22 litres G24 in furrow with seed
- Starter - 125 lbs 16-16-16 in 2 x 2 banded with planter
- Side dressing Nitrogen (28%) - June 19

Harvested: November 26, 2014

Strathroy Site Greenbin Plot information – 2015 Corn Plots

- Greenbin compost applied April 27 (immediate shallow incorporation)
- Corn planted May 2, 2015, Starter - 125 lbs 16-16-16 in 2 x 2 banded with planter
- Corn Replanted May 29, 2015 (due to frost)
- 140 lbs N applied to check plots (compost treatments already had adequate N)

Compost Application – Summary of Applied available nutrients	Retained Ammonium-N: 75% Available Organic-N: 30% Available Nitrate-N: 95%

2015 Yield Results
Average:
No compost No N 104.7 bu/ac
No compost 120 lbs N 147.7 bu/ac
Compost no N 143.5 bu/ac

Treatment	Yield (bu/ac)	2013 compost overlap	% Moisture	Test Weight (lbs/bu)	Bulk Density 2015 g/cm^3	PSNT ppm $NO_3 + NH_4$-N	PSNT N rec * (lbs N/ac)
No compost, 120 lbs N	154.8	no compost	20.8	54.9	1.47	3.3	184
Compost no N	152.2	6.6 ton	20.1	55.0	1.36	4.0	175
Compost no N	149.7	6.6 ton	19.5	56.2	1.22	5.2	170
No compost no N	104.7	13 ton	21.2	53.8	1.36	3.8	180
Compost, no N	130.7	6.6 ton	20.5	55.1	1.41	8.4	150
Compost, no N	141.6	No compost	19.5	56.4	1.23	4.3	175
No compost, 120 lbs N	138.6	No compost	20.1	55.3	1.47	3.2	184
	* PSNT N recommendation based on 145 bu/ac yield goal Bulk Density - check treatments average 91 lbs/ft3 and average of compost treatments 82 lbs/ft3 - additional pore space and water holding capacity.						

Appendix IV(i) details analysis as conducted by A&L Biologicals Canada Inc. on the effect of different treatments on bacterial communities associated with corn plants.

Rotation Economics

The Rotation Economics table (below) attempts to show the short-term/long-term economics where short-term looks only at the cost and return of the current crop to which the compost is applied. The organic matter value is longer-term, therefore looking at current and subsequent crop yields tends to show OM value as opposed to just nutrient value. Costs and yield benefits calculated over the whole rotation gives a more realistic economic picture of the value of the organic amendment.

Summary (2 reps) Recommended N Rate	Yield bu/ac	Yield Δ	Short-term Benefit Corn value – Fertilizer/compost cost ($/ac)		Corn/Soy Rotation Benefit - Comments
Check + 130 lbs N	182.5	---	821 – 111 =	710	(starter fertilizer + N) - Crop nutrient removal = (-$ 50)
TRY Recycling + 72 lbs N	185.8	3.3	836 – 276 =	560	[$160 compost nutrient value + $76 fertilizer value) – $163 crop removal] + ($4.5 x 3.3) + $60 = $ 148
Orgaworld + 36 lbs N	197.2	14.7	887 – 244 =	633	[$212 compost nutrient value + $ 55 fertilizer value) – $173 crop removal] + ($4.5 x 14.7) + $60 = $ 220
Rotation benefit: [Fertilizer value of compost – (crop nutrient removal - starter fertilizer - commercial N applied)] +/- (corn yield increase over check plot x $4.50/bu) + (soy yield increase over check x $11/bu)					

Strathroy Site

The farm at Strathmere Lodge seniors' home was a perfect site for a compost test, says its operator and manager, Nick Stokman.

The farm's sandy soil is relatively low in organic matter. Since it's on the edge of the Town of Strathroy, the management agreement with the County of Middlesex stipulated that manure not be applied.

The Lodge, owned by Middlesex County, and the Middlesex Soil and Crop Improvement Association, or MSCIA, has run the 65-acre farm on the property since 1986.

At the end of the last ice age, the land was on the edge of a glacial lake. It was the site of a dairy farm until the early 1970s. After that, the owners rented it to the highest bidder.

While the soil is generally light sand, there's significant variability in percentages of sand, silt and clay, especially deeper in the profile. But the constant concern is moisture-holding capacity, and it was the main driver for adding organic material.

When the association took over, they switched to no-till farming of corn, soybeans, wheat and alfalfa. They soon dropped the wheat, which usually ran out of soil moisture during grain fill in the summer.

The alfalfa did well. A nearby dairy farm bought that crop, but when it was sold there was no longer an outlet for it. So for the past 15 years, the Strathmere farm has been in a corn and soy rotation. With no-till, "we've been putting organic matter back, although not as much as we'd like," Stokman says. "We thought compost could help to solve the problem."

For the trial's first year, 2013, MSCIA got Greenbin residential source-separated organic wastes from the Orgaworld Canada Ltd. facility, south of London. It was applied on two test plots, at 6.5 and 13 tonnes per acre, before corn was planted.

But a late-May frost killed the corn so it was replanted in mid-June. "The data was supportive of compost use," Stokman says. The results indicated a higher yield and some tests showed an increase in soil bacterial activity. "But I don't have a lot of faith in the data due to the replanting."

Last year, soy was planted on the same field without additional compost. "We wanted to see how much the previous year's application brought to this year's crop," Stokman says. The data suggest, "there's not a significant advantage" with the Greenbin compost. "There was a small difference, not a significant difference, in yield. It may be related to the fact that, this year, we had sufficient moisture. The effect might have shown up more in a dry year."

That's because organic matter acts like a sponge. A one per cent increase in it is capable of absorbing up to one inch of water, Stokman says. "If there's a dry spell in July and an inch increase in water in the soil, and corn uses one-third of an inch per day, that gives you three or four more days. It's so much better."

Meanwhile a new test was conducted on a different field, with Orgaworld compost as well as leaf and yard waste from TRY Recycling Inc., located north of London. Both composts were analyzed so that the nitrogen application in each test plot could be equalized.

The Green Bin compost was applied at 6.5 tonnes per acre. That amount contained about 130 pounds of nitrogen. The TRY Recycling product was applied at 9.2

tonnes per acre and contained about 55 pounds of nitrogen. The Green Bin compost applied contained twice the phosphorus applied with the TRY Recycling product, while the potash levels were equal. The difference in product application rates relates to their bulk densities. Spreader settings and speed were kept the same on both.

To reduce odour, capture volatile nutrients and speed up microbial activity, the compost was quickly incorporated, although just disked in to a depth of about one and a half inches.

Four strips of each compost product were applied along with four checks without compost. Two of the Greenbin strips and two of the TRY Recycling strips received no additional side-dress nitrogen. The other two strips of Greenbin compost received an additional 36 pounds of nitrogen, "the thinking being that in case the compost did not bring enough nitrogen we would put on a little extra," Stokman says. The remaining two strips of TRY Recycling compost had 72 pounds of side-dress nitrogen applied. As well, 130 pounds of nitrogen was applied to three check strips, and one check strip received none. This procedure meant that all the plots receiving side-dress nitrogen had total available nitrogen of about 130 pounds.

In general, the plots treated with Greenbin material showed more vigorous growth early on, since the compost supplied nitrogen from Day One, Stokman says. The leaf and yard waste on its own didn't perform as well, but with the nitrogen supplement it matched the Greenbin compost. Stokman cautions that the vigorous early growth isn't useful on its own. "It looked a bit greener, but looks don't translate to yield all the time. Yield is the economic driver. The visual might make you feel good, but if it doesn't translate into yield it doesn't mean much."

The tests showed some significant differences in yield:

- The check with no added nitrogen produced 146.2 bushels per acre.
- The check with 130 pounds of nitrogen added produced 182.5 bushels.
- Leaf & Yard compost and no added nitrogen produced 145.3 bushels.
- Leaf & Yard compost plus 72 pounds of nitrogen produced 185.8 bushels.
- Green Bin compost and no added nitrogen produced 198.3 bushels.
- Green Bin compost plus 36 pounds of nitrogen produced 197.2 bushels.

Stokman understands the benefits of compost. "If we'd known back then what we know now we'd have done things differently – put compost in 20 years ago, or doing other things to build organic matter."

Compost provides the same nitrogen supplied by commercial fertilizers, with the benefit that, "if we can improve the soil overall by utilizing the Greenbin or any compost or even crop leftovers, that's good.
"When we apply commercial nitrogen products, we're trying to do it in a manner that's environmentally friendly. We use the corn nitrogen calculator to determine the correct amount. If we can get more of that nitrogen component from material that also brings other things to the table – more organic matter and biological activity and better substrate – that's certainly an advantage."

But compost is not a quick fix: "Changing soil organic matter is a long process," Stokman says. The Greenbin compost added a little over 5,000 pounds of organic matter. The Leaf & Yard compost added 3,400 pounds. Soil biological activity starts the breakdown of this material and changes it into other forms. "Only about 20 per cent of the added material will end up as relatively stable organic matter. It is a long and slow process to build organic matter levels in the soil."

And even if applying it could deliver all the nutrients that crops require, it couldn't replace all commercial fertilizer. There's far too little to supply all of Ontario's acreage. On the other hand, there could be a market for all the potential compost in the province, if issues with costs and logistics of transporting it could be resolved.

Stokman didn't have to pay for the compost used in his test but, like most participants, says transportation costs would be a major impediment. "The big bill is trucking from point A to point B, especially since we're dealing with a relatively bulky product and the truck doesn't have a return load.

"Certainly the agronomy is there. As for the economics, I don't know. But they will be the determining factor."

2. Sarnia site - Lambton County

i. Research Conducted during the Years of / with Crops of:

2014: Wheat
2015: Corn

ii. Compost Analysis

Feedstock: Source-Separated Residential Organics

iii. Overview of Research Approach, Observations & Results

Parkland Farms manages several thousand acres near Sarnia, many on heavy clay soils. Compost was applied before the field-scale trial could be set up and as a result they were not replicated. NASM plans were required for the compost, with application occurring after wheat harvest 2014 onto red clover cover crop and in Spring 2015, ahead of planting corn (Please Note: not all data has been compiled to-date; however the most important discovery from this project was the timing management for compost application).

Spring 2015 had near-perfect conditions for planting but the Spring-applied compost still resulted in significant compaction resulting in a yield decrease between 20 and 25 bu/ac. Application after wheat harvest when soil conditions, lower in the soil profile, are less prone to compaction damage will become a recommended practice - a BMP - for clay soils).

Compost applied after wheat harvest with cover crop resulted in uniform stand of corn the following spring

Compost spring applied ahead of corn planting into ideal soil conditions resulted in deep compaction and significant yield reduction in compacted areas

Parkland Farms

Parkland Farms is big: The business covers 12,000 acres — owned, rented or shared — scattered throughout Lambton County in southwestern Ontario.

Most of the land is used for cash crops — corn, soybeans and wheat — so it's a good candidate for compost, says Dave Curry, the agronomist for this complex operation, which employs up to 30 full-time staff.

Parkland isn't officially part of the trial, but Curry applies Greenbin compost from the Orgaworld Canada Inc. facility, south of London, on some of the land, and has gained good insights about using it on a commercial scale. He has also tried a bit of compost made from leaf and yard waste by Try Recycling Inc.

In the past, commercial fertilizer provided 95 per cent of the crop nutrients, and organic matter came from cover crops and stubble, Curry says. The addition of compost "is a completely independent thing. We were looking for another source of fertility." We jumped on board because we think it's the right idea."

The largest field Curry manages covers 250 acres. Since the farms are spread over a large area, "we see everything," in terms of topography and soil, although most are quite flat, with clay-loam. Most of the compost is being applied to a few fields that are sandier, and lower in organic matter. Last year, it went on 1,500 acres: The target for 2015 is to spread 12,000 tons on 3,000 acres.

Curry also focuses the compost on land owned by Parkland, a family business, rather than shared or rented fields, because of the long time frame involved with using it. "There's a huge investment when spreading compost, plus a multiple year return. If I was renting, I'd need to have a contract for several years. But it's hard to get long-term contracts since commodity prices go up and down. If you're a landowner, you might not want to rent at a fixed price, since the land might be worth more in five years."

Ontario needs to enlarge its organic waste collections to ensure a sufficient supply of compost as demand grows, he says. "Hopefully we can push government for more greenbin programs. In 10 years, maybe you'll be able to get as much compost as you want."

The plan is to spread compost before the corn rotation — the heaviest user of fertility — ideally in late summer, after winter wheat is harvested. At that point, the ground is dry, compaction isn't a problem and the compost has time before the spring planting season to become active in the soil.

All the compost is incorporated into the soil immediately after application, to reduce run-off and, where houses are nearby, prevent odour complaints. The cultivation goes to varying depths: Heavy clay might need to be tilled down to 16 inches, while lighter soils required only three or four.

Compost doesn't eliminate chemical fertilizers, Curry says. How much he continues to apply depends on the results of soil tests. "We vary the rate of application based on that. On some farms we can reduce fertilizer by 100 per cent; on others, we're only going to cut back 50 per cent." The amount might fall further in future as the compost slowly releases nitrogen.

Parkland has used red clover as a cover crop for winter wheat. Next year, Curry plans to plant oats at a low rate, combined with an application of compost, to take up nutrients, prevent erosion and supply organic matter before the corn goes in.

Parkland is now the biggest buyer of compost from Orgaworld's London facility. Curry says he pays a "reasonable" market price, but transportation and equipment costs “make it tough. The compost cost is a small portion of the total. We have two full-time guys on the road making two trips each per day to and from London with walking-floor loaders.” Storage and holding, to let compost be purchased year-round and stockpiled, is another cost. It required construction of a pad, surrounded by a dike, to prevent run-off.

In addition, “we needed to buy a big payloader to pile it, plus a large manure spreader, with a dedicated tractor and hire someone to operate it.” Spreading also costs more — perhaps six times as much as commercial fertilizer.

The material from Orgaworld contains 45 to 50 per cent organic matter. The Try Recycling product is 20 to 30 per cent. “That’s a value you can’t build into the cost equation. I don’t know what number to put on it.”

With that undefined but substantial advantage included, compost “is a wash for us,” Curry says. “But for a smaller operation, if you were adding in all these costs maybe it wouldn’t be as beneficial.”

Orgaworld’s compost contains “more plastic than I’d like to see,” Curry says.” One farmer he works with didn’t want the product on his land.

“Plastic is more of an aesthetic issue. Who wants to spread plastic? There’s also a bit of glass that could limit using it to grow fruits and vegetables.”

However, Orgaworld promises a new process should remove most of the plastic, he says.

Parkland Farms hasn’t yet taken any compost plots to yield, but plans to do side-by-side tests this summer and fall, Curry says. “Because of our large acreage, we are doing multiple plots. I will have a great handle on yield response by next fall.

“I’m excited to see more results. On the other hand,” he adds with a laugh, “maybe I don’t want to make publicity so other farmers jump on board.”

Curry is clearly sold on greenbin compost. The main problem, he says, is that there’s too little of it: “If we could get twice as much from Orgaworld we’d haul it right away.”

Ontario needs to enlarge its organic waste collections to ensure a sufficient supply of compost as demand grows, he says. “Hopefully we can push government for more greenbin programs. In 10 years, maybe you’ll be able to get as much compost as you want.”

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Ontario needs to enlarge its organic waste collections to ensure a sufficient supply of compost as demand grows, he says. “Hopefully we can push government for more greenbin programs. In 10 years, maybe you’ll be able to get as much compost as you want.”

3. Winchester Research Farm Site

i. Research Conducted during the Years of / with Crops of:

2012: Corn
2013: Corn; Soybeans
2014: Corn

ii. Compost Analysis

Feedstock: Leaf & Yard Waste

COMPOST ANALYSIS			
Sample ID: OrgaWorld Compost Ottawa Lab Number: 728005			
For: Winchester Research Farm Field:			
Reported Date: March 2013			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Dry Matter (%)	48.9		
Nitrogen (total) (%)	1.09	21.80	5.80
NH4-N (ppm)	48	0.00	0.00
Phosphorus (total) (%)	0.21		
Phosphate (P as P2O5) (%)	0.48	9.50	7.70
Potassium (total) (%)	0.76		
Potash (K as K2O) (%)	0.91	18.30	16.50
Organic Matter (%)	38.7		378.00
Carbon:Nitrogen Ratio (C:N)	20 : 1		
Calcium (%)	2.51	50.30	
Magnesium (%)	0.46	9.10	

COMPOST ANALYSIS			
Sample ID: Biosolids pellets Smiths Falls Lab Number: 728006			
For: Winchester Research Farm Field:			
Reported Date: March 2013			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Dry Matter (%)	94.7		
Nitrogen (total) (%)	3.5	70.00	38.90
NH4-N (ppm)	139	0.30	0.00
Phosphorus (total) (%)	1.53		
Phosphate (P as P2O5) (%)	3.52	70.60	56.30
Potassium (total) (%)	0.31		
Potash (K as K2O) (%)	0.37	7.50	6.70
Organic Matter (%)	74.8		1,417.00
Carbon:Nitrogen Ratio (C:N)	12 : 1		
Calcium (%)	1.57	31.40	
Magnesium (%)	0.57	11.40	

iii. Overview of Research Approach, Observations & Results

Research-scale plots were first established at the Winchester Research Farm in 2012 with their continuing every year since to determine the short- as well as long-term impact of compost and biosolids pellets on soil health and crop productivity.

With soil fertility levels considered to be "adequate" and soil organic matter levels being between 3.5 and 4%, a series of plots were established to investigate a range of scenarios: from assuming that the compost/biosolid pellets would provide zero nitrogen input to assuming that the compost/biosolid pellets would provide the full nitrogen input need as well as scenarios in-between. Check plots with and without nitrogen were also established.

There is a wide range of plot yields within the same treatment approach, resulting in there being a less significant difference between treatments than what the average numbers indicate. Perhaps the most important observation from this research to-date is that there is an upfront need for additional nitrogen when using leaf & yard-waste based compost is utilized in agriculture. While there is significant nitrogen content in the leaf & yard-waste based compost, it is being released more slowly reflective of the soil micro-organisms not being able to mineralize the nutrients quickly enough to meet immediate crop needs. As well, the "right" additional N rate is dependent on the weather conditions of that year.

Compost on Corn - Winchester Research Farm, 2012 and 2013(2)

Treatment	2012 Yield (bu/ac)		2013 Yield (bu/ac)		2014 Yield (bu/ac)	2014 Yield range
150 lbs/ac N (using Urea)	**257**	(1)	**220**	a	**194**	182-204
Biosolids Pellets + 125 lbs/ac N (Urea)	**247**	a	**209**	a	**178**	161-200
Compost (10 ton/ac) + 150 lbs/ac N (Urea)	**235**	a	**216**	a	**159**	121-180
Compost (10 ton/ac) + 75 lbs/ac N (Urea)	**241**	a	**185**	b	**135**	131-145
Compost (20 ton/ac)	**182**	b	**155**	c	**118**	74-175
No compost, pellets or N fertilizer	**157**	b	**163**	c	**88**	51-102

(1) yields results with the same small letter indicates no statistical difference
(2) plot results were influenced by drainage - site was tile drained in 2015

Leaf & Yard Compost –a C:N ratio of 35:1 (2012); 17:1 (2013)
2012 analysis: DM 68%; N avail = 5 lbs; P_2O_5 = 8 lbs; K_2O = 14 lbs
Biosolids Pellets applied @ 2.2 T/ha with C:N ratio of 9:1
2012 analysis: DM 95%; N avail = 30 lbs; P_2O_5 = 82 lbs; K_2O = 3 lbs

Subsequent Yields – Organic Amendments on Corn
Winchester Research Farm 2014

Treatment	**Corn Yield** (bu/ac) – Compost Applied 2012		**Soybean Yield** (bu/ac) – Compost Applied 2013	
150 lbs/ac N (using Urea)	**189**	a[1]	**50.1**	a
Biosolids Pellets + 125 lbs/ac N (Urea)	**205**	b	**51.7**	a
Compost (10 ton/ac) + 150 lbs/ac N (Urea)	**201**	b	**48.8**	a
Compost (10 ton/ac) + 75 lbs/ac N (Urea)	**201**	b	**47.3**	a
Compost (20 ton/ac)	**204**	b	**49.6**	a
No compost, pellets or N fertilizer	**204**	b	**48.4**	a

[1] small letters that are the same means there is no significant yield difference. Within-treatment variability was high.

SCOTT BANKS

Scott Banks is one of a team of research and extension specialists who studied the impact of compost on agricultural land.

Banks, employed by the Ontario Ministry of Agriculture, Food and Rural Affairs, conducted the field trials at the Winchester Agricultural Station in Eastern Ontario, a satellite of the University of Guelph.

The results of three years of trials, on 24 plots at Winchester are thought-provoking.

The tests began in the spring of 2012, when several different combinations of compost and chemical fertilizer were applied to the plots, each treatment repeated four times. The first year's crop was corn; the second, soybeans; the third, back to corn.

This is what went on the research plots, each 10 feet by 20 feet:

- A "full" rate of nitrogen fertilizer, or 150 kilograms per hectare, to supply the required rate for corn.
- A full rate of compost, or 22 tonnes per hectare, plus 150 kilograms of fertilizer. The compost is a combination of source-separated organics and leaf and yard wastes from the Orgaworld Canada Inc. facility near Ottawa.
- A full rate of compost plus 75 kilograms of fertilizer.
- A half application of compost, or 11 kilograms per hectare, plus full fertilizer.
- No compost or fertilizer.

For the 2012 corn crop, "the bottom line is that we didn't see any crop yield response to the compost treatments as compared to the straight full nitrogen treatment," Banks says.

In fact, the yield seemed to depend on whether fertilizer, rather than compost, was applied. Combining compost and fertilizer produced a bigger crop than compost alone. But when full rate of compost and full nitrogen fertilizer were combined, the yield was actually less than with fertilizer alone. This is likely the result of some of the nitrogen fertilizer being tied up by the compost.

With soybeans, the year following the one when the compost and nitrogen treatments were applied "there was no difference in response. Statistically, the yields were not different."

In 2014, nitrogen was applied at 150 kilograms per hectare over all the previously treated plots. There was no statistically significant difference in corn yield between the various plots.

But Banks says the results weren't disappointing. In fact, "it's somewhat what we expected."

Three years is a short time for a compost trial, he explains. Compost supplies organic matter, microbial activity and structure to the soil, but is of limited value for nutrients. Compost always releases its nutrients more slowly than fertilizer does. And in the first couple of years, because of its high carbon-nitrogen ratio, it might even reduce the amount of nitrogen available, as that nutrient is tied up helping the carbon material to decompose.

The project was not designed to show the results, but rather was intended to be a long-term trial over 10 to 15 years to see the benefits of compost. Three years isn't a long enough study, Banks says.

The main message, he adds, is that using compost involves a long-term commitment to building soil; it's not usually a short-term route to better yields, although production might increase under favourable circumstances.

"You can't count on compost to supply what the crop needs. Not that there's no value in terms of building organic matter, but you've got to do that long-term. Any farmer using compost would have to be thinking long-term: It builds over time instead of an immediate response.

"We tell farmers, the reason for putting compost on is that it's adding organic matter to the soil. The bottom line for growers is that when it comes to yield response, you're not going to see it in the first few years."

The soil at Winchester is a medium to heavy silt-loam. It was chisel ploughed each fall and cultivated twice before the spring planting.

Many Eastern Ontario farmers till their land before planting corn, rather than practising no-till, Banks says. The aim was to see how compost would work for them. Besides, tillage would incorporate the compost into the soil quicker and going to no-till would introduce additional variables. As well, "the thought is that if you're putting on compost you have to do some tillage to incorporate the compost. No-till means it takes a longer time to get the benefit of compost."

The soil at this site was not analysed for microbial activity, but "the ultimate indication is a difference in yield. If there's an improvement in soil biology, there should be an increased yield. We didn't see that in the short time we were dealing with."

The key, again, is the test's short time frame. Banks had hoped the trial would last five years, and possibly 10 or 12. But lack of funding, and the fact the land that the test plots were on is to be re-tiled, means it can't continue on the same site this year.

There are too many variables to reach a quick conclusion, Banks says.

Most important are changes in temperature and moisture from year to year, Compost would have more impact in a drought than under wet conditions, especially applied on lighter, sandy soils.

After a few years, when compost starts releasing its nutrients, it might supplant some of the need for fertilizer. Would that happen, and how long would it take?

And are there other management practices to improve the soil that would be faster and more cost effective?

All these factors are important because compost is an expensive way to obtain nutrients, when compared with commercial fertilizer, Banks says. "The thing with compost is that you're adding that organic material, not just nutrients to improve the soil. At the current price it's not the cheapest way to go. Is it worth the cost? The test was only for three years, so I'm not sure."

Despite these uncertainties, Banks believes compost is valuable, as long as it's kept in perspective.

"I think there's still opportunity for more compost to be used. There are more people looking for it than can get it. If the price is right, growers will still apply it.

"Generally most growers understand what compost is; that it's a long-term improvement option, not short-term. It's part of a very long-term strategy."

4. Castleton Site

i. Research Conducted during the Years of / with Crops of:

2012: Soybeans
2013: Wheat
2014: Corn
2015: Soybeans

ii. Compost Analysis

Feedstock: Leaf & Yard Waste Compost

COMPOST ANALYSIS			
Sample ID: 4 Miller Row B			
Reported Date: March **2012**			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Dry Matter (%)	54		
Nitrogen (total) (%)	0.95	19	2.4
NH4-N (ppm)	2	0	0
Phosphorus (total) (%)	0.23		8.5
Potassium (total) (%)	0.57		12.3
Organic Matter (%)	42.7		462
Carbon:Nitrogen Ratio (C:N)	25:1		
Calcium (%)	3.1	61.9	
Magnesium (%)	0.37	7.4	

COMPOST ANALYSIS			
Sample ID: 5 Miller Row H			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated availability per Ton**
Dry Matter (%)	51.4		
Nitrogen (total) (%)	0.98	19.6	2.9
NH4-N (ppm)	3	0	0
Phosphorus (total) (%)	0.21		7.7
Potassium (total) (%)	0.63		13.6
Organic Matter (%)	40.6		417
Carbon:Nitrogen Ratio (C:N)	23:1		
Calcium (%)	3.42	68.4	
Magnesium (%)	0.37	7.4	

COMPOST ANALYSIS			
Sample ID: Miller			
Reported Date: March **2014**			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Bulk Density	630 kg/m^3	39.3 lbs/ft^3	
Dry Matter (%)	50		
Nitrogen (total) (%)	0.89	18	1.5
NH4-N (ppm)	16	0.03	0
Phosphorus (total) (%)	0.24		9
Potassium (total) (%)	0.55		12
Organic Matter (%)	21.2		212
Carbon:Nitrogen Ratio (C:N)	13:1		
Magnesium (%)	0.37	7.4	
Sulphur (ppm)	1,073	2.1	

iii. Overview of Research Approach, Observations & Results

The soil at the Castleton site is classified as a light-textured, rapidly draining Pontypool sand, ideal for tobacco crop in the past. As such, the goal for the greenbin compost research was to build organic matter and moisture-holding capacity to improve consistency of yield. The effort to build organic matter at this site has been on-going for about 10 years, beginning with the application of paper bio-solids and followed with compost applications. The 10-year measurements indicate that soil organic matter has increased +0.5 percent in the overall time period.

Compost was added ahead of the soybeans in 2012 and again ahead of the corn crop in 2014. Results for the corn year do not show a large difference and suggest that the 125 lbs of commercial nitrogen combined with relatively high fertility soil was adequate. A 0.5% increase **represents approximately ½ inch (11,300 gal/ac or 513,400 litres/ha) extra soil water-holding capacity with every rain event.** Erosion on this farm has decreased significantly and crop growth is more uniform. These are all indicators of improved soil health, however, putting an economic value on these improvements is difficult.

Treatment	2012 Soybeans	2013 Wheat	2014 Corn	2015 Soybeans
	Yield bu/ac	Yield bu/ac	Yield bu/ac	Yield bu/ac
Fertilizer Check	31	72	150	30
Compost @ 10 T/ac	34	76	154	37.4
Compost @ 20 T/ac	33	80	155	36.2

- Miller Compost applied Fall 2011 and Fall 2013
- @ 10 ton/ac rate supplied: ~ 54 – 88 – 99 lbs/acre N - P_2O_5 - K_2O
- 2014 – Corn planted May 5, Liquid Starter: 3 – 12 – 0 - 3S – 0.3Zn - 0.1 Mn lb/ac with planter
  Nitrogen: 125 lbs applied May 6 (as 28%).

SCOTT MAYBURY

As a research chemist, Scott Mabury likes to experiment.

Having grown up on a farm in the Midwestern United States, he enjoys rural life.

So experimenting with compost came naturally to him as he worked to improve the 300-acre former tobacco farm in Northumberland County that he acquired in 2000 and started farming on five years later.

"The farm had been rented, so not a lot of work was done on the sandy loam soil," Mabury says. It was "challenged. From the beginning, I wanted to improve it," particularly the organic matter and tilth.

With no animals on the farm or nearby, manure wasn't an option. Given his interest in research, Mabury tried several alternatives to build up the organic matter.

One was sludge from a paper recycling plant. It was half high-quality clay and half cellulose, so it boosted the soil structure, but didn't supply nutrients. Part of this experiment -- related to his specialty as professor of environmental chemistry at the University of Toronto; the fate of chemicals in the environment -- was to research what happens to the potentially toxic chemicals in some paper as the sludge decomposes: He found they are soon converted to a non-toxic form.

He investigated biosolids which he considers a bigger challenge because of the potential infectious components, salts and metals. "You don't want to put something on ... that would compromise the use of farmland. Around my area, though, I think it's a viable option."

He also practised no-till farming on his rotation of three years of alfalfa followed by corn, soybeans and winter wheat, chopping up the corn stover and other stubble so it would incorporate into the soil more quickly, a practice he calls vertical tillage. But that source wasn't sufficient.

He was aware of compost and approached Christine Brown at a farm show to discuss using it. "I told her that being an environmental chemistry professor, I like the idea of experimenting." With that, he got involved in the Greenbin compost trials, using material -- a combination of residential source-separated organics and leaf & yard waste -- from Miller Waste Systems Inc. in Pickering.

The test "makes farming more fun," he says. "There are questions to be answered, changing the variables and seeing what the outcome is."

"My intention is to increase the soil quality and grow bigger crops. The fundamental question is, what is the agronomic value of compost."

The compost obviously supplies nitrogen, potassium and phosphorus: holds moisure; and reduces erosion on the light, sandy land. Mabury says that he's not as sure about any increase in microbial activity: "It's difficult to measure."

In terms of crop production, though, "it's a no-brainer. If you put compost on, you get bigger yields." Maybury has completed three years of a five-year trial on 10 acres of his land. The test plots with compost produced five bushels more soybeans per acre, a 15-bushel increase in wheat and, even without side-dressed nitrogen, 5.5 added bushels of corn.

Maybury works the farm on weekends. The rest of the time he's in Toronto, where he is also the U of T's vice-president of university operations, overseeing a staff of 1,100. "I wanted a balance between rural and urban life, and I wanted my kid to grow up in a rural environment," he says. "I'm used to hard work."

He is also interested in building the soil as in getting a quick return from his farm, and that colours his view of the economics of compost.

It is more expensive and time-consuming to apply and the cost of transportation is high: The compost is free but he pays for trucking it the 90 kilometres from Miller's facility to his farm. So far, he's taken 15 tractor-trailer loads, at $10 per tonne, or $340 per load. That distance, "is a little beyond the comfort zone." There are also expenses like $20,000 for a new spreader.

Which leads to a tough question: "If I had to pay for the compost, would I continue to buy it after the project ends? I believe the answer would be yes. I wish I was clearer."

But there are many variables to consider; for example, the economics if compost only needs to be applied once every three, or perhaps five, years. And "different soild have a different capacity for a yield bump." The importance of compost's water-holding capacity depends on the weather and the ability of a particular soil to retain moisture. he'd also like to know more about compost's impact on how and when nitrogen is released to the plants; information that might let him buy less compost.

"Is it worth it? I believe so," he says. "The rub is, I have a non-monetary interest: I want the soil to be better than when I got it. I'm putting in extra effort to make the soil more resilient and healthy than before."

5. Acton Site

i. Research Conducted during the Years of / with Crops of:

2013: Fields I & II: Forage

ii. Compost Analysis

COMPOST ANALYSIS			
Sample ID: PEEL - Acton Site			
For: Field 5/6			
Sample Date: May 13, 2013			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Dry Matter	56.2		
Nitrogen % (Total)	1.43	28.6	10
NH4-N ppm	840 ppm	1.7	
Phosphorus (Total)	0.36%		0.13
Phosphate (P as P2O5)	0.83%	16.8	
Potassium (Total)	0.64%		0.14
Potash (K as K2O)	0.77%	15.4	
Organic Matter	42.30%		
pH	8.2		
Carbon:Nitrogen Ratio (C:N)	16:1		
Sulfur	1313.4		2.63
Bulk Density (As Received)	349 kg/m3		
Conductivity (@ 25 deg C)	5.86 ms/cm		
Sodium	0.34%	6.8	0.07
Aluminum	670		1.34
Boron	24.7		0.05
Calcium	2.48%	49.5	0.50
Copper	14.9		0.03
Iron	1492.4		2.98
Magnesium %	0.23	4.7	4.60
Manganese	68.6		0.14
Zinc ppm	50.6		0.10

Feedstock: Biosolids Pellets

Biosolids Pellets Analysis			
Sample ID: BioSolids Pellets			
Field 5/6			
Sample Date: May 13, 2013	Reported Date: May 21, 2013		
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Dry Matter	94.5		
Nitrogen % (Total)	4.41	88.2	56.7
NH4-N ppm	1480	3.0	
Phosphorus % (Total)	3.0		110.40
Phosphate (P as P2O5)	6.9	16.8	
Potassium% (Total)	0.64%		0.14
Potash (K as K2O)	0.14	15.4	
Organic Matter	0.17		
pH	6.7		
Carbon:Nitrogen Ratio (C:N)	7:1		
Sulfur ppm	10243		20.49
Bulk Density kg/m3 (As Received)	857		
Conductivity (@ 25 deg C)	7.56 ms/cm		
Sodium %	0.13	6.8	2.60
Aluminum ppm	4904		9.81
Boron ppm	46.3		0.09
Calcium %	4.89	49.5	97.80
Copper ppm	1199		2.40
Iron ppm	46995		93.99
Magnesium %	0.75	4.7	15.00
Manganese ppm	312		0.62
Zinc ppm	960		1.92

iii. Overview of Research Approach, Observations & Results

Acton Site – Compost and Biosolids Pellets on Forages (Beef Hay)

Field 5	Yield (t/ac)	% Δ	Quality Parameters				Milk lbs/ton	% Δ	Milk lbs/ac	% Δ
			CP	ADF	NDF	RVF				
Fertilizer	**1.59**	---	13	44	57	89.8	**634**	---	**991**	---
Compost @5 ton/ac	**1.49**	- 4.5	14	41	55	97.0	**865**	+26	**1,263**	+22
Compost @10 ton/ac	**1.68**	+ 3.2	14	42	54	97.3	**871**	+27	**1,425**	+31

Using MILK 91 – using default values except for quality parameters shown above)

Ideal quality for dairy alfalfa grass hay harvested at mid-bud is: CP 18; ADF 35; NDF 45; RFV 127

Fertilizer treatment had higher yield but lower quality due to higher volume of grass & weeds

Calibration of compost application to forage crop

Biosolids pellets applied at same time

Visible difference with growth advantage from compost application

Soil health demonstrated by soil microbial activity and ideal soil aggregate development

The forage site was chosen because of the extremely low soil fertility in the fields. Soil P ranged between 8 and 14 ppm while K levels ranged between 29 and 67 ppm. The plant tissue samples taken during the growing season revealed that nutrient cycling was occurring since all tissue analysis was within the normal range; however, fertilizer treatments were significantly lower in potassium than treatments with organic amendments added.

Another observation in comparing forage quality comes from the "activation" of the nutrients from compost compared to biosolids pellets. The biosolids pellets were coated with a fibrous material to help with storage and transport. The microorganisms in the soil have to break down the coating. The time difference in the availability of the nutrients between the pellets and the compost is evident in the yield and quality results. The treatments with the compost added grew and reached maturity more quickly than the treatments with the coated biosolids pellets. Since maturity affects quality, this difference is evident in milk/ton results for field 6.

Yield was measured using a scissors cut approach, and samples were also measured for quality *[Crude Protein (CP), Acid Detergent Fibre (ADF), Neutral Detergent Fibre (NDF), Relative Feed Value (RFV)]*. A Wisconsin software program takes quality indicators and calculates milk production based on yield and quality. This program was utilized to put the yield and quality differences into economic context.

Ideal quality for dairy alfalfa grass hay harvested at mid-bud is: CP 18; ADF 35; NDF 45 and RFV 127. Beef cattle do not have the same requirement for high quality hay so often hay is cut at a more mature stage to take advantage of higher yields.

Lower CP and RFV and higher ADF and NDF indicate greater maturity/lower quality

- Results indicate that forage was mature (beef hay), resulting in lower quality compared to dairy hay
- Forage yield was highest where compost was applied
- Forage quality where pellets were applied is better.
- Pellets take longer to break down, while nutrients in compost were available more quickly

More rapid nutrient availability in low fertility field resulted in more rapid forage growth and earlier maturity.

Field 6	Yield (t/ac)	% Δ	Quality Parameters				Milk lbs/ton	% Δ	Milk lbs/ac	% Δ
			CP	ADF	NDF	RVF				
Pellets	**1.66**	---	12.4	39	58	96	**853**	---	**1,278**	---
Pellets + Fertilizer	**1.59**	- 4.5	12.4	41	57	93	**757**	-12.7	**1,203**	-6.2
Pellets + Compost	**1.72**	+ 3.2	12.9	42	57	93	**749**	-13.9	**1,289**	0.9
Compost + Fertilizer	**1.74**	+ 4.5	12.2	40	61	88	**645**	-32.3	**1,065**	-20.0
Pellets + Compost + Fertilizer	**1.83**	+12.9	12.4	43	58	90	**665**	-28.1	**1,182**	-8.1

Using MILK 91 – using default values except for quality parameters shown above)

Ideal quality for dairy alfalfa grass hay harvested at mid-bud is: CP 18; ADF 35; NDF 45; RFV 127

Lower CP and RFV and higher ADF and NDF indicate greater maturity/lower quality

Measuring the Impact of Soil Organic Matter from Organic Amendment Additions

Improvements in soil quality take time and are difficult to measure. Ideally the fertilizer benefit and the yield difference between the treatment for each crop in the rotation between applications will show the organic matter benefit from the organic amendment. A rotation that includes a forage-based rotation and/or cover crops in combination with organic amendments will show the soil quality advantage more quickly. The photos in the above table show the soil aggregates and microbial activity that were evident, especially where the compost was applied. The winter of 2013-2014 was especially cold with record amount of winter-kill in forage fields. Winter kill occurs when forages are under stress due to low fertility, poor drainage, disease, and results in a loss of plant stand. Often fields are replanted. The application of compost and biosolids pellets in these fields helped the nutrient cycling and active microbial population that helped prevent winter kill.

BOB KERR

The soil on the rented field was desperately poor; says veteran farmer Bob Kerr. In parts of it, hardly anything would grow.

The land, that he took over five years ago, was exceptionally low in potash and phosphorus and also lacking in sulphur. For three years, he had spread heavy applications of chemical fertilizer and, in some areas, bio-solids pellets. But the work had little impact on the yield of hay, grown for the farm's 55-head Angus cow/calf operation. "It didn't seem to do much good," Kerr, who also grows cash crops on his 300 acres of owned and rented land, northeast of Acton, in an area first settled back in 1824.

He used manure from his cattle on the home farm, but the rented land was too far away to haul that material. "I thought there must be another way of getting the fertility up," he says.

Then, Christine Brown invited him to participate in the Ontario Green Bin compost trial.

Kerr, who has been farming for nearly half a century, began his tests two years ago on nearly 30 acres of the depleted soil. The test area was divided into six 40-foot strips, treated with varying amounts and combinations of compost, bio-solids pellets and commercial fertilizer. The compost, a mix of leaf and yard waste and residential source-separated organics from the Region of Peel Composting Facility in nearby Caledon, was applied at six and 10 tonnes per acre.

Kerr was nervous about the procedure. The compost would be applied after the alfalfa was already growing, and he was worried it would be crushed under the spreader's wheels and the weight, because it went on quite heavily in some places. "I didn't know what to expect. I wasn't impressed, especially since we trampled on so much of the alfalfa putting it on."

But the compost result was phenomenal, he says. The late application "didn't bother the hay. I don't know why. The alfalfa just grew back up through it."

Second-year results, on 15 acres and with more compost added, were equally good, says Kerr, who managed a 75-head dairy her for 38 years until an arm injury left him unable to handle milking.

He believes the high yield is due more to the boost in organic matter and microbial activity — evident in much higher worm activity — than the added nutrients. Weather and moisture retention didn't seem to be big factors in the increased production.

This year, he plans to apply compost, at about six tonnes per acre, to a different, more fertile, 55 acres where he'll grow soybeans and barley. This land "doesn't need fertilizer, but it needs the organic matter and the compost will help the worm life," he says. He would have preferred to spread it last fall, but didn't get it in time, so it will go on the field this spring.

And that leads to a couple of qualifiers to Kerr's positive view of compost.

He could have pellets or commercial fertilizer applied to the 55 acres in about three hours. With compost, he estimates the job will take four days, because the quantity of material is so much larger. "Compost requires a lot more labour and time. It's a time-consuming pain."

That will not only create a tight time squeeze with spring application but is also an added cost no matter when the compost is applied, which leads to Kerr's major uncertainty with compost.

Kerr paid $5 per tonne for the compost, but there was no charge for the 45-minute haul to his farm from Peel's composting facility, for either the trial or the two trailer loads he plans to use this year. But while the compost price is "incredibly reasonable," the cost of trucking the material might be prohibitive if he had to shoulder it.

After all, he'll still need to apply commercial fertilizer; probably nearly as much as without compost, to get all the nutrients the crops require.

"Compost is pretty good, but if I had to pay for the transport, I probably wouldn't use it … I wouldn't bother with it."

It is, he adds, "more of a long-term thing."

Bob Misener

Bob Misener has a passion for agriculture, and feeding people while being "green" and conservation minded. That includes a strong, lifelong interest, stemming from studies at the University of Guelph, in the health and quality of soil, and "leaving it better than we found it."

So it's no wonder the veteran farmer has strong views on how compost should be handled.

For 35 years, Misener and his family "made a poor living" growing cash crops on 5,000 acres south of Hamilton. Over that time, he added sewage sludge and compost to the soil to increase its organic matter and fertility and reduce erosion.

"It wasn't easy," he says. "We had a huge amount of investment for the return. It was more satisfying than profitable."

He sold the large farm in 2009 and "retired" to 84-1/2 acres east of Acton, in Wellington County. "We're in a pretty rough area; hilly, with not much flat ground. It's on moraine soils, on the edge of the Niagara Escarpment; gravelly, with clay here and there."

The farm had been owned by a man who worked for Ford Canada in Oakville. "He'd bought the land to raise his family of five in a healthy environment," Misener says. Part had been rented to farmers, but most was left, untended, in hay and pasture for five decades.

As a result, while the soil was structurally sound, it had lost much of its fertility, the fencerows were out of control and the weeds were severe.

With neighbor, Bob Kerr, who is also participating in the municipal compost trials on his own farm, Misener has worked to build up his soil. They planted soybeans for two years, then, reverted to hay, which he calls, "an excellent crop for soil preservation" if it's well managed.

The land is not suited to cash cropping, Misener says. "I think frequent cropping of erodible land is madness. This is the kind of place you only break up and put in crops to control weeds and build up fertility. Most of the farm is much better suited to forage production."

Misener and Kerr put compost, from the Region of Peel Composting Facility, on ground to be planted in soybeans in 2012, and on hay last year. With both crops, the outcome was significant, but not surprising Misener says. "It got good response, which I expected having used thousands of tonnes before." on the previous large farm. He doesn't have yield data but, "you could see the strips in the hay field; they were higher, with better colour and more re-growth."

Misener's experience has led to his robust conclusions about compost. "My basic opinion is that it's useful if applied when the soil has the necessary bearing strength to be worked without significant compaction." In the first place, that means it should be used only where and when required.

"If a field has high soil tests, don't put it on. Put it where it's needed," Misener says.

He also recommends applying compost at lower rates more frequently, rather than heavy, infrequent treatments. And it should be spread at times when plants need it and the soil can handle the equipment. "If you're doing damage to the soil by putting compost on at the wrong time, it doesn't make sense.

"Putting compost on with a bulldozer in winter will get rid of tonnes of it, but how much of it do you want to wash away? It can also be toxic if you put enough on, and there are odour questions."

More research is needed to establish safe and appropriate application rates for compost, he says.

Then, he says, municipal compost producers should be responsible for dewatering the material and building storage facilities for it in rural areas, perhaps on land provided by farmers, to hold it until it's needed and can be spread advantageously.

"Agriculture occurs from April to October or November. This is the period of the year when compost may be spread sensibly. I'd look at a number, get the tonnage, and figure out where to store it. That would let farmers receive compost when it's proper to put it on."

The expense of storage would be justified because "you'd be preserving nutrients, and letting compost be used at the rates it should be used." And farmers' costs would be reduced.

Compost should also be priced so that farmers can afford to apply it to produce food, Misener says. They should get a bonus for using it properly, rather than a penalty.

Most important is a commitment to use compost t getting rid of it at the least cost to cities. Let's get the big picture.

"By and large in Ontario there's very little land being put through rotations aimed at building or even maintaining soil. It's for quick profit; sustainability is not the goal."

Looking after the land is not a short-term proposition. It's long-term, Misener says. And compost could make a major contribution. "It's a valuable public asset that could be a win-win for cities and agriculture. This is a real opportunity for our society to be smart."

6. Woodstock (Outdoor Farm Show site)

i. Research Conducted during the Years of / with Crops of:

2013: Corn
2014: Soybeans
2015: Cereals

Organic Amendments were applied ahead of a corn crop in 2007, 2010 and 2013.

ii. Overview of Research Approach, Observations & Results

This was not one of the original compost sites for the study, but because the long-term benefits of organic matter were being tracked, this site is included in the final report.

At the Outdoor Farm Show site, long term rotation plots were set up in 2007, with organic amendments added once per rotation (per 3 yrs) and with one treatment receiving 100 tons of compost the first year only (2007). The results shown below show the advantage in soil quality and yield.

Outdoor Farm Show Site – Woodstock	Soil Test			Moisture	Yield
Treatments (rep average)	**OM** %	**P** ppm	**K** ppm	**%**	**bu/ac**
check	2.9	12	41	28.5	104
10 t/ac solid cattle manure	3.0	16	52	26.3	222
20 t/ac solid cattle	3.1	23	67	26.4	209
4 t/ac broiler poultry manure	3.0	25	54	25.6	227
5 ton compost	3.3	21	51	26.2	229
100 t/ac dairy compost (2007)	3.4	24	46	25.8	213
4 t/ac DDGs	3.1	21	54	25.8	219

Organic Amendments were applied ahead of a corn crop in 2007, 2010 and 2013
Crop Rotation: Corn, Soybeans, Spring Cereals
OM = Organic Matter; DDGs = Dried Distiller Grains
Plots hand harvested October 2013 at COFS (Canada's Outdoor Farm Show Site – Woodstock)

Organic amendments including manure and compost were applied once per rotation since 2007. In this photo, visible differences in crop growth and maturity can be observed in the soybean growth.

7. Plattsville

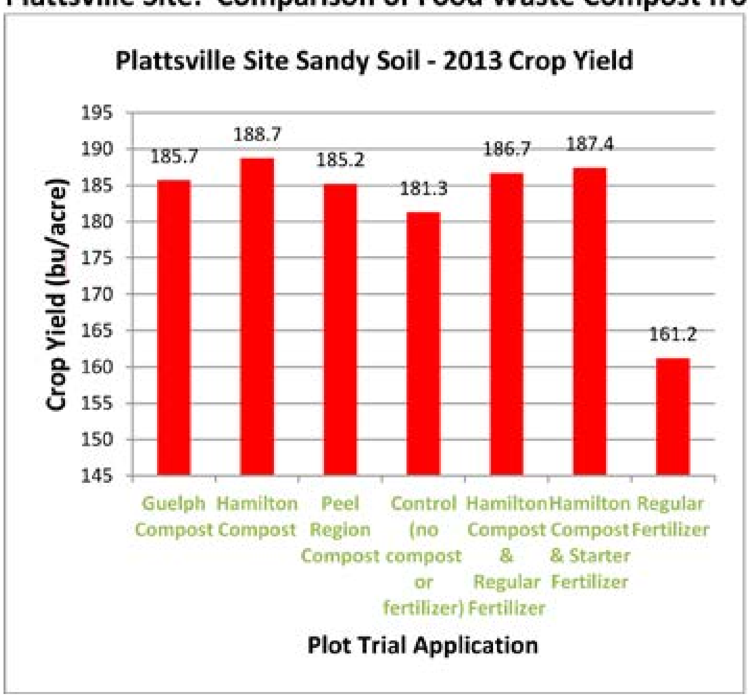
i. Research Conducted during the Years of / with Crops of:

2013: Corn
2014: Soybeans

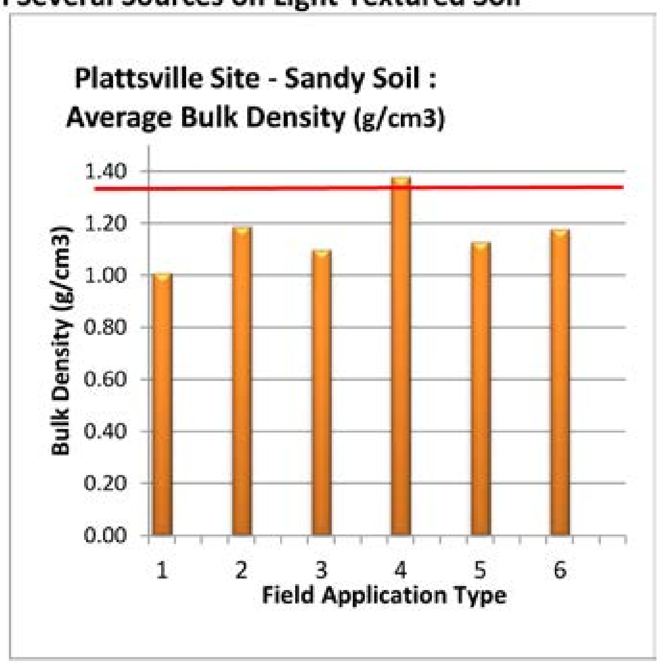
ii. Overview of Research Approach, Observations & Results

The Plattsville site and the Jarvis site had compost from Hamilton, Guelph and Peel Region applied to the same field and same crop and compared to commercial fertilizer to monitor and compare the differences in fertility (crop yield) and determine the impact on soil health characteristics – in this case, soil bulk density. The Plattsville site was a light-textured, sandy soil (burford sandy loam) while the Jarvis site was a heavy-textured Haldimand clay.

Plattsville Site: Comparison of Food Waste Compost from Several Sources on Light Textured Soil



1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4. Control (no compost; fertilizer only), 5. Hamilton compost + fertilizer, 6. Hamilton compost + starter only, 7. Regular fertilizer only

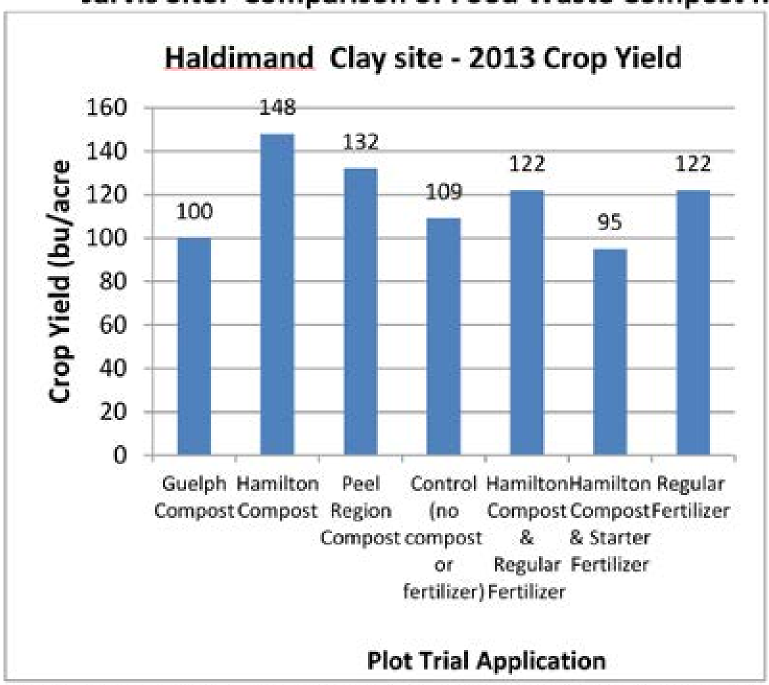


1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4. Control (no compost; fertilizer only), 5. Hamilton compost + fertilizer, 6. Hamilton compost + starter only

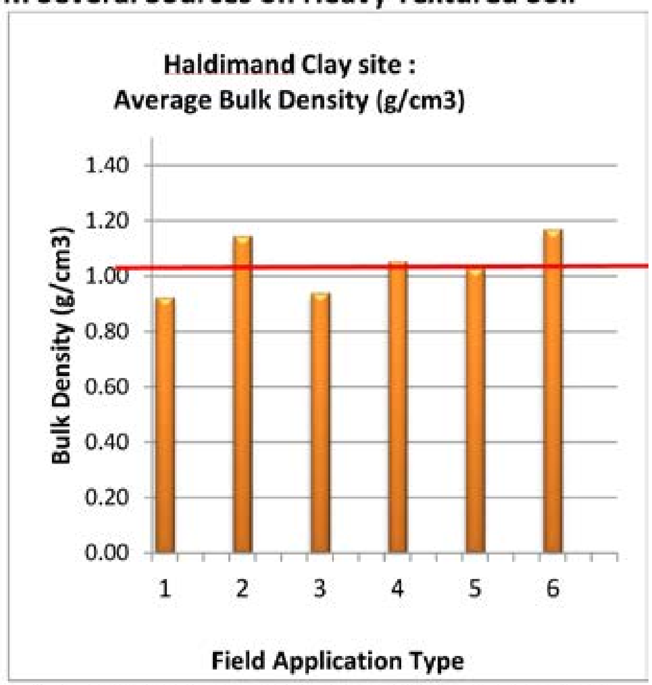
To try and show changes in moisture-holding capacity, several different methods were experimented, however bulk density was chosen to determine if there were consistent differences. Bulk density measures the weight of the soil, where the more dense the soil, the fewer air and water spaces in that soil. A more dense soil weighs more. The bulk density measurements are variable across a field due to field traffic, water movement, ponding, and other site characteristics. The measurements however do show a trend that was more defined in the sandy soil.

The graphs above show bulk density measurements for the Burford sandy loam, and below for the Haldimand clay The control treatments generally are denser (more compact) than for the treatments where compost was applied. This is more evident in the sandy loam than the clay soil. The red line in the graphs show the bulk density of the control treatment where no compost was applied while the treatments with compost had more pore space and were lighter in weight. The higher the reading (weight) the higher the bulk density. Lower numbers indicate more pore space and water-holding capacity.

Jarvis Site: Comparison of Food Waste Compost from Several Sources on Heavy Textured Soil



1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4. Control (no compost or fertilizer), 5. Hamilton compost + fertilizer, 6. Hamilton compost + starter only, 7. Regular fertilizer only



1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4. Control (no compost or fertilizer), 5. Hamilton compost + fertilizer, 6. Hamilton compost + starter only

Frank Peters

Frank Peters began using municipal compost on his small Oxford County farm because of his job.

Peters and his wife bought their farm 10 years ago. It is, he says, a great place to raise their four sons.

About 50 acres are in cash crops and another 30 in hay, with 30 head of beef cattle and four draft horses. The animals didn't produce enough manure to cover the farm and Peters knew all about compost.

As Business Unit Manager at AIM Environmental Group, his work involved marketing the material the company produces from organic wastes in Hamilton and Guelph. Agriculture was the company's only market.

"I used manure and compost from the start," Peters says. "I've been doing trials for six years," including the past three participating in the program being managed by Christine Brown, of OMAFRA.

The tests, in sandy soil on corn, soybeans and hay, have involved a variety of side-by-side comparisons. One year, strips treated with compost were compared with others that received commercial fertilizer and others with no added nutrients. Another year, the tests compared results with compost, bio-solids and digestate from an anaerobic digester. Yet another time, it was compost compared with manure and no treatment.

"With the official trials, we got technical," Peters says. "Before I looked only at yield. Now, we started soil sampling and looking at plant benefits and tissue samples."

Those trials put a lot of emphasis on comparing results using compost, applied at five and 10 tonnes per acre, from a variety of producers, including AIM's Hamilton and Guelph operations and the Region of Peel Composting Facility.

"The results showed there's definitely a benefit to compost," Peters says. "I thought I'd get a bigger change in results with compost, but we did not."

With only compost applied, the Hamilton product produced 148 bushels per acre; the Peel compost, 132 bushels, and the Guelph product, 100. On strips treated with regular commercial fertilizer, the yield was 122 bushels and a test with nothing added produced 109. On the positive side, compost consistently reduced the soil's bulk density, meaning it became fluffier and more aerated.

The results were mirrored each year, Peters says.

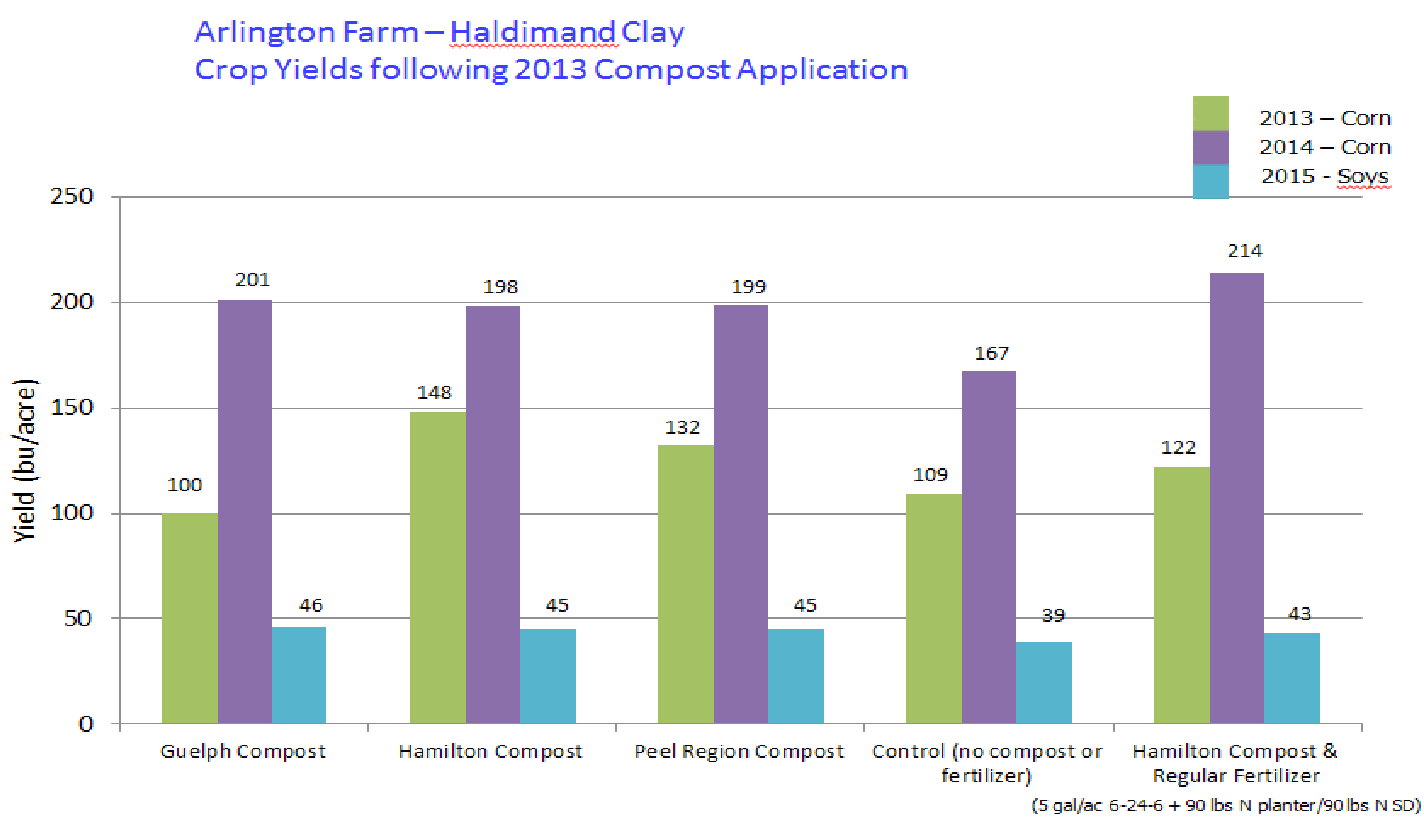
"You find the biggest yield jump on spot land, that's not had organic matter added for a long time."

8. Jarvis Site

i. Research Conducted during the Years of / with Crops of:

2013:	Corn
2014:	Corn
2015:	Soybeans

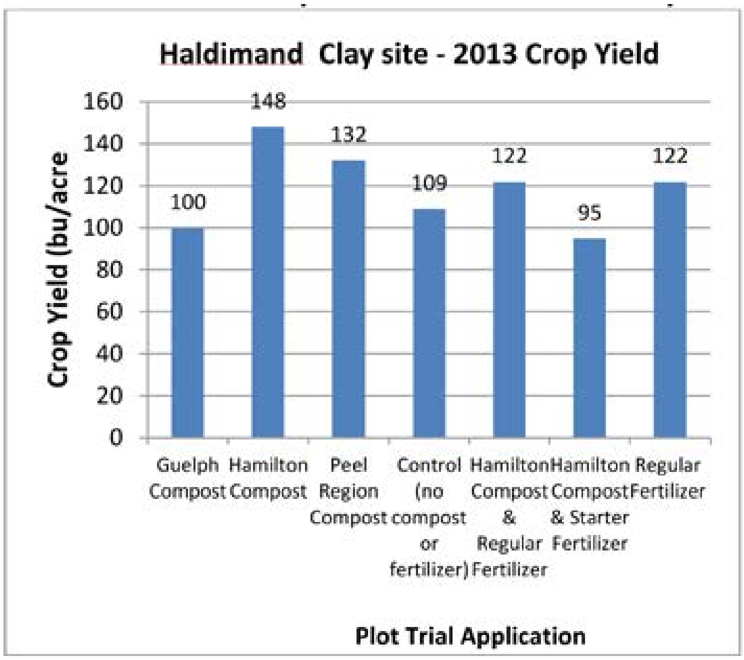
Comparison of Different Greenbin composts compared to no-fertilizer control			
Treatment	2013 **Corn**	2014 **Corn**	2014 **Soybeans**
Guelph Compost	100	201	46
Hamilton Compost	148	198	45
Peel Region Compost	132	199	45
Control	109	167	39
Hamilton Compost + Fertilizer	122	214	43



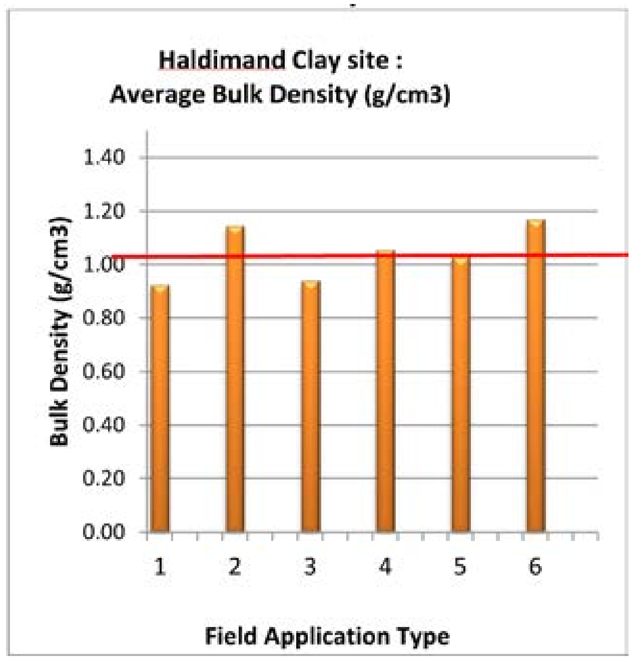
ii. Overview of Research Approach, Observations & Results

Several fields had compost applied, beyond the plots with the treatments. The corn fields planted in heavy clay soils and, in the 2015 growing season, experienced cooler and wetter growing conditions. Higher than normal June and July rainfall resulted in saturated soils and in increased denitrification of nitrate in the soil. Using a Soil Scan 360 (used to measure relative soil nitrate levels), the fields where compost was applied had a greater portion of the nitrogen in organic form -- where mineralization-to-nitrate is based on microbial activity in the soil. This activity is highest when soils are warm and moist (not saturated). The graph below shows the nitrogen release from the compost (red line) while comparing the temperature and rainfall. The release of nitrogen in 2015 occurred well after the highest N requirement from the corn which resulted in late season benefits to yield. The commercial nitrogen treatment suffered from significant denitrification during periods when soils were saturated.

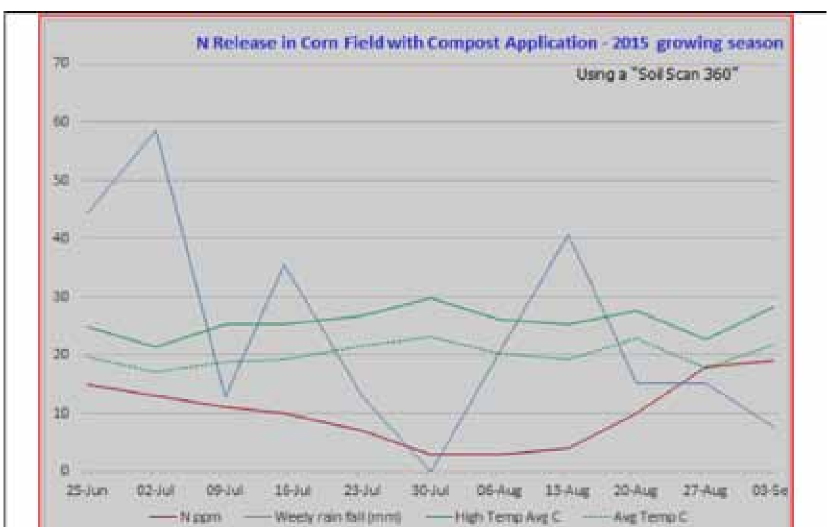
Jarvis Site: Comparison of Food Waste Compost from Several Sources on Heavy Textured Soil



1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4. Control (no compost or fertilizer), 5. Hamilton compost + fertilizer, 6. Hamilton compost + starter only, 7. Regular fertilizer only



1. Guelph compost, 2. Hamilton compost, 3.Peel compost, 4. Control (no compost or fertilizer), 5. Hamilton compost + fertilizer, 6. Hamilton compost + starter only



N –release from compost (red line) in summer 2015 did not occur until after mid-August while corn needs highest in mid-June to early August

Arlington Farms

After using compost for a decade, Mike Lishman is convinced of its benefits.

Now, as part of the Green Bin tests, he wants to dig deeper; to find out exactly what happens within the soil after compost is applied.

“I’m interested in biological activity,” says Lishman, whose 500-acre home farm, in Haldimand Country, 35 kilometres south of Hamilton, has been in his family for more than half a century. “We know that compost has bacteria similar to root enhancements that we put on to stimulate root growth. I want to look further at what’s going on beneath the soil surface. Eighty per cent of the crop yield comes from the roots. I want to know what’s going on below.”

Lishman runs a busy operation, with one full-time employee and part-time help when required. Most of his own land is in a three-year rotation — one year of corn followed by two of soybeans. He also does custom work, such as cultivating, planting and combining, on thousands of acres on neighbouring farms. He also sells and applies fertilizer, compost and manure, and supplies seeds. His father keeps about 150 pigs and 50 sheep for private freezer sales.

He started using compost as an alternative to manure, which he says is a great product but is hard to come by, can contain “unknowns,” and has “issues of public perception, especially when it’s used on rented land.”

After he met Frank Peters of AIM Environmental Group, the company delivered compost it produces in Hamilton from residential source-separated organic wastes of several municipalities. “After a year I saw something was happening,” Lishman says. “AIM had product and I had places to use it, and connections with other farmers, so we started to apply it to our land and custom lands.”

Over the past few years, Lishman has spread about 15,000 tonnes of compost annually. That includes about 1,000 tonnes on his home farm, where each field gets one application of 10 to 15 tonnes per acre every three years, before corn is planted. The compost is incorporated into the heavy clay soil to root depth to help it break down and control odours. The soy goes in, without tillage or additional compost, among the corn stover. Most of the fields have now gone through two full rotations with compost.

Lishman always tests the soil after about a month of growth to see whether nitrogen must be added. With compost, it never does, he says.

Yields and biological activity both increase with compost, Lishman says. There’s more worm activity; “even on cold days you see worms. You can see them pulling leaves into the soil.” Corn is now bred for stability so it’s slower to biodegrade, and the stover can last for years. “But with compost, after a year there’s no stover left. It’s all chewed up.” For the past four years, he has applied compost to 1,000 acres of corn stover at just two tonnes per acre to speed the process.

With the custom work, each farm is different, he says. “Everyone has his own budget. Eighty per cent apply compost at three to five tonnes per acre. That’s affordable and gives a bit of a bang.” On the other hand, some orchards and vegetable crops have compost applied at 25 tonnes per acre.

Lishman is entering the third year of compost tests associated with Christine Brown’s project. “Ours are a bit different,” he says.

On other farms, compost from a single source is compared against chemical fertilizer. Lishman, however, is applying compost from four sources to test plots on his home farm — AIM in Hamilton, the Peel Region Composting Facility, the Orgaworld Canada Inc. facility in London, and the City of Guelph's Organic Waste Processing Facility, also operated by AIM.. This method is part of his quest to understand how compost behaves in the soil. Each type is applied at both five and 10 tonnes per acre and all the crops are planted with a starter fertilizer.

Yield doesn't vary much among the four products, even though Peel's includes leaf and yard waste and they all look and feel different from each other.

"That doesn't surprise me." Lishman says. "When I'm spreading compost, Peel's looks like wood chips, Hamilton's is more like manure, Guelph's is finer and powdery and the material from Orgaworld contains more plastics and other contaminants — "it seems to glisten." But "they are the same product; the nutrients line up."

Still, he says, they all have unique qualities, which need to be studied. "We're looking at biological activity. We take roots to a laboratory where they're crushed and the juice is analyzed for different bacteria."

"I know there are benefits from compost. I'm trying to figure out the benefits we don't see: Does more biological activity and organi c matter release nutrients that would otherwise remain bound up in the soil?"

Lishman compares the economics of compost and commercial fertilizer by calculating the cost of each supplying an equal amount of potassium. By that measure, even with its much higher transportation and application costs, compost is cheaper, especially when the cost for each field is spread over three crop years. It also supplies more nitrogen as well as sulphur, organic matter and the microbial activity.

"The big thing is the added benefits, what we're doing to the soil," he says. "Soil is like a bank account. You need to invest in it for it to pay dividends."

In the shorter term, "if we see a three- or four-bushel increase in yield, that's better than buying another 100 acres."

But the key is the longer term; maintaining and building soil health, he says. For that, compost must be both accepted and available.

Lishman says most of the farmers for whom he supplies compost like the product. They're concerned about logistics and the cost of transportation, but "I've never had a customer take it and not use it again."

Supply is a crucial issue, he says. All of the composting facilities are operating at their capacity, "but we're not using five per cent of the resource. We need the government to put more money in to organics collection programs. Along with that, residents need to put fewer contaminants in their Green Bins. Some municipalities are better at education and enforcement than others, he says. "It has to start at the curb-side."

Equally important, "we need to change the vision of people. The feedstock is not waste. It's an organic amendment. All we're doing is putting stuff that came from the field back in the field. It's a really healthy way to go."

9. Inglewood Site - Caledon

i. Research Conducted during the Years of / with Crops of:

2012: Corn
2013: Corn

ii. Key Findings

Key Findings: Side-by-side comparisons are an excellent method of evaluating practices, however this site demonstrated the importance of uniform field characteristics and replicated comparisons. There was only one replication at this site and the one treatment was in an area where drainage was very poor. The difference in yield results, therefore, was not a true comparison of the potential benefit of compost.

However, there were several observations that were made at this site. When applying the compost, the goal was to apply two application rates using the same spreader. Calibration is very important to determine the exact amount of nutrients applied and to help with future application by noting the tractor settings. The goal was to apply a normal rate and double the normal rate. Application speed was set to be half as fast as the settings for the normal rate. Below is an example of the calibrations taken at the Caledon site.

Half the speed does not give double the rate. The slower speed resulted in a narrower application of 17 ft width instead of 40 ft, which tripled the application rate. This was also observed when different compost products were applied with different bulk densities. The lighter the bulk density of the compost, the wider the application width. Wind direction will also affect application distribution when a material is very low bulk density.

A field with uniform field characteristics including good drainage and replicated treatments will give the best opportunity for accurate results.

An example of calibration – double the speed does not result in double the rate.

Contaminants (plastic bread tags, fruit stickers) continue to be a problem.

Tim Armstrong

Tim Armstrong has the time and patience needed to apply compost.

He spreads manure on his fields at less than two kilometres an hour.

Armstrong, a fifth-generation farmer, runs a 45-head dairy herd and grows hay and 40 acres of corn on his 100-acre home farm and 80 rented acres, north of Brampton.

With such a small operation, “I like taking my time and getting a good spread pattern; a nice even spread,” he says. “I could do it faster, but I’m more patient than most farmers. I can afford to take a week to spread 10 or 20 acres with compost.”

That small scale is one of the factors that give Armstrong, 48, a unique perspective on compost.

He has always used the manure from the cattle on his home farm and also incorporated crop stubble on all his fields to provide organic matter. But he needed more and decided to try compost. Getting it was easier than for most other farmers, since he’s less than three kilometres, or a 45-minute round trip, from his source — free for the test — the Region of Peel Composting Facility in Caledon. He drives his manure spreader to the facility to pick up loads, six tonnes at a time. The material is Peel’s mix of residential source-separated organics and leaf and yard waste. He could have had the supply trucked, but “I drove since it was so close and for such a small plot.”

Armstrong began the four-year trial in 2011, with the plan to spread compost only in that first year. That’s part of the test protocol, intended to determine the future residual impacts of compost. Two half-acre plots were treated at a rate of nine tonnes per acre plus 50 pounds of commercial fertilizer, for nitrogen. Two more received a “high rate” of 22 tonnes of compost, with no commercial fertilizer. Two check plots got commercial fertilizer at the recommended rate.

In that first year, with corn planted on the test plots, the check plots produced 148 and 151 bushels per acre, while those with the high compost rate produced 156. The plots treated with the low rate of compost came in at only 138 bushels, but Armstrong notes that their production was reduced by problems with excess moisture at the end of one field.

Corn was planted again in 2012 and 2013. No compost was applied and all the plots got the recommended application of commercial fertilizer. The results showed a residual impact from the compost, although the differences in yield narrowed each year.

Last year, a wetter summer, Armstrong planted soybeans in all the test plots, again with the recommended application of fertilizer and no additional compost.

The plots that had received the heavy compost application in 2011 produced 1,368 pounds of soybeans. The low-compost plots yielded 1,278. The check plots came in at 1,360 and 1,345 pounds. Those results are not statistically significant, Armstrong says. “It’s the same pattern every year, but the variability goes down.”

From all of this Armstrong concludes that, “it’s very beneficial to put compost on if you don’t have manure.” Cattle manure contains more nutrients than the compost and his supply is free. Compost would cost $5 per tonne plus transportation if he were obtaining it outside the trial, and it also takes more time to spread.

“It’s too expensive after you haul and spread it. Most farmers will just want to call their commercial fertilizer provider,” who will do their fields in a couple of hours.

The price of compost might be $5 to $15 lower than commercial fertilizer per acre but trying to compare it is difficult, he says. Fertilizer has a huge time advantage, and it releases its nutrients more quickly and predictably. Compost provides organic matter and microbial activity, which are hard to put a price on. It also holds moisture, but the value of that benefit depends on the type of soil and whether the growing season is wet or dry.

“It’s tough to say what’s good and bad. But if it’s a drought year, that’s where compost really shines.”

In any case, if weather permits, he plans to apply compost on hay this year on land outside the test area. His aim is to get a better quality, higher nutrient product to sell to people with horses on nearby farms and rural estates.

“I’ve never tried compost, but with fertilizer, you get more nutritious hay,” he says. “We’ll see the results. The more you put into your soil, the more you’ll get out of your crops.”

Overall, Armstrong says, compost is a good idea, but it might be too expensive and time-consuming for most farmers under the current circumstances. “With the cheap-food policy, it’s getting tougher and tougher.”

There’s plenty of potential to produce compost from organic wastes, and it would be preferable to have it produced near farms, to cut the transportation cost. “They’d have a better participation rate from farmers,” he says. For now, “most farmers will just want to call their commercial fertilizer provider,” who will do their fields in a couple of hours.

Even better, Armstrong suggests, compost should be free. “By using it, the farmer is doing a good thing, and helping the environment. You’re putting it back into the soil that you’ve taken the products from.

“We’re doing a favour to the public. You don’t want to haul organic wastes to landfill.”

10. Orton Site

i. Research Conducted during the Years of / with Crops of:

2012: Corn
2013: Corn
2014: Soybeans

ii. Compost Analysis

Compost Analysis			
Sample ID: RP012/**M3B**			
For: Region of Peel Compost Farm:			
Reported Date: April 18, 2012			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Bulk Density (kg/m3)	325		
Sulfur (ppm)	2007.2		4.01
Dry Matter (%)	68.5		
Nitrogen (total) (%)	1.92	38.3	13.3
NH4-N (ppm)	1,418	2.8	2
Conductivity (@ 25 degrees C) (ms/cm)	5.34		
Phosphorus (total) (%)	0.55		20.24
Potassium (total) (%)	0.84		18.14
Organic Matter (%)	54.1		741
Carbon:Nitrogen Ratio (C:N)	16:1		
Sodium (%)	0.41	8.2	8.20
Aluminum (ppm)	776.1		1.55
Boron (ppm)	13.0		0.03
Calcium (%)	4.42	88.3	88.40
Copper (ppm)	19.7		0.04
Iron (ppm)	1720.4		3.44
Magnesium (%)	0.30	5.9	6.00
Manganese (ppm)	92.7		0.19
Zinc (ppm)	53.3		0.11

Compost Analysis			
Sample ID: RP012/**M3B**			
For: Region of Peel Compost Farm:			
Reported Date: April 18, 2012			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Bulk Density (kg/m3)	325		
Sulfur (ppm)	2007.2		4.01
Dry Matter (%)	68.5		
Nitrogen (total) (%)	1.92	38.3	18.2
NH4-N (ppm)	14.18	2.8	
Conductivity (@ 25 degrees C) (ms/cm)	5.34		
Phosphorus (total) (%)	0.55		20.24
Phosphate (P as P2O5) (%)	1.26	25.2	
Potassium (total) (%)	0.84		18.14
Potash (K as K2O) (%)	1.01	20.1	
Organic Matter (%)	54.1		1082
Carbon:Nitrogen Ratio (C:N)	16:1		
Sodium (%)	0.41	8.2	8.20
Aluminum (ppm)	776.1		1.55
Boron (ppm)	13.0		0.03
Calcium (%)	4.42	88.3	88.40
Copper (ppm)	19.7		0.04
Iron (ppm)	1720.4		3.44
Magnesium (%)	0.30	5.9	6.00
Manganese (ppm)	92.7		0.19
Zinc (ppm)	53.3		0.11

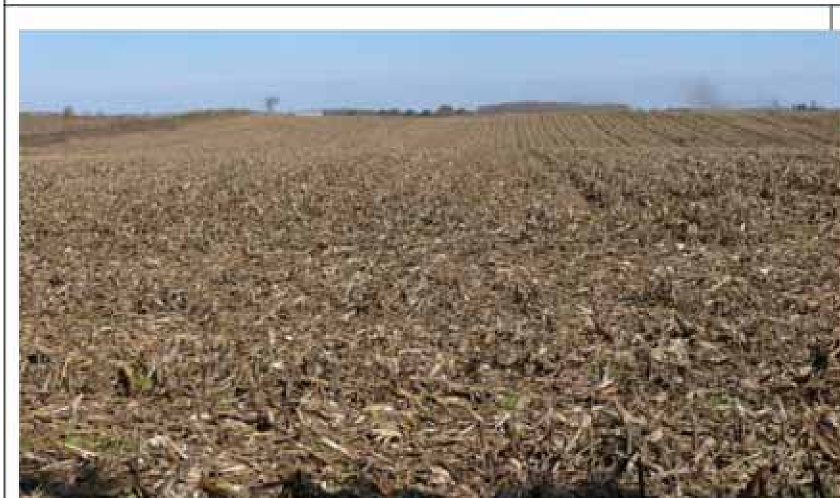
Compost Analysis			
Sample ID: RP012/**M3A**			
For: Region of Peel Compost Farm:			
Reported Date: April 18, 2012			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Bulk Density (kg/m3)	473		
Sulfur (ppm)	1716.6		3.43
Dry Matter (%)	67.22		
Nitrogen (total) (%)	1.96	39.3	16.3
NH4-N (ppm)	2011	4	
Conductivity (@ 25 degrees C) (ms/cm)	5.87		
Phosphorus (total) (%)	0.37		13.62
Phosphate (P as P2O5) (%)	0.85	17.1	
Potassium (total) (%)	0.77		16.63
Potash (K as K2O) (%)	0.92	18.5	
Organic Matter (%)	53.1		1062
Carbon:Nitrogen Ratio (C:N)	15:1		
Sodium (%)	0.38	7.5	7.60
Aluminum (ppm)	627.3		1.25
Boron (ppm)	10.7		0.02
Calcium (%)	2.75	54.9	55.00
Copper (ppm)	17.4		0.03
Iron (ppm)	1400.7		2.80
Magnesium (%)	0.23	4.7	4.60
Manganese (ppm)	60.8		0.12
Zinc (ppm)	42.9		0.09

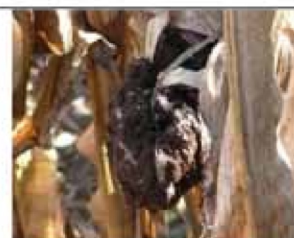
Soil Test: Nov 1, 2011 (pre-application)		
pH	6.9	
OM	2.9	%
P	25	ppm
K	136	ppm
Mg	145	ppm
Na	8	ppm
S	11	ppm
Zn	2.9	ppm
Mn	49	ppm

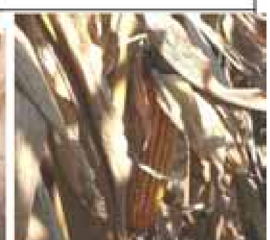
Soil Test: October 22, 2012

Treatment	pH	P ppm	K ppm	OM %	Sulphur ppm
Fertilizer Check	6.1	35	74	2.0	11
14 T compost	6.2	42	159	2.3	14
10 T compost	6.3	31	125	2.4	14
10 T compost	6.7	25	128	3.1	12
14 T compost	6.6	28	114	2.8	12
Fertilizer check	7.3	32	122	2.6	11

Harvest Date: Oct 22, 2012
Corn Variety: DeKalb 34-27
Starter: 4-22-13 + 4 magnesium + 1.4 zinc @ 110 lbs/ac
Fertilizer: 46 – 0 – 0 @ 250 lbs/ac (115 lbs actual N)







Treatment	Field Length (ft)	YIELD (bu/ac @ 15.5%)	Moisture (%)	Test Weight (lbs/bu)	Comments
Fertilizer – no compost	---	**< 100**	---	---	• Weedy (grasses) • Sandy soils – evidence of moisture stress in several spots in field • High amount of smut (black dust from combine)
14 T compost	2056	**103.4**	21.1	56.0	
10 T compost (+ N)	2056	**105.7**	22.0	53.9	
10 T compost (+ N)	2056	**104.7**	21.2	55.3	
14 T compost	2056	**105.6**	20.1	55.3	
Fertilizer – no compost	1884	**102.0**	20.7	55.4	
Chicken Manure + compost + 119 lbs N	1884	**91.8**	21.3	54.7	

Treatment	Moisture	Yield
Compost	21.1	104.75
Fertilizer – no compost	20.7	< 102.0

iii. Overview of Reserch Approach, Observations & Results

The soils at this farm are very light and the topography is rolling. The treatments consisted of two rates of compost; 14 T/ac and 10 T/ac with additional nitrogen to meet crop needs which was compared to a fertilizer-only check. One extra other treatment at harvest included chicken manure with compost. The key finding at this site revealed a good crop response where compost was applied. Where chicken manure (which is a rich source of nitrogen) was applied along with compost, there was a yield reduction because too much nitrogen was applied. Field variability, especially in pH levels, across the field made in-depth analysis of this field difficult.

Wayne Cunningham

Wayne Cunningham started with discarded mushroom beds when he ventured into using compost for the 500 acres he farms near Georgetown, northwest of Toronto.

He was rotating three crops — corn, soybeans and winter wheat — on his light, sandy, relatively dry soil, and needed organic matter. With the shift from mixed farming to cash crops, manure was no longer available within a reasonable distance.

A decade ago, a neighbour who worked with a nearby mushroom grower suggested Cunningham try the fertilized straw in which commercial producers raise the fungus. Discarded after a single crop, it would cost next to nothing, except for trucking.

Its performance on his crops was “decent,” Cunningham recalls. But the straw contained tough baling string that got caught in his spreader and had to be cut out with a knife a couple of times a day.

He needed something better.

Five years ago, on a tour of Peel Region’s composting operations, organized for the local Soil and Crop Association, he met OMAFRA’s Christine Brown, who invited him to join the compost trials she was organizing.

Cunningham, who has farmed for 30 years, agreed. Now, he has completed field trials of Peel Region’s mix of leaf and yard waste and Green Bin source-separated organic wastes on a complete three-cycle rotation.

The plan, he says, was to apply the compost in varying amounts on carefully measured strips of land covering a total of 10 acres. It would go on just once, in the first spring of the trial, before he planted corn.

“Chris’s theory was to put it on one time every three years. Corn is usually the crop you need to feed the most. Then we’d see the benefit to the soy and wheat.

“The main aim was to find out how much to use. There’s no use dribbling a wee bit of compost on, but don’t overdo it.”

The conclusion: For Cunningham, a “relatively light” covering of about 10 tonnes per acre achieved the right balance between too little and too much. “You need the 10 tonnes to get enough nutrients to justify it,” he says. His typical corn yield is 140 bushels per acre. The amount of compost that should be applied would likely be higher in areas where better soil or more heat and sunshine, produce bigger, faster growing crops that demand more nutrients.

For the trial, Cunningham applied the compost in spring, just before planting the corn with nitrogen starter.

On the rest of his farm, not part of the formal trial, he continues to apply it in the fall, after the winter wheat harvest, using a standard manure spreader. At the same time, he plants a variety of cover crops, including oats, peas, crimson clover and radish, to provide organic material, hold the soil nutrients and prevent wind and water erosion. This schedule — which, Cunningham says, "gives the bugs in compost a chance to get working:" — sets up the soil for the spring planting of corn.

Using compost reduces but doesn't eliminate the need for chemical fertilizers, Cunningham says. "I don't think we can use it alone." The Peel Region compost is relatively low in nitrogen, and much of that nutrient is consumed in breaking down the carbon. Commercial fertilizers also provide a more predictable release of nutrients, and the ability to provide a quick shot when required, just like a runner needs to gulp a bottle of water after a race, he says. "You have no real way of knowing when the nutrients in compost are available." Part of the trial is to get a better understanding of that issue.

As a result, he uses nitrogen, broadcast just before planting and also applied as a starter with the seeds, "to get the corn out of the ground." Wheat also needs additional nitrogen, and soybeans benefit from a light application of potassium and phosphorus before planting.

Still, "if there's 20 or 25 pounds of potassium and phosphorus in a ton of compost, that's fertilizer I don't have to buy."

"If it costs me $20 per tonne to get compost to my field, it's worth $16 to $18 for those nutrients, but I also get better moisture retention and microbial activity," he says. "I'm not sure how you put a value on that."

"Worm activity is extreme now. There are literally thousands of worms. Water retention and soil tilth are better. The soil smells better."

Cunningham says he views compost as a replacement for manure. "Analysis shows it's very similar in nutrient content. If I was sitting next to a chicken or pig farm I wouldn't need it. But I don't have manure. "

Using compost, along with minimal tillage, is part of his effort to rebuild his soil — a widespread issue across Southern Ontario. "We've got to start rebuilding the soil or it will turn into a desert. Any time you till a field you start breaking down the carbon base, and eventually, it's gone."

"I farm to build my soil. You only get out of it what you put back into it."

On top of that, he supports recycling of organics and any other wastes. "I hate seeing anything dumped into waste. I'm a firm believer in recycling everything you can."

"Short-term I'm not going to get a big result. The next generation will, if they keep farming this land."

11. Thorndale Site

i. Research Conducted during the Years of / with Crops of:

2013: Strawberries
2014: Strawberries

ii. Compost Analysis

Feedstock: **Greenbin compost**

Compost Analysis			
Sample ID: ORGA - Thorndale PLOT			
For: Greenbin Compost Farm:			
Reported Date: June 14, 2013			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Bulk Density (kg/m3)	462		
Sulfur (ppm)	2085.8		4.17
Dry Matter (%)	67.8		
Nitrogen (total) (%)	2.49	49.8	26.4
NH4-N (ppm)	2623	5.2	
Conductivity (@ 25 degrees C) (ms/cm)	8.81		
Phosphorus (total) (%)	0.53		19.50
Phosphate (P as P2O5) (%)	1.22	24.2	
Potassium (total) (%)	0.69		14.90
Potash (K as K2O) (%)	0.83	16.7	
Organic Matter (%)	45		900
Carbon:Nitrogen Ratio (C:N)	10:1		
pH	6.1		
Sodium (%)	0.78	15.6	15.6
Aluminum (ppm)	2028.9		4.1
Boron (ppm)	14.8		0.03
Calcium (%)	2.66	53.3	53.2
Copper (ppm)	27.7		0.06
Iron (ppm)	2089.2		4.2
Magnesium (%)	0.34	6.9	6.8
Manganese (ppm)	120.0		0.24
Zinc (ppm)	152.8		0.31

Feedstock: Leaf & Yard Compost (2015)

MANURE ANALYSIS			
Sample ID: Leaf & Yard Compost Lab Number: 1278005			
For: Thorndale site			
Reported Date: May 13, 2014			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Dry Matter (%)	61.7		
Nitrogen (total) (%)	0.98	19.50	-0.5
NH4-N (ppm)	142	0.30	
Phosphorus (total) (%)	0.21		7.73
Phosphate (P as P2O5) (%)	0.48	9.60	
Potassium (total) (%)	0.53		11.45
Potash (K as K2O) (%)	0.64	12.70	
Organic Matter (%)	30.2		
pH	8.10		
Carbon:Nitrogen Ratio (C:N)	17:01		
Bulk Density (as received) kg/m3	596.00		
Sulfur	1170.80		2.34
Conductivity (@ 25 degrees C) (ms/cm)	3.15		
Sodium (%)	0.07	1.50	1.40
Aluminum (ppm)	2182.80		4.37
Boron (ppm)	15.00		0.03
Calcium (%)	3.70	7.39	74.00
Copper (ppm)	35.50		0.07
Iron (ppm)	5644.30		11.29
Magnesium (%)	0.79	15.90	15.80
Manganese (ppm)	219.20		0.44
Zinc (ppm)	251.00		0.50

Treatment Averages	2 T/ac greenbin	0 T/ac (South)	4 T/ac greenbin	0 T/ac (North)
Berries per plot – 5 harvests	119	87	97	74
Average weight /berry (g)	22.2	21.9	20.4	21.0
Total weight - 5 harvests (g)	2,725	2,325	2,118	1,844
2014 % Winterkilled plants	8	3	16	4

iii. Overview of Research Approach, Observations & Results

Compost has a good fit with horticultural crops since there is always a need for organic matter. The Thorndale site enabled compost to be applied at 2 rates (2 T and 4 T/ac) while establishing the beds. The early results showed a very good response to compost with bigger and more berries. The winter season stressed the crop with record low temperatures (-22°C) and resulted in significant winter kill to the crop. The winter kill was higher in the 4 T/ac compost bed and lowest in the check treatment. The mineralization of organic nitrogen most likely affected fall dormancy and left those plants more vulnerable to the cold.

Key Findings: Foodwaste greenbin compost is nutrient rich and higher in sodium, increasing the risk to a high value crop like strawberries. A leaf & yard waste compost that is not as nutrient rich is likely a better fit in horticultural crops such as strawberries. In 2015, leaf & yard compost was applied during the summer to an oat cover crop ahead of establishing the beds. This will improve soil health without impacting winter hardiness.

Compost application (June 5, 2013)

Incorporation of compost into beds using a roto-tiller.

Re-shaping the beds

Securing the plastic and irrigation drip tape

Compost
before application

Strawberry beds just planted

Future: Established beds yielding fruit

Rudy Heeman

Rudy Heeman is unique among the farmers participating in the municipal compost trials: The most important crop on his farm, just east of London, is strawberries, not cash crops, and that's what he tested.

The Heeman family has been farming in Thames Centre since 1963. Rudy, along with his wife Florence, now grows crops on 300 acres of clay-loam soil. With his parents, Bill and Susan, sister Rita and son Will, along with numerous staff, they also operate a greenhouse and garden centre.

Strawberries are the highest-value crop in the farm's rotation, which also includes corn, soybeans, edible beans and wheat, with cover crops to provide organic matter and hold the soil. Heeman grows 50 acres worth of strawberries every year, including some pick-your-own; moving them around so they're planted in the same location only once every eight years.

It's a complex operation, Heeman says. "We try to keep the farm in a good rotation. We meet whatever the fertility demands are for the crop. I always try to plan the rotation out three or four years down the road."

One third of the strawberries are the day-neutral variety, which means they keep blooming and producing fruit throughout the summer and into October. They are planted as early as possible in the spring, harvested that season, over-wintered, harvested again the following season, then ploughed in, to be replaced by another crop.

Before getting involved with the compost trials, Heeman used only water-soluble commercial fertilizer; precisely applied through drip hoses to meet his plants' carefully monitored needs, based on biweekly tissue samples.

The trials were done on 300-foot strips. Two strips had compost applied; one at 4,000 pounds per acre, the other at 8,000 pounds — a total of 16 tonnes from the Orgaworld Canada Ltd. Facility in London.

The compost was spread only once – before the plants went into the ground. It was roto-tilled into rounded mounds which were then covered with plastic. The strawberries were planted through the plastic.

Two check strips were created in the same way, but with the normal use of fertilizer and no compost. Neither compost nor fertilizer was applied to any strips during the second year of the trial.

Heeman says he didn't see much impact on yield from the compost. But in terms of general plant health, the 8,000-pound rate of compost application was too high, he says. "We had some unhealthy salt build-up," and "some mortality during the first four to six weeks. But once the plants were established they were fine."

However, the plants on the strips that received 4,000 pounds per acre of compost fared as well as those on the check strips.

Heeman didn't have to pay for the compost or its transportation, and he hasn't worked out the economics if he had to cover those costs.

But he has concerns about the material.

In the first place, he says, while he might use it to improve long-term soil health, similar to how he employs cover crops, it couldn't replace fertilizer as an immediate source of nutrients. "Strawberries are a high-value crop and their nutrient needs can change quickly. That's why we do tissue tests biweekly and adjust the fertilizer application according to the results. With compost, it's not precise enough. We need the precision of fertilizer; not the hit and miss of compost."

In addition, he wouldn't use it in any manner if it were like the sample he got for the trials: "There was a lot of plastic in it; tags and food stickers. I wouldn't buy the stuff.

"I'd consider using it if it was clean. But who's guaranteeing what I'm getting? Once it's dumped on your property, it's yours. They won't take it back."

12. Oakland Site – Norfolk

The Oakland and Byng sites were Ontario Soil and Crop Improvement Association projects initiated base on interest in the application of greenbin compost to agricultural land.

i. Application Details

Site Location: Jenkin Rd between Smith Hill Rd and Cockshutt Rd.

Treatments	plot length ~ 1,560 ft	
14	30 lbs Commercial N	36 ft
13	% 100 of normal N as Commercial N	36 ft
12	3/4 compost - (~8 ton/ac – no additional N)	36 ft
11	$\frac{3}{4}$ compost + $\frac{1}{4}$ Commercial N - (~8 ton/ac + N)	36 ft
10	30 lbs Commercial N	36 ft
9	100 % of normal N as Commercial N	36 ft
8	3/4 compost - (~8 ton/ac – no additional N) x 3 x 4	36 ft
7	$\frac{3}{4}$ compost + $\frac{1}{4}$ Commercial N - (~8 ton/ac + N) x 5 x 1	36 ft
6	High rate of compost x 2 x 5	36 ft
5	3/4 compost - (~8 ton/ac – no additional N) x 1	36 ft
4	$\frac{3}{4}$ compost + $\frac{1}{4}$ Commercial N - (~8 ton/ac + N) x 5 x 2	36 ft
3	High rate of compost - No additional N x 3 x 4	36 ft
2	100 % of normal N as Commercial N	36 ft
1	30 lbs Commercial N	36 ft?

N

Compost applied April 24th

Analysis:	**Total Nutrients**		**Available Nutrients**
Dry matter:	48.7%		
Total N:	1.53 %	30.6 lbs/ton	
Ammonium N	2100 ppm	4.2 lbs/ton	~ 3 lbs/ton
Organic N	1.32 %	26.4 lbs/ton	~ 8 lbs/ton
Phosphorus	0.22 %		~ 8 lbs/ton P205
Potassium	0.36 %		~ 8 lbs/ton K20
Calcium	1.49 %		~ 30 lbs/ton
pH	5.0		
C:N rotio	14:1		
Organic Matter	38.5 %		

Calibration:

Bag (sheet) Measurement = 40 x 48 inches or 0.0003061 acres (3267 bags fit into 1 acre)

3/4 rate compost measurements:	**Rate in tons/ac**	**Available Nutrients (N-P-K)**
4.5 lbs	7.35	81 – 59 - 59
8.7 lbs	14.2	156 – 114 - 114
0.25 lbs (1st load – spreader not working properly)	0.41	5 – 3 - 3
3.8 + 0.25 + 0.55 lbs**	6.21 + 0.41 + 0.90	83 – 60 - 60
4.25 lbs	6.94	76 – 56 - 56
3.75 lbs	6.13	67 – 49 - 49
3.75 lbs	6.13	67 – 49 - 49
4.26 lbs AVERAGE	6.95 ton/ac	76 – 56 – 56

High rate compost measurements:	**Rate in tons/ac**	**Available Nutrients (N-P-K)**
9.0 lbs	14.7	162 – 118 - 118
6.2 lbs	10.1	111 – 81 - 81
15.3 lbs (high rate behind spreader)	25.0	275 – 200 - 200
10.5 lbs	17.2	189 – 138 - 138
10.25 lbs AVERAGE	16.74	184 – 134 – 134

Observations and comments:

- Spreader application was approximately 60 ft
- 3.8 was rate applied without overlap; 0.25 lbs from far load and 0.55 from load beside plot
- From original plot design: switched the full N rate with the low commercial N rate so that overlap doesn't add more nitrogen than anticipated. Changed the 125% to 100% since overlap will add 5-15 lbs of additional N to the full N rate plot.
- Field length where compost was applied was about 1560 ft.
- Compost consistency was very good, but additional calibration needs to occur so that clumps coming from the paddles are more evenly distributed. Application rate is highest right behind the spreader.
- Plastic contaminants are too high for long-term application. This should improve over time with continued consumer education.

Treatment	November Soils						Moisture	Test Wt	**Yield**
	pH	P	K	OM			%	lbs/bu	**Dry bu/ac**
140 lbs N	6.7	33	110	3.0			18.6	56.7	223.4
30 lbs N	6.7	26	103	3.3			18.9	56.0	183.5
High compost	6.7	36	97	3.5			18.4	56.7	220.9
8 Tonne Compost + 72 lbs N	6.4	33	81	3.0			18.3	56.8	222.8
8 Tonne Compost	6.8	24	60	2.7			18.9	56.8	203.8
High Compost	7.0	14	70	2.8			18.6	57.0	219.9
8 Tonne Compost + 72 lbs N	6.7	17	71	2.9			18.6	56.0	223.6
8 Tonne Compost	6.5	26	87	2.8			18.5	57.2	191.1
140 lbs N	6.3	34	85	2.9			18.5	56.0	222.3
30 lbs N (Narrow)	6.3	28	89	3.5			18.4	56.8	185.2
8 Tonne Compost + 72 lbs N	7.0	48	106	3.8			18.5	56.2	217.9
8 Tonne Compost	7.2	19	93	3.6			18.8	56.6	201.9
140 lbs N	6.5	35	75	3.5			18.8	56.1	188.0
30 lbs N	6.5	33	69	2.8					
No alpine									
With alpine									
Average									
140 lbs N	**6.5**	**34**	**90**	**3.1**			**18.6**	**56.3**	**221**
30 lbs N	**6.5**	**29**	**87**	**3.2**			**18.8**	**56.1**	**185**
High Compost	**6.7**	**25**	**84**	**3.2**			**18.5**	**56.9**	**219**
8 Tonne Compost + 72 lbs N	**6.7**	**33**	**86**	**3.2**			**18.5**	**56.3**	**220**
8 Tonne Compost	**6.8**	**23**	**80**	**3.0**			**18.7**	**56,9**	**198**

Spring soil sample:

pH	6.1
OM	3.3
P	25
K	86

13. Byng Site - Haldimand

i. Research Conducted during the Years of / with Crops of:

2010: corn

ii. Amendments Analysis

Turkey Manure analysis		Total Nutrients	Available Nutrients
DM	59.8 %		
Total N	3.32 %	66.4 lbs/ton	~23 lbs/ton N late winter applied
NH4-N	7000 ppm	14.0 lbs/ton	~25 lbs/ton N spring applied
Phosphorus	1.33 %	48.9 lbs/ton P205	~25 lbs/ton P205
Potassium	1.61 %	34.8 lbs/ton K20	~35 lbs/ton K20
C:N	8:1		
O.M.	47.2 %	944 lbs/ton	
Calcium	2.02 %	40.4 lbs/ton	
Magnesium	0.50 %	10.0 lbs/ton	

Compost applied April 24th

Analysis:		Total Nutrients	Available Nutrients
Dry matter:	48.7%		
Total N:	1.53 %	30.6 lbs/ton	
Ammonium N	2100 ppm	4.2 lbs/ton	~ 3 lbs/ton
Organic N	1.32 %	26.4 lbs/ton	~ 8 lbs/ton
Phosphorus	0.22 %		~ 8 lbs/ton P205
Potassium	0.36 %		~ 8 lbs/ton K20
Calcium	1.49 %		~ 30 lbs/ton
pH	5.0		
C:N rotio	14:1		
Organic Matter	38.5 %		

Biosolids analysis:

Dried Dewatered Material

27.3 % Dry Matter

65 lbs/ac available N (NH4-N + NO3-N)

238 lbs/ac Organic N (~48 lbs/ac available in year of application)

200 lbs/ac Total P (~ 160 lbs P205 of which ~85 lbs are available in year of application)

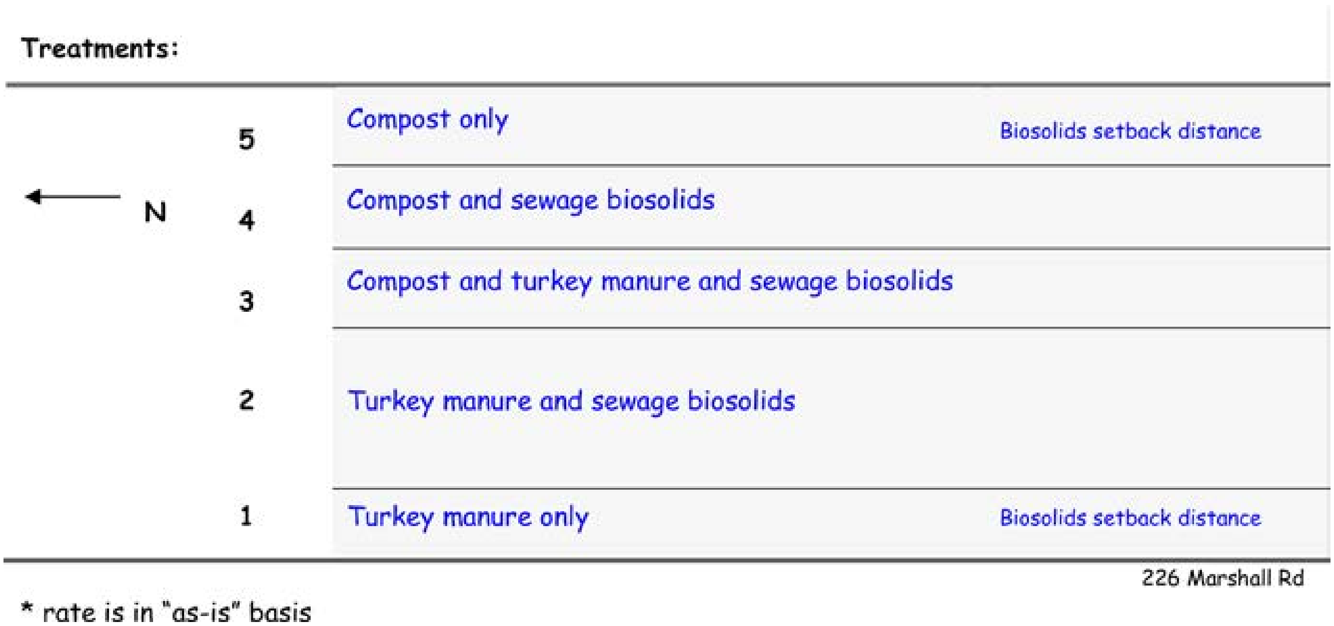
iii. Overview of Research Approach, Observations & Results

The results of the two sites compared demonstrated that, in the 2010-growing season, the greenbin compost behaved similarly to what would be expected from solid livestock manure. Yield results were similar to manure applied to meet two thirds to three quarters of the nitrogen needs. Organic matter additions will help build soil organic matter and lead to long term sustainable soil health, but improvements maybe difficult to measure in the short term.

To put organic matter contribution into perspective using book values: It would take 35 years to build soil organic matter by 1 % by adding 8 tons of greenbin compost once-per-rotation-plus-crop-residues compared to 60 years it would take to build SOM by 1 % by just returning crop residues.

Calculations assumed a fine textured (clay) soil with 3 % soil organic matter (SOM) where all crop residues and roots are returned to the soil in a corn-soybean-wheat rotation and where ~1 ton carbon (~ 8 ton greenbin compost at 45% dry matter content) added once per rotation (once in 3 years) and assuming a 2% decomposition rate. This would result in a 0.03% increase in SOM per year.

Co-operator: Byng site
Site Location: Lot: 13 Conc: 4 Twp: Town of Dunnville (42.856130, -79.641790)



- Biosolids will provide ~ 65 lbs available NH4-N and NO3-N + ~48 lbs from Organic N; 83 lbs available P205 and < 10 lbs K20
- Farm has been in pasture for past 30 years. Worked 2009 and planted to soybeans
- Soil test 8 ppm for P and K was low (another soil sample taken May 4)

Compost Application: May 3rd 2010

Sample weights 1st & 2nd pass (5th gear) Knight side-slinger spreader (application goal = 8 ton/ac)

			overlap		Total application (ton/ac)	
1	7 paces from edge of spreader	2.5 lbs	4 paces	22.7 lbs	4.1 ton + 37.1 ton =	41.2 ton/ac
2	10 paces (30 ft)	1.2 lbs	6 paces	6.5 lbs	1.7 ton + 10.6 ton	12.3 ton/ac
3	3 paces (10 ft)	19.65 lbs		none	32.1 ton + 0	32.1 ton/ac
4	5 paces (15 ft)	12.7 lbs	1 pace	2.8 lbs	20.7 ton + 4.6 ton	25.3 ton/ac
5	8 paces (24 ft)	1.75 lbs	5 paces	11.25 lbs	2.9 ton + 18.4 ton	21.3 ton/ac
	Average	7.6 lbs		8.65 lbs	12.4 ton + 14.1 ton	26.5 ton/ac

Sample weights 3rd & 4th pass (10th gear) Knight side-slinger spreader (application goal = 8 ton/ac)

	Distance from spreader	overlap		Total application (ton/ac)
1	6 paces from edge of spreader	11 paces	5.3 lbs	8.7 ton/ac
2	4 paces	10 paces	10.25 lbs	16.7 ton/ac
3	1 paces	6 paces	3.5 lbs	5.7 ton/ac
4	3 paces	9 paces	10.6 lbs	17.3 ton/ac
5	2 paces	7 paces	11.25 lbs	18.3 ton/ac
	Average		8.18 lbs	13.36 ton/ac

Knight Side-slinger 5th gear (application goal = 8 ton/ac)

30	25	20	15	10	5	0 ft	distance (feet) from spreader
2	3	2.5	21	32		5	tons/ac measured

Average Rate Applied = 12.5 ton/ac

Treatment	lbs N Applied (all sources)		P_2O_5 lbs	K_2O applied	Moisture %	Test Wt lbs/bu	Yield Dry bu/ac
Compost only	148 + 56 =	204	139	139	20.5	56.1	189.9
Compost + Biosolids	148 + 113 + 56 =	317	300	147	21.0	56.0	191.5
Turkey Manure (spring) + Biosolids	138 + 113 + 56 =	307	460	230	20.2	56.7	197.6
Turkey Manure (winter) + Biosolids	127 + 113 + 56 =	296	460	230	19.2	---	202.5
Turkey Manure only	138 + 56 =	194	300	222	19.3	---	199.7
Average					**20.04**	**56.3**	**196.6**

Treatment	November nitrates NO_3-N + NH_4-N	lbs N		Summer Nitrates NO_3-N + NH_4-N = lbs N	November Soils pH P K OM
Compost only	11.4 + 2.7	56		7.2 9 149 4.9	7.2 9 149 4.9
Compost + Biosolids	9.3 + 3.9	53		6.1 11 150 5.3	6.1 11 150 5.3
Turkey Manure (spring) + Biosolids	16.9 + 2.9	79		6.6 13 122 4.7	6.6 13 122 4.7
Turkey Manure (winter) + Biosolids				---	---
Turkey Manure only	34.1 + 2.4	146		7.3 25 138 5.1	7.3 25 138 5.1
Average				6.8 14.5 140 5.0	6.8 14.5 140 5.0

Treatment	November Soils pH P K OM			lbs N	Summer Nitrates NO_3-N + NH_4-N = lbs N
Compost only	7.2 9 149 4.9		17.3 + 2.9	81	58.3 + 2.1 = 242
Compost + Biosolids	6.1 11 150 5.3		13.6 + 3.1	67	32.2 + 3.1 = 141
Turkey Manure (spring) + Biosolids	6.6 13 122 4.7		20.2 + 2.5	91	56.8 + 3.0 = 239
Turkey Manure (winter) + Biosolids	---				28.8 + 3.1 = 128
Turkey Manure only	7.3 25 138 5.1		24.8 + 2.5	109	22.1 + 3.6 = 103
Average	6.8 14.5 140 5.0				

Turkey manure (winter) applied end of February @ 5.5 ton/ac
Turkey manure (spring) applied May 2010 @ 5.5 ton/ac
Biosolids applied May 5, 2010 @ 10.95 wet T/ac predicted to supply 113 lbs N; 85 lbs P205 and <10 lbs K20 (appl" yr)
Compost applied May 3, 2010 @ ~13.5 ton/ac
May Soil Test : 6.5 pH, 4.7 OM, 9 P, 151 K, Lincoln Heavy Clay soil

BRIAN RICKER

Brian Ricker's family has farmed in the Flamborough area, near Hamilton, for five generations. When his brother took over the family farm in 1993, he bought 125 workable acres in South Cayuga, where he built a home.

Since then, he has expanded by another 575 acres, at Dunnville on the north shore of Lake Erie, near the mouth of the Grand River: "The neighbours kept selling me their land so I kept on buying it," he says. He also rents 300 acres.

Ricker now grows cash crops and raises about 70,000 chickens. Those birds don't produce enough manure for his land, so he buys turkey manure from neighbouring farms, within about 15 kilometres of his fields.

The soil is relatively heavy Haldimand clay. "If you treat clay right, it will treat you right."

He applies manure at about 10 tonnes per acre once every eight years, doing a part of his land each year. That schedule is more efficient than more frequent applications, and it works for Ricker. "My soil is all clay. It's not like sand; it holds the fertility for years. If you put fertility in, it's like an RRSP; if you put a bunch in one year you can withdraw it over several years without getting into trouble."

Ricker also takes the same long-term approach to commercial fertilizer. "I'll take the lowest fertility field, and do soil tests. If it's a little low in, say, potassium, I'll put 300 pounds per acre on the field. That will cost about $5,000, but that field is then good for five or six years. The next year, I go to the next lowest field. In my situation, I don't work every field every year."

His test involved comparing yields from about five acres of a field treated with municipal compost from AIM Environmental Group in Hamilton with the results from the rest of the field with turkey manure applied.

The entire field, which he had bought the previous year, had low fertility, he says. "It had been run down; just in hay and grazed for 20 years. They didn't put anything back into it, so while nutrients were low it didn't hurt the soil structure.

"We analyzed the manure and compost side by side. It appeared as though the compost did just as good a job as the manure in bringing the fertility up."

The first trial crop was corn. With either manure or compost, and some fertilizer starter, the yield was 200 bushels an acre. "That's insane for that land," Ricker says.

He'd "absolutely" prefer to use compost instead of turkey manure, "which smells and annoys the neighbours." And compost contains more potash.

But he doesn't use it because his land is too far from AIM's facility and trucking costs would be prohibitive. Including hauling, the local manure costs about $10 a tonne. On the same basis, compost would be $30.

Plastic is another issue with municipal compost, Ricker says. His supply had "a fair amount — tiny chunks of plastic, from bags. All things being equal, that's the only problem with it.

"It doesn't interfere with application, and it might be okay on my own farm, but I'd be nervous about putting it on rented land."

Even on his farm, though, "it would be worrisome spreading that amount of plastic every couple of years. When plastic breaks down it releases heavy metals and other stuff you don't want.

"If they could get the plastic out, which they said they would, it's the same as manure. It's real good."

14. BRETT SCHUYLER

i. Research Conducted during the Years of / with Crops of:

2013:	Apple Orchard
2014:	Apple Orchard
2015:	Apple Orchard

ii. Overview of Research Approach, Observations & Results

2 ton/ac applied every year to apple orchards – near Simcoe

compost from AIM Environmental is applied in early spring before dormancy breaks @ 2 ton rate:
~ 20 – 22 – 20 lbs/ac available N – P205 – K20
~ 1500 lbs organic matter

BRETT SCHUYLER

By Ontario standards, Brett Schuyler's family has been farming for a long time — their story goes back to the early 1800s, when the land north of Lake Erie was being settled.

By the same standards they also farm a large area — nearly 1,000 acres of apple and cherry orchards and 3,000 acres of cash crops, mostly owned and some rented, near the town of Simcoe.

The farming operation, which Schuyler runs with his father, brother and uncle, is not formally part of the compost trial. But for the past four years the family has been using the mix of Green Bin source-separated organics and leaf and yard waste supplied by AIM Environmental Group in Hamilton.

The aim was to reduce consumption of what Schuyler calls "rock fertilizer," his name for potash and other mined products, and to take advantage of "a high quality fertilizer that's renewable and good value for the price."

Compost was initially spread with a mulcher near the base of the a few trees in the orchard — planted in sandy soil over glacial till — at an annual rate of about one and a half tonnes per acre.

Although no side-by-side tests were conducted, the compost results were so good, considering costs and benefits, they decided to use it on the entire orchard.

He doesn't have specific results, but "it looks like it has gone well. Certainly nothing has gone drastically bad. We haven't seen any negatives from switching to compost. We believe it's helping us get better fruit quality and less disease, but we can't be sure."
The turf between the orchard rows is darker green and "looks really good," where it's growing near the compost, "but did it make my trees grow better?"

Compost, applied in winter when the ground is frozen but before "significant" snow has accumulated, has entirely replaced commercial fertilizer, although herbicide is still used to prevent weeds close to the trees, where they can't be mowed.

The orchard's previous commercial fertilizer program cost about $100 per acre. Compost costs about $15 per tonne, including the long truck haul from Hamilton, or less than $25 per acre. Because of the much larger quantity involved, it's much slower and more expensive to apply but, "it's still a big saving," Schuyler says.

On the fields, the family grows corn for several years in a row, depending on soil conditions, followed by soybeans for one year. Since the timing of the rotation is staggered, about 800 acres of soy are treated with compost each year.

That means, between the orchard and the cash crops, about 2,700 tonnes of compost are applied annually.

Compost goes on during the winter after the corn harvest before the switch to soy; at one and a half tonnes per acre. It entirely replaces the previous 200 pounds of potash. But commercial fertilizer is still used for corn, without additional compost: "We haven't changed the corn program at all," Schuyler says.

As with the orchard, "I can say we've seen no negative impacts" on the soybean crop when compost replaced fertilizer. "We've had very good soy yields since we started doing it, but it's all anecdotal."

The corn appears to have received some residual benefit, he says.

Compost "is generally a better fertilizer source, but I'd be very reluctant to say it makes the yield better. I believe it increases yield, but it's hard to prove." Even so, "I'm very happy with the product."

The compost is left on the soil, with no incorporation. "If we work it in, we lose all sorts of topsoil and nutrients over the winter. If you just leave it on, the trash (stubble from the previous crop) keeps it in place. We've elected to let it sit on the surface and let the worms work with it."

Schuyler sees little evidence of run-off with compost. And compared with the previous fertilizer program, the cost "is a wash."

Many farmers apply compost at 10 tonnes per acre, but Schuyler says his farm's lighter treatments reduce the chance that nitrogen will be tied up with breaking down the carbon content, he says. "The system consumes it a lot faster."
If compost were free, "we'd put it on at a higher rate. You could put down more and have some benefit," Schuyler says. But with the current amount, the farm soils are in good shape. "It's a good maintenance program."

But while compost is "an infinitely better source of fertility" than the mined "rock" products, cost is a concern. "I wouldn't want to be paying much more than we are now. If it gets much more expensive, you start thinking about commercial fertilizer again."

Schuyler says they don't apply compost to the roughly 40 per cent of cropland they rent. "We don't want to risk offending the person we're renting from. People have an idea that it's garbage, even though it would do a lot of good for their land."

More education about compost would help, he says. "There's just confusion. We've got so used to farming with rock fertilizer." Compost produces "a bit of an odour," but it's "a dream … the least foul stuff I've ever used" compared with manure and sewage sludge.

The big issue, Schuyler concludes, is the need to find alternatives to conventional fertilizer and to make use of wastes.

15. PAUL SULLIVAN

Paul Sullivan

Paul Sullivan has heard, first hand, the major concern about applying municipal compost to agricultural land.

Sullivan is an agronomist who works with farmers in eastern Ontario. While none of his consulting clients participated in the official compost trials, several have tried the material, through tests organized by the Ontario Soil and Crop Association.

The side-by-side trials on corn were conducted in 2011, using compost from Orgaworld Canada Ltd., which gets its feedstock from the City of Ottawa. It compared results with compost alone, compost with side-dress nitrogen, and nitrogen alone.

The yields were statistically identical, Sullivan says. “From the standpoint of short-term impact, and the following year, the observation is that there wasn’t much difference.”

The test location already had good organic matter, and the compost, with a substantial proportion of leaf and yard waste, had a relatively high, 15:1 ratio of carbon to nitrogen, he says. “It appears the compost caused a bit of tie-up of the nitrogen and reduced the initial impact.”

The same pattern held in the subsequent two years, when the entire test area, alternating corn and soybeans, was treated with the usual applications of commercial fertilizer.

But last year, with corn, “there seemed to be a bit higher yield in that field … a visible difference in the crop.”

That result follows the expected pattern with compost on agricultural land: Its long-term soil benefits outweigh its immediate impact on yields.

A handful of his clients applied compost to their land following the test, mostly in fields with low fertility, sandy soil where nutrient levels are lower. Only one, who trucked it himself, is considering using it again, and only “if he can get it cheaper.”

“It seemed to fit in certain soils where we perceive the most benefit,” Sullivan says. “But on a general basis, that’s not necessarily the case. With the overall understanding and experience of the material, one thing that’s hard to evaluate is what the contribution of it is.”

Compost costs more to buy, transport and apply than fertilizer or manure, Sullivan says. “Manure doesn’t come without application cost. But it’s part of a livestock operation; they have to do something with it.

“Mostly due to the cost of compost … and the difficulty in seeing the effect on the crops, it’s been something that the interest in it has been somewhat limited among clients of mine.

“Farmers can’t afford to spend upfront for benefits that may not show up for four or five years,” especially when the benefits are difficult to quantify. I’d think from my guys’ reaction who used it and didn’t see much initial benefit, it becomes something we’d need to see more immediate benefit than we’re seeing.”

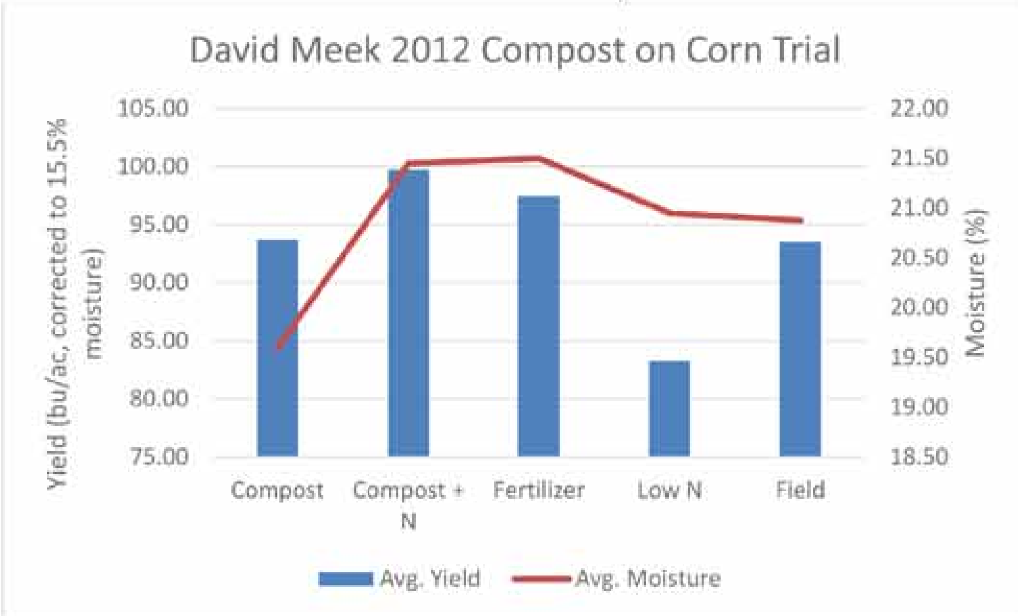
16. Belfountain Site – Caledon

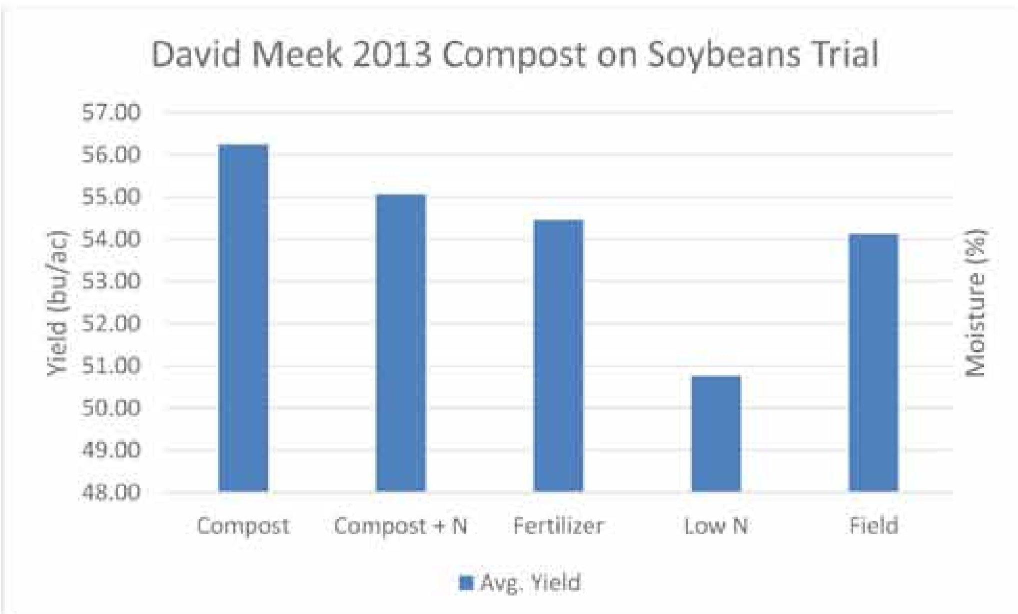
A dairy farm has the benefit of forage-based rotations and manure and generally the soils on the farm have relatively high organic matter content. When land is purchased further away from the cattle and away from the manure source, there is an appreciation for the benefits that manure brings to crop production.

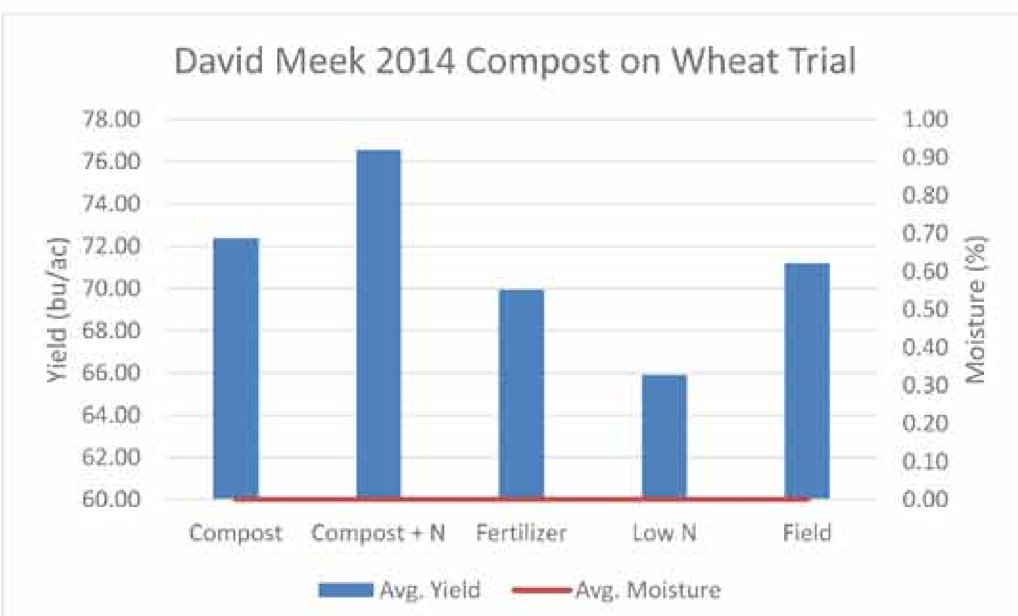
Compost can provide similar benefits to solid dairy manure which was one of the purposes of the field trial at the Belfountain site. Compost was applied in 2012 and yields were monitored for the following three years with a corn, soybean and wheat crop. Yield results show an advantage to compost and compost with additional nitrogen for corn and wheat. Results are shown below for the 3 years.

Bulk density measurements were taken from each field and the results for this field are shown below The higher the bulk density percentage of the soil, the less pore space and the less water holding capacity. The results show and advantage to the compost treatments. Bulk density is variable across a field and depends on previous management, field traffic areas, differences in soil texture, etc. Improvements in water holding capacity take time and can be enhanced with combination of practices including forages in the rotation, wheat and cover crops in the rotation along with the addition of organic amendments.

Compost Analysis			
Sample ID: RP012/**M3B**			
For: Region of Peel Compost Farm:			
Reported Date: April 18, 2012			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Bulk Density (kg/m3)	325		
Sulfur (ppm)	2007.2		4.01
Dry Matter (%)	68.5		
Nitrogen (total) (%)	1.92	38.3	13.3
NH4-N (ppm)	1,418	2.8	2
Conductivity (@ 25 degrees C) (ms/cm)	5.34		
Phosphorus (total) (%)	0.55		20.24
Potassium (total) (%)	0.84		18.14
Organic Matter (%)	54.1		741
Carbon:Nitrogen Ratio (C:N)	16:1		
Sodium (%)	0.41	8.2	8.20
Aluminum (ppm)	776.1		1.55
Boron (ppm)	13.0		0.03
Calcium (%)	4.42	88.3	88.40
Copper (ppm)	19.7		0.04
Iron (ppm)	1720.4		3.44
Magnesium (%)	0.30	5.9	6.00
Manganese (ppm)	92.7		0.19
Zinc (ppm)	53.3		0.11


David Meek 2012 Compost on Corn Trial
105.00
100.00
95.00
90.00
85.00
80.00
75.00
22.00
21.50
21.00
20.50
20.00
19.50
19.00
18.50
Yield (bu/ac, corrected to 15.5% moisture)
Moisture (%)
Compost
Compost + N
Fertilizer
Low N
Field
Avg. Yield
Avg. Moisture


David Meek 2013 Compost on Soybeans Trial
57.00
56.00
55.00
54.00
53.00
52.00
51.00
50.00
49.00
48.00
Yield (bu/ac)
Moisture (%)
Compost
Compost + N
Fertilizer
Low N
Field
Avg. Yield


David Meek 2014 Compost on Wheat Trial
78.00
76.00
74.00
72.00
70.00
68.00
66.00
64.00
62.00
60.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Yield (bu/ac)
Moisture (%)
Compost
Compost + N
Fertilizer
Low N
Field
Avg. Yield
Avg. Moisture

Bulk Density and Soil Calculations

Sample Date: June 19, 2013

Treatment	Soil Water Filled Pore Space (%)	Soil Porosity (%)	Average Soil Porosity (%)	Average Bulk Density	Hectare Furrow slice (Mg/ha)	Soil Organic Carbon (Mg/ha)	Soil Organic Matter (Mg/ha)
1	0.56	0.53					
	0.52	0.57					
	0.54	0.56	0.55	1.19	1783.56	35.31	60.74
2	0.51	0.55					
	0.54	0.56					
	0.47	0.62	0.58	1.12	1686.39	33.39	57.43
3	0.54	0.56					
	0.61	0.52					
	0.62	0.52	0.53	1.24	1862.18	36.87	63.42
4	0.51	0.52					
	0.59	0.49					
	0.50	0.55	0.52	1.26	1891.77	37.46	64.43

Treatments

1 Compost
2 Compost + Commercial N
3 Fertilizer
4 Low Rate Nitrogen

17. GERRY VELDHUIZEN

i. Research Conducted during the Years of / with Crops of:

2012: Corn
2013: Soybeans

ii. Compost Analysis

COMPOST ANALYSIS			
Sample ID: AIM - Hamilton			
For: Wainfleet Site			
Parameter	**Analysis Result**	**Pounds per Ton**	**Estimated Availability per Ton**
Dry Matter	59		
Nitrogen % (Total)	1.17	23.4	5.0
NH4-N ppm	8 ppm	0	0
Phosphorus (Total)	0.26%		9.6
Potassium (Total)	0.61%		13.2
Organic Matter	46.6 %		550
Carbon:Nitrogen Ratio (C:N)	22:1		
Calcium	3.03%	74.8	
Magnesium %	0.71%	14.2	

Gerry Veldhuizen

Gerry Veldhuizen views soil as a bank: You invest in it now to get a return later, he says. And that's how he uses compost.

Veldhuizen has farmed all his life near Wainfleet, near the east end of Lake Erie's north shore. He originally raised dairy cattle on 170 acres. But 12 years ago, with his knees shot and "finding it pretty painful to get around," he bought a grain elevator, expanded to 800 acres and switched to cash crops.

After a few years, he shifted to virtually no-till farming; only breaking the top inch of soil before planting corn.

He started the compost trial in 2012 on small plots behind the grain elevator. He applied his normal rate of commercial fertilizer on one plot, compost and fertilizer on another, and compost alone on the last, before planting corn in all the plots. The compost went on at a rate of three tonnes per acre.

The results seemed positive: With compost, the corn yield was up by four or five bushels an acre. But Veldhuizen says the test wasn't a conclusive because 2012 was a drought year. His yield with fertilizer was 146 bushels per acre. Adding the compost, a mix of residential source-separated organics and leaf and yard waste from AIM Environmental in Hamilton, raised it to about 150 bushels. But in a year with normal moisture, the same land, with only fertilizer, would average around 175 bushels.

"That was a good year as a demonstration, since it was extremely dry. It showed a good gain. In a good year, with consistent rain, I'm not sure how much yield benefit you'd see."

The following year was "decent:" With no compost added, soy production increased by about one and a half bushels an acre, to 55 bushels, which was slightly above average.

But, the weather doesn't always co-operate," Veldhuizen says. That fall, the field was too wet to plant winter wheat so Veldhuizen went back to corn in the spring. But conditions were difficult, the crop was late and he didn't keep track of the plots. "There were no visual differences. I wasn't expecting any difference in yield at such a low rate of production."

Despite the difficulties and uncertainties, though, Veldhuizen says, "I had seen enough of a benefit from compost in the test plot to try it on a larger field." In 2013, on 70 acres near the test plots, he did a shallow incorporation of compost at 10 tonnes per acre, then, planted soybeans.

But he says it's too soon to discuss the impact of compost on this larger field. "We spread one to one and a half inches across the field. On an acre that's a fair amount of organic material. I'm hoping it has a five-year benefit to it. I hate giving numbers on one year. You need five years to get numbers that are reliable," unless, as in the small trial, you're directly comparing one field with another at the same time.

"You can't just apply it one year and say, 'I've got this much production.' It takes multiple years."

This year, he'll try corn on the same area. It's good, productive soil and over the year since it was applied the compost will have had a chance to break down and be able to release more nutrients, he says. For 2016, he plans to apply compost on fields with heavier clay soil eight miles from his home farm, where he wants to plant wheat.

Veldhuizen's plan is a rotation of corn followed by soybeans and wheat, with compost applied, at the "heavy" 10-tonne rate, after the wheat comes off in August. At that point, the soil is dry and won't compact. As well, "there's time to deal with it then, and by next spring, you're ready to gain the full benefit from the compost." He might also plant cover crops — oats or rye grass — with the compost.

"I'm looking for an increase in organic matter, which gives you better moisture retention," he says. "It's a project. You're continually trying to improve the soil. It's a long-term thing."

If he orders compost from AIM during the winter for August delivery he has no problem getting all he wants. "If I called in August I don't know if it would have been available."

With the larger application in 2013, the only visible contamination in the compost was bits of the plastic grocery bags in which many people put out their Green Bin organics, instead of using compostable bags. "You get pieces in your field. It didn't bother me at all. I only saw them when I was incorporating the compost; driving across the field and looking at what's there. Last spring, I didn't see anything in the soil."

Economics is a major issue, Veldhuizen says. It costs $300 an acre to get compost on to his land, including buying, trucking and spreading the material at 10 tonnes per acre. That's $21,000 for the 70-acre field, which is, "a fair chunk of change. It's too expensive to do blanket coverage over all my acreage. With the acres I have got and the cost, I can only do so many a year."

On the other hand, one application might produce benefits for several years.

In any case, he'll target the compost on lower-yielding fields, which lack soil structure and organic matter, "to make them more productive over time."

But he'll continue to use commercial fertilizer, at the previous rate, which is where the concept of the bank comes in. "When I apply the compost I don't give it any credit for fertility. I put it in the soil bank. I balance what I'm taking up and putting in with commercial fertilizer. Any fertility from the compost goes in the bank. You're always looking to build soil."

"I'm confident I did increase soil fertility and nutrient levels," with compost. "To say you're not getting any economic benefit — I am, but I can't put a number on it.

"It's too early to tell the impact of compost. It's a long-term benefit."

II. APPLICATION LOGISTICS AND THE ECONOMICS OF COMPOST

i. The Current Challenge of Using Compost in Agriculture

Right now, there is a disconnect between expenditure and results.

Farmers must pay the cost of acquiring, transporting and applying compost upfront just as they do with commercial fertilizers. But unlike commercial fertilizers, compost doesn't always result in immediate, quantifiable increases in crop yields. Depending on a variety of weather, soil and other factors, yields might rise, remain constant, or even decline in the first year or two of compost application. Compost's benefits accrue over several years and as soil health gradually improves, so does yield.

This means that farmers are being asked to pay in advance the entire cost of a product that likely will not generate full results for them for several years. Added to this, some farmers must continue to buy and apply commercial fertilizer along with compost, to maintain yields at least until the compost benefits take hold. And compost is more expensive to transport and time-consuming (and therefore expensive) to apply.

A few other challenges have also been identified:

- Lenders don't consider compost use as a conventional practice, making it less likely they'll offer financing.
- Provincial regulations governing the application of non-agricultural source material (NASM) might unduly and unnecessarily restrict the use of compost (Exhibit vi)
- Compost characteristics vary widely among compost from various producers but the actual differences and their impacts are not well understood.
- With compost facilities producing the material continuously and farmers needing to apply it at finite times during the year, storage can be an issue.
- The relatively long time it takes to spread compost increases the possibility that weather will interfere. This, in turn, can cause problems in scheduling deliveries of the material. It can be hard on both farmers and truckers if, for example, rain forces postponement of deliveries.
- Compost is much more abrasive than manure on spreading equipment.
- In some cases, particularly where the lease is for a short duration, this discourages long-term investments in soil health.

As well as the challenges noted above, additional issues were identified as part of a roundtable meeting initiated by the Region of Peel and The Compost Council of Canada which included the producers of compost used in the study, A&L Canada Laboratories and a noted agronomist, Lise Leblanc of LP Consulting, along with representatives/ observers of both the Ontario Ministry of Agriculture, Food & Rural Affairs as well as the Ministry of Environment and Climate Change. These are summarized below:

- **The Need for Product Quality Consistency:** Once farmers agree to buy compost, they must receive a consistent quality product that works with their crop production program.

- **Logistics and Transportation:** Trucking costs from compost facility to farm location can present a financial barrier. Distance, absolute amount per truckload and handling are some of the factors that impact the cost per truckload. Skilled drivers, attune not only to on-time delivery and product placement at farm destination but also having some product knowledge, are invaluable.

- **Seasonal Delivery Requirements:** Compost must be delivered when farmers want it. It is usually applied only twice a year; before spring planting and in fall. At those times, it's needed in a hurry. Composters or their contractors must have enough people and equipment available to meet that demand.

ii. The Price, the Value and the Costs involved in using Greenbin Compost in Agriculture

According to calculations done by Christine Brown, Nutrient Management Lead – Field Crops, Ontario Ministry of Agriculture, Food & Rural Affairs and lead researcher of the *Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost Trials*, the compost produced from the greenbin collection programs across Ontario currently contributes over 55,000 Tonnes of organic matter back to Ontario soils and contains over $5.25 million/year in crop-available fertilizer equivalent.

While compost for landscaping and other application uses is sold in the range of $20 to $40 and even higher per tonne, agricultural sales for greenbin compost are currently $5 to $10 per tonne. Volume quantities as well as differing perspectives on the purpose and value of compost application (soil amendment, fertilizer and/or organic matter) contribute to this current price differential. This price-per-tonne has improved significantly over recent years, building from a situation less than ten years ago when there was virtually no demand from agriculture with compost product being given away instead of being sold.

Transportation from compost facility-to-farm is the biggest expense in the cost equation, varying with the distance involved. Compost is sold in bulk to agriculture and its low bulk density (approximately 25 – 30 lbs/cubic foot) makes transport and handling expensive. Application cost of compost is calculated at approximately $3 to $5 per tonne. When transportation and application costs are combined, they can often exceed the nutrient value of the compost.

For compost to be effective in current financial perspectives, its benefits in increased yields and nutrient savings must be "costed" over the whole rotation as opposed to just the year of application. Improvements in soil quality and importantly, soil health, take time and are difficult to measure.

The value of organic matter – a fundamental component of compost's uniqueness in soil health as well as its ever-greater recognition as an effective tool in climate change mitigation – has yet to be financially defined. Because compost's organic matter is essential to soil health as well as has demonstrated clear benefits in climate change mitigation, much more work needs to be devoted to assigning a dollar value on organic matter, not generally acknowledged in agriculture's current financial assessment of compost.

This missing financial value is key to catapulting demand and use for compost in agriculture.

iii. Recommended Next Steps to Overcome Current Financial Barriers

In addition to the agricultural researchers who lead in championing the use of compost for soil health and improved crop yields in the long term, the full complement of the skills and focus of the Ministry of Agriculture, Food & Rural Affairs needs to be turned to recognizing the organics recycling industry and the soil-based products that are produced as part of the product portfolio of agriculture in the province.

Working together with the Ministry of Environment and Climate Change along with the compost industry, the Ministry of Agriculture, Food & Rural Affairs has a wide range of support options to select from to help advance compost sales for the benefit of the local economy and environment.

Included in the options available for review and selection are:

- Financial incentives to improve soil health parameters – both for the owners of the farmland and those who utilize it for agriculture. This support should be available to either users or to help ease some of the application dynamic (eg. establishment of central storage sites or expansion of distribution channels currently being used to access fertilizer and other crop inputs; reducing the cost of transportation);
- Loans to cover the cost of compost and equipment that would be backed by and repaid from future cost savings and/or increased revenues or to allow payments to be amortized over the full term of crop applications. For example, for Ontario cash-crop farms that employ a three-year rotation of corn, followed by soybeans and wheat, compost needs to be applied just once in that cycle, before the corn is planted. That means its cost (and potentially loan repayment) could be spread over three years benefiting from three potential yield increases.;
- Adjustments to tax treatment, with the use of compost being potentially considered as capital cost rather than a regular business expense;
- Reviewing government regulations (such as NASM) to appropriately address the balance between environmental considerations and product usage. Government regulations for NASM should ensure that valuable nutrients are preserved and surface and underground waters are protected but without placing unnecessary restriction on compost use. In fact, because of compost's contribution to soil health and run-off prevention, the regulations should promote its use.
- Reducing the cost of transportation, reflecting the value of climate change mitigation benefits, assessing tax options as well as reviewing different product formats to increase tonnage per load are just some of the options to be examined in more detail to fully capture the need for cost reductions in this area.
- Delivery of compost, at a cost not charged to farmers, from production facilities to central storage and distribution sites near to where the material will be applied. This would cut farmers' transportation and storage costs while easing the discrepancy between continuous production and time-specific (seasonal) application of compost.
- Recognizing that about 40% of Ontario farmland is rented, operated with short term leases and sometimes owned by developers waiting for land use change and build opportunities, developing the economic rationale to improve soil health. Growers don't want to put money into land that's not theirs. Some developers even forbid soil enhancement to limit its fertility and agricultural preservation rationale.

Experts such as agronomist Lise Leblanc of LP Consulting and farmer/producer Mike Lishman of Arlington Farms believe that land renters and owners can benefit from compost and its application on farmland.

Leblanc recommends spending time with the owner, talking about how good compost is and the cost to the farm if it's not used.

Lishman suggests farmers use compost as leverage to get a good lease deal; they can propose to pay lower rent on, perhaps, a five-year lease in return for soil improvements that increase the farm's value. This, in turn, could let the owner raise the rent when the lease expires. The approach might work especially well if a farmer is willing to upgrade marginal land that has little or no current value.

The workshop also identified the need for:

- Increased emphasis on information about compost application methods and equipment to help make it easier for compost producers and users to decide how to approach the application (Appendix V).

- Increasing support for awareness building and training programs, making a stronger connection between "Farmer Feed Cities" and "Cities Feed Farm Soils" to emphasize the importance of long term soil health, appropriate utilization for crop yields, improved input quality in the greenbin programs.

  Messages to be considered for emphasis includes:

  i. Investing in compost is cheaper than acquiring additional land to increase a farm's crop yield;

  ii. Compost is positive for the environment and using it makes a farmer a better steward of the land;

  iii. Compost usage is just one of the tools in the arsenal for improved productivity along with currently strongly promoted techniques such as reduced tillage, cover crops and crop rotations, etc.

- Increasing specificity in economic benefits of value to specific farm applications. For example: With no-till farming, adding compost can speed the decomposition of corn stover, in turn, making more of its nitrogen available to the following year's crop and helping cut the fertilizer bill.

- Long term research into the "value-added" aspects of how compost works in the soil; for example, whether and precisely in what ways it changes soil biology, increases microbial activity, releases bound-up nutrients and replaces essential materials such as sulphur, which is no longer supplied in Ontario by emissions from coal-burning electricity generators. Such ongoing long-term research and experience on "complete fields" versus just test plots is essential. As noted by Mike Lishman, a leader in compost application in agriculture, "Test plots are not enough. We need to know what the stuff is doing to the soil. That's 10 to 15 years."

- Building the value of compost and the return of organic matter to agricultural soils into the financial incentives being developed to address climate change and mitigate its impact.

- Enhancing the awareness and understanding of the Compost Quality Alliance (CQA) program to better develop understanding of the many product attributes and components contained within compost, helping to differentiate different compost products and focus their use to maximize soil and crop performance.

  More information is also needed on how much and when, compost should be applied, having detailed knowledge and understanding of how farmers operate and what they want/need for their soil, providing the compost product that meets their needs.

- Building better compost application knowledge and specificity of use. Gilles Moreau of McCain Foods suggests that the knowledge of the application of compost to build organic matter should be developed in the same way that has happened with the use of lime, added to regulate a soil's acidity. Years of production data show that potato crops thrive at a pH of around six. Growers know that when pH drops to 5.6 or 5.7, it's time to add enough lime to boost it back to a little above the desired level. These treatments are expensive but last three or four years and are budgeted for over that period. "There's no similar data for organic matter," Gilles Moreau, McCain Foods, says. "That's a serious lack of knowledge." Growers need to know the original organic matter, what level is required for the best yield, at what point it's too low and more should be applied, and in what quantities, for optimum results.

- Reducing feedstock contaminants through improved waste generator awareness of their role in product quality delivery and impact on soil inputs in addition to enhancements in processing technology and screening.

If there is a shortfall in this project, it is due to the very limited timeframe involved in the applied research aspect of the *Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost Trials*. A three-year research trial is not long enough. To fully capture the learning to be realized from this project, it is strongly recommended that the research trials continue to be financed and supported, at minimum for a 2nd full cycle of the rotation.

III. BUILDING THE NETWORKS AND MARKETING PLAN TO INCREASE GREENBIN COMPOST's AWARENESS, ACCEPTANCE AND USE IN AGRICULTURE

i. Approach

The complexity of marketing compost cannot be underestimated.

While considerable monies and attention have been devoted to help establish infrastructure to collect and recycle organic residuals (albeit not at all significant in comparison with other materials in the recycling stream), the same has not been true for the marketing of the final product, compost.

Consequently, of equal-if-not-greater importance to the applied research work that was being conducted on Ontario farmland, the *Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost Trials* also focused on identifying and establishing a better understanding for the strategy and mechanics involved in marketing greenbin compost within the agriculture community.

Included amongst the activities involved in this aspect of the project were:

- Introductory meetings with various agricultural organizations in Ontario to learn of their focus and work (Exhibit VII)
- Attendance and exhibits at select agricultural conferences and field days to learn about the dynamics of these events and how compost could be best promoted in these forums (Exhibit VIII)
- Providing updates about the trials via presentations and contributing articles at industry events within the agricultural and waste management sectors (Exhibit IX)
- Creating a trial compost field day to explore the concept and elements involved in making the event successful (Exhibit X)
- Conducting a session with compost producers and representatives from both the Ministries of Agriculture and Environment to provide input on their experiences in marketing compost to agriculture opportunities to build a compost industry marketing program (Exhibit XI)
- Identifying existing government support programs which could help advance the use of compost in agriculture as well as those which are creating barriers to progress (Exhibit XII)

ii. Observations and Recommendations

Even with solid research data and excellent distribution methods, the successful marketing of compost in agriculture depends on the fundamental components of product quality and promotion.

A. PRODUCT

i. Agronomics

The full value of compost goes beyond the typical fertilizer equation of N-P-K, extending to also include a range of micronutrients and very importantly, organic matter. It is the latter that helps differentiates compost from other amendment and fertilizing alternatives, helping to build back soil quality and maintain soil health.

While the price of organic matter has yet to be fully quantified in terms of its value in moisture-holding capacity, greenhouse gas sequestration and soil resilience, the opportunity exists to increase awareness and discussion on the value of compost to overall soil health and our environment.

The Compost Quality Alliance (CQA), its product testing and agronomic attributes & values declaration regime, has begun to support this dialogue (Exhibit vii) and yet much more could be accomplished with increased support from government and industry involvement.

Incentive programs such as GLASI: Great Lakes Agricultural Stewardship Intiative (Exhibit vi) and the determination of the appropriateness of classifying immature compost in the most restricted category of NASM: Non-Agricultural Source Materials (Exhibit vi) are immediate opportunities for greater market advances of greenbin compost in agriculture.

ii. Aesthetics

Currently, the “foreign matter” (primarily small pieces of plastic debris in the form of film and hard “chips”) which can found in compost produced from greenbin compost can be a deterrent to having it applied to agricultural soils. Aesthetically, this material detracts from the perceived quality of compost.

With the use of finer screens, inspection and removal of non-compostable items prior to processing and other technology, compost producers have reduced the presence of this debris considerably. But this adds significant costs to the processing system and does not completely eliminate the problem.

Ultimately, the solution rests with residents, their awareness of the situation and having them use the greenbin for only materials that can be composted at their organics recycling facility.

Sending a “do it better” message by municipalities to their residents is not easy. Imposing too many rules or enforcing their rules too stringently sets up a precarious situation of balancing diversion rates with end market quality. And right now, there is more emphasis on diversion than product manufacturing within municipal organics recycling operations.

The main solution is education, to ensure people know what should go into their greenbin, what should be left out and why this is important. Tours of facilities – including for those who are the frontline in the collection of the greenbin from households, community and neighbourhood events, positive reminder messages, advertising and compost sampling can all be included in a program whose objective it is to improve the incoming quality of greenbin materials to be composted. A focused educational component in the schools is also very important, reflective of children being more likely to accept the message and take it home to educate and remind their parents.

Advances in certified compostable products and packaging – particularly when extended across the full packaging/product category to enable the mass production requirements of organics recycling facilities to effectively manage these inputs – provide future opportunities for reduction in input contamination.

As well, ever-better screening equipment, possibly sourced through financial assistance from product and packaging manufacturers and marketers and/or improved end-product revenue, can also help reduce potential physical contamination in finished compost.

B. PROMOTION

Contributed articles, involvement at agricultural farm meetings, trade shows and conferences and participation in farm tours and field days are all important aspects of an excellent upfront and ongoing promotion campaign for greenbin compost usage in agriculture.

The development of targeted training programs to build awareness and comfort in the use of the product is also essential.

As well, the compost industry must establish a greater rapport with agrologists who work with the farm community. The agrologists can offer great value to both sides of the compost market equation: for those in the compost industry, the agrologist can work with the compost proponent to ensure that the product will meet the farmer's needs. In turn, the agrologist, who conducts soil and crop check-ups for farmers, can direct the farmer as to the right application and appropriate use.

Establishing an ongoing and longterm work partnership with the Certified Crop Advisors and working with their association to build training courses suited to their learning needs will help tremendously to further this market opportunity.

The preparation of this field test was carried out with assistance from the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

LIST OF APPENDICES

SOIL: Our Eroding Asset

SOURCE: Environmental Commissioner of Ontario

http://ecoissues.ca/Soil:_Our_Eroding_Asset

The Vital Importance of Soil

When we think of resources, we typically think of our aquifers, lakes and rivers, our forest resources, our oil, gas and mineral reserves, and our terrestrial and aquatic plant communities. We don't usually think of soil as a resource. Yet we rely on soil to produce our food, degrade our solid wastes, clean our water, and provide dependable habitat for the countless microbes (at least 10,000 species per gram of soil) that provide these vital ecological functions. Soil is the rich, diverse, and dynamic matrix within which terrestrial life functions.

Cropland soils are vital to our economy. In 2006, Ontario's approximately 3.7 million hectares of cropland produced $8.8 billion in farm receipts. The Ontario farm and food processing sector generates over $30 billion in sales annually – representing more than 35 per cent of Canada's agri-food sector GDP. Our agricultural exploitation of the soil resource has also become much more efficient over time; for example, the average seed-corn yield has doubled from about 3.5 tonnes per hectare 30 years ago to about 7.0 tonnes per hectare at present. Similar increases have been achieved with other important crops, such as soybeans.

Much of this increase in productivity is a direct result of fossil fuel based inputs, such as inorganic fertilizers, pesticides and mechanization, combined with agronomic advances in plant hybridization and genetics. More recently, however, the sustainability of this approach has been called into question. Should we not be asking whether this high level of productivity and the methods used to achieve it could be affecting the quality and quantity of available fertile soil? The ECO believes that it is time to take a close look at the status of Ontario soils and to consider whether we are managing them in a sustainable way.

Soil and Organic Matter

Soil consists of a mixture of organic and mineral particulate matter of various sizes and proportions. In the topsoil layer, the mineral portion contains sand, silt and clay, and the relative amounts of each of these determine the soil's characteristic texture. Clay is the finest portion and provides for the water-holding capacity, while the larger particles of sand and silt provide pore spaces that keep the soil aerated and drained. Soils form slowly from parent material (rock) that has disintegrated through abrasion, chemical and physical processes and biological activity.

Overall, the amount of soil organic matter (SOM) ranges from one to ten per cent of the total dry weight of soil. The organic components of SOM include: raw plant residues (less than 10 per cent); a humus portion fairly resistant to further biological breakdown (40 to 60 per cent); and biologically "active" organic material (10 to 40 per cent). The active fraction – where microorganisms, particularly bacteria and fungi, break down the complex organic matter and recycle its nutrients – is a particularly important component of fertile soil. The microbes and other microfauna create what scientists call a "food web" – a biological matrix that improves soil structure, increases both water retention and infiltration, provides a slow-release nutrient supply appropriate for plant requirements, reduces nutrient loss through leaching, and increases system resilience to external impacts.

This biological matrix depends on organic matter to provide food for the organisms. If the food web is diminished due to the loss of organic matter, the soil becomes more liable to compaction and much more prone to erosion. The loss of water-holding and infiltration capacity makes crops more susceptible to short-term drought effects. A reduction in beneficial microbe populations or diversity reduces the soil's overall productivity and necessitates greater dependence on potentially costly external inputs of fertilizer to the cropping system.

SOM declines when land is first cleared and put into agricultural use, with most of the loss occurring within the first ten years. Information on SOM levels and long-term trends in Ontario soils is extremely limited. One study, in the mid-1990s, found that for 16 study sites ranging across Ontario, deforestation and cultivation over the decades had released about 34 per cent of the soil carbon in the top 250 mm to 350 mm of soil.

The Problem of Soil Erosion

The substantial carbon losses described above greatly increase our croplands' susceptibility to erosion. The most common agents of erosion are tillage, wind and water. Erosion caused by tillage on steep slopes is primarily a localized concern. Wind erosion may become a concern if climate change increases the frequency of droughts, but has not been a major problem to date because of Ontario's humid climate. Water erosion, on the other hand, is widespread, sometimes highly destructive and, therefore, the major environmental concern.

How serious a problem is soil erosion in Ontario? To answer this big question, we need to know:

1. How much topsoil is Ontario losing on an annual basis?
2. What is the annual replacement rate for topsoil?
3. In what direction is the trend moving? Are our efforts at soil conservation improving or failing?

Complete answers to these three questions are not available – a problem in itself – although there are some disturbing partial answers.

With regard to annual topsoil loss, estimates based on actual sampling and measurement are sparse to non-existent. However, Agriculture and Agri-Food Canada (AAFC) has compiled a comprehensive series of reports on "Agri-Environmental Indicators," which use Census of Agriculture data and Soil Landscape of Canada maps to assess the risk of various rates of soil erosion for all provinces. These risk estimates are based on data regarding physical factors, such as slope, slope length and lack of cover, and fineness of the soil. They do not consider the level of organic matter. Table 1 summarizes the most recent estimates of water erosion risk in Ontario.

Table 1: Cropland Water Erosion Risk in Ontario 2001

Erosion Risk Category	Annual Soil Loss Rate (tonnes/hectare)	Percentage of Soils in Risk Class (2001)
Very low	< 6	56
Low	6 – 11	15
Moderate	11 – 22	16
High	22 – 33	7
Very High	> 33	6

From: Agri-Environmental Indicator Report Series, Report No. 2 (AAFC)

According to this analysis, as of 2001, 44 per cent of our land had the potential to erode at rates greater than six tonnes per hectare per year. To put this into perspective, for almost half of our cropland, we are at risk of losing at least one tonne of soil for every tonne of grain corn produced. For up to 29 per cent of our arable land, the potential loss rate is at least twice that.

If the above represents our annual risk of soil loss, what would be a reasonable estimate of the replacement rate? Soil regeneration rates have been reported in the range of 0.5 to 1.1 tonnes per hectare per year. This is considerably lower than the six-tonne-per-annum level set by AAFC as "low risk," meaning that even our low-risk croplands may be losing their topsoil at a rate well above that of natural replacement. We cannot say at what rate this is actually happening, because we do not have the data, but we can say that the risk of this type of unsustainable loss is very high for a very large proportion of our croplands.

From a policy perspective, both the Canadian and Ontario governments have defined "tolerable" (T) soil loss not in terms of soil replacement, but rather in terms of sustained crop productivity. This is because, in practice, soil loss risk could not be kept within soil replacement rate levels for row crops, such as corn and soybeans, unless very conservative practices or multi-year crop rotations with forage crops were implemented. The value for T has usually been set by determining soil loss rates below which crop yields have been noticed to decline. For instance, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) uses a T value of 6.6 tonnes per hectare per year, while AAFC uses a T value of 7.0 tonnes per hectare per year.

Unfortunately, the concept of "tolerable" seems to have replaced the concept of "sustainable" in our soil management policy. Perhaps this is because the loss of quality topsoil can be an insidiously gradual process. It is masked by the use of inorganic fertilizers – at least until dire symptoms, such as noticeable erosion damage or marked declines in major crop yields, “suddenly” appear. According to OMAFRA, this lack of awareness of soil loss occurs because “continuous advances in soil management and crop production technology … have maintained or increased yields *in spite of soil erosion*” [emphasis added]. By ignoring the continuous loss of the natural soil resource, farmers are becoming locked into an expensive dependence on inorganic fertilizer that threatens the resilience and sustainability of our agricultural system.

The risk of soil erosion can be reduced through certain management practices, such as cover cropping and conservative tillage technologies. In terms of cover cropping, perennial covers of hay and pasture give a high degree of protection to the soil, as compared to widely spaced row crops such as corn, which provide very minimal soil protection. Other uses of cover crops include: protecting bare soil between harvest and next planting; covering the bare soil between rows of conventionally grown crops; and renewing the soil’s nutrient supply during fallow periods (e.g., green manures).

Conservation tillage practices that substantially reduce water (and tillage) erosion include: “no-till,” where seeds are drilled directly into the soil; “chisel ploughing,” where the main function is to loosen and aerate the soils without turning, while leaving crop residue at the top of the soil; and “disk harrowing,” where the soil’s surface layers are disked (cut) but not turned. The traditional mouldboard ploughing and associated secondary tillage, on the other hand, set up conditions that are conducive to water and tillage erosion, and to accelerating the loss of organic matter.

Soil Management Policy in Ontario

The above analysis certainly indicates that soil erosion is a serious concern in Ontario. Is the trend for the better, or for the worse? A short history of soil management policy in Ontario is illustrative in this regard. Serious problems with soil degradation in Ontario began occurring in the early 1960s. More sustainable practices, such as mixed livestock-cropping systems, high proportions of forage and cereal grain production, and multi-year crop rotations, had begun to be replaced by intensified crop production, crop specialization, the separation of livestock operations from crop production, and off-farm inputs of fertilizers.

It is particularly worthy of note that early soil conservation planning services for farmers, offered as extension services from the Ontario Agricultural College from 1945 until about 1958, were phased out due to growing interest in commercial fertilizers as a substitute for plant nutrients lost because of soil erosion. In 1978, a report by the Pollution from Land Use Activities Reference Group (PLUARG) showed the scale of erosion, sediment and nutrient runoff from land uses in the Great Lakes Basin and raised awareness in the agricultural community to begin to address these issues. It was not until the 1980s, however, that programs began to appear to assist farmers in addressing environmental issues and implement conservation practices. Several major programs were initiated over the period from 1983 to 1995, which brought some change to Ontario’s agricultural practices and resulted in some improvements. (Readers are referred to Section 7 in the Supplement to this Annual Report for a description and history of these programs.) Reductions in erosion risk by 2001 are evident in Table 2, comparing soil erosion risk category distribution for that year with 1981.

Table 2: Cropland Water Erosion Risk in Ontario, 1981 to 2001.

Erosion Risk Category	Annual Soil Loss Rate (tonnes/hectare)	Percentage of Soils in Risk Class (1981)	Percentage of Soils in Risk Class (2001)
Very low	< 6	44	56
Low	6 – 11	22	15
Moderate	11 – 22	15	16
High	22 – 33	11	7
Very High	> 33	8	6

From: Agri-Environmental Indicator Report Series, Report No. 2 (AAFC)

Despite the modest improvements shown above, Ontario still had, as of 2001, one of the lowest proportions (56 per cent) of land in the very low risk class and the largest share (six per cent) of cropland in the very high risk class, compared with other provinces. The reader should bear in mind, furthermore, that the risk levels used in the above assessment are based on the concept of tolerable, rather than sustainable, soil loss.

The programs of the mid-1980s to mid-1990s expended over $100 million, and at their peak, 25-30 full- time OMAFRA staff were working on soil conservation programs directly with landowners, Conservation Authorities and farm organizations. As OMAFRA's priorities began to shift, these staff were subsequently re-deployed and OMAFRA began to rely on farm organizations, such as the Ontario Soil and Crop Improvement Association (OSCIA), along with Conservation Authorities, to deliver cost-share programs to farmers, while the ministry focused on providing training to farm groups.

Canada's Green Plan of the early 1990s introduced a pilot program to develop Environmental Farm Plans (EFPs), which were initiated, with OMAFRA technical support, in 1993. Environmental Farm Planning is a voluntary, confidential process used by farmers to identify environmental risks on their farm and to develop strategies to mitigate them. In the currently available federal-provincial funding for farm stewardship and conservation measures, EFPs are required before landowners qualify to receive cost-sharing dollars.

Most program initiatives to conserve soil now fall under federal-provincial agreements under the aegis of the Agricultural Policy Framework (APF). We do not yet know whether or not the more recent programs have continued the slight improvement trend that was started in the early 1990s. In 2008, the federal Commissioner of the Environment and Sustainable Development (CESD) audited the Environment Section of the Agricultural Policy Framework, to examine whether its objectives for environmentally sustainable agriculture were being achieved and to assess its ability to report on performance under this section. Among other concerns, the report identified a lack of monitoring data necessary to track the effectiveness of the programs.

ECO Comment

While some progress has been made since the 1980s, we still have a situation where a predominant portion of our agricultural soils are being managed in a way that is clearly not sustainable. We do not know how much of our soil is being lost each year at unsustainable rates, but the information that we do have suggests that almost half our cropland is at risk of losing topsoil at a rate that is much greater than its replacement rate. Moreover, we have no guarantee of sustainable soil loss rates on any of our croplands.

Reports within the last ten years indicate that agricultural soil conservation practices have been adopted over a relatively small percentage of the province's croplands. No-till practices have increased substantially in the last 20 years, yet the percentage of overall cropped land under no-till remains less than 20 per cent.

Meanwhile, climate change appears to be changing Ontario's weather patterns, increasing the likelihood of more intensive runoff events. One recent report has warned that more frequently occurring spring rain events, coming at a time when soil is left unprotected by crops, could potentially increase erosion rates by one or more orders of magnitude. Economic shifts are also coming into play. Agricultural operations continue to increase in size and specialization, and there is rising interest in production of grain for ethanol and soybeans for biofuel, and in the use of crops and crop by-products as alternative fuels for electrical generation. These trends may increase the amount of high-risk cropland brought into use at the same time as they create a demand for agricultural "wastes" that could substantially reduce the amount of organic matter returned to the soil.

We can only suspect the dimensions of the overall soil problem. We do not have enough information about actual soil erosion rates to be able to do a proper assessment, nor is there sufficient information upon which to evaluate the effectiveness of the most recent cost-sharing programs that have been available under the Agricultural Policy Framework.

Similarly, the monitoring of sediment loss from watersheds is insufficient to enable us to identify trends in soil loss related to changing practices or climate change and thus to prioritize watershed areas of concern. The last substantive effort, carried out under PLUARG in 1978, estimated the average annual transport of sediment via tributaries to the Canadian portion of the Great Lakes at 1,084,000 tonnes. We have no recent data to determine whether this situation has changed and, if so, by how much.

Finally, given its importance to soil health, it seems inconceivable that we know virtually nothing about our soil organic matter and how it is changing. This is information that could be of great value not only in saving and enriching Ontario's soil, but in developing strategies for sequestering carbon to offset greenhouse gas emissions. We must find ways of overcoming the economic barriers to re-incorporating organic "wastes" back into agricultural soil.

The ECO encourages OMAFRA to set an aggressive soil conservation agenda for its part in the new federal-provincial programs, and to undertake comprehensive soil mapping review, soil erosion assessment and monitoring to support the evaluation of program effectiveness. The ECO also believes that successful programs, past and present, deserve to be re-assessed, and to have their best elements considered for re-institution. Historic cutbacks in staff who implemented technology transfer and extension programs also need to be reviewed. While farm organizations, such as the Ontario Federation of Agriculture (OFA) and OSCIA, are doing a good job of delivering programs, OMAFRA staff is needed to represent provincial interests in their interaction with these groups and directly with farmers. Experience has shown that the areas of the province that have the highest adoption rates of conservation practices are those that have benefited from the work of highly qualified field personnel and aggressive promotion of scientifically and economically based initiatives. Finally, the ECO suggests that OMAFRA consider replacing the concept of “tolerable soil loss” (which does not represent a sustainable level) with “net soil loss” (i.e., soil lost to erosion less natural and engineered replacement) and subsequently develop a long-term strategy to bring Ontario’s net soil loss down to zero. This could be done in conjunction with initiatives to sequester carbon as part of a joint soil conservation/climate change mitigation strategy.

Ecologist C.S. Holling defined resilience as “the ability of a system to maintain its structure and patterns of behaviour in the face of disturbance.” In the case of our croplands, resilience implies not only an ability to maintain productivity (i.e., in commercial terms, to produce a crop) in the face of climatic stresses, such as drought, heavy rainfall and other extreme events, but also an ability to maintain and renew itself on a sustainable basis. At a time when climate change and economic shifts are presenting significant new challenges to the agricultural community, we need to be assured that Ontario’s soils are in good standing.

APPENDIX II


Acceptable green bin items
Baked goods, cereal, flour, grains, pasta, rice and nuts
Vegetables
Fruits
Dairy products, eggs/eggshells
Bones, meat and fish (raw and cooked)
Coffee grounds, filters, tea bags and loose tea
Greasy pizza boxes, microwave popcorn bags
Fats and oils
Sauces and condiments
Shredded paper
Cotton balls, facial tissue, paper towels and toilet paper rolls
Visit peelregion.ca/waste for instructions on how to recycle these organic items and many more.
11

compostquality.ca

ALLIANCE DE LA QUALITÉ COMPOST QUALITY ALLIANCE

qualiteducompost.ca

Compost Product Quality Over and Above Government Regulations

Both provincial/territorial and federal governments have established guidelines for the testing and sale of compost products. Criteria include maturity/stability, trace elements, pathogen as well as moisture content and depending on ingredients, N-P-K. Sampling standards as well as reporting requirements are also included in the regulatory framework under which compost facilities must operate.

The Compost Council of Canada and our members have been actively involved in the development as well as the ongoing reviews of these guidelines. During these reviews and as part of the ongoing nurturing of the advancements of organics recycling across Canada, it became apparent that, while these guidelines meet the requirements from the perspective of government regulators, there was an important need to go above and beyond these guidelines to also reflect agronomic parameters that would help ensure that the right compost was used for the right purpose.

Hence the Compost Quality Alliance (CQA) was developed – to not only reflect government regulations but to go over and above requirements to also test for the agronomic properties of compost and direct its usage appropriately.

CQA is a voluntary initiative, open to all compost producers across Canada. Upfront operational audits as well as testing procedures are required of all CQA-members along with an ongoing sampling regime and attribute focus and market sale.

Look and Shop for the Compost Quality Alliance (CQA) on your compost and soil products.

Feed the Soil … COMPOST!

Conseil canadien du COMPOST Council of Canada

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Nutrient Analysis and Estimate of Available Nutrients for Organic Amendments Used in the Project

	OrgaWorld Compost-Ottawa		Orga World compost-London		Smith Falls Biosolids Pellets	
	Analysis	Available (lbs/ton)	Analysis	Available (lbs/ton)	Analysis	Available (lbs/ton)
						
Description:	Uncured - In-vessel ~ 30 days to finish - ↑yard waste than London		Uncured - In-vessel process ~ 30 days start to finish		Processed biosolids CIFA product	
Dry Matter %	81.9	1,638	76.6	1,532	89.1	1,782
Total Nitrogen %	1.54	8.6 + 1.7 = 10.3	2.78	14.9 + 4.5 = 19.4	2.78	16.6 + 0.14 = 16.7
NH_4-N (ppm)	1,143		3,003		96	
Phosphorus %	0.50	18.4 (P_20_5)	0.62	22.8 (P_20_5)	1.60	59
Potassium %	0.97	21.0 (K_20)	0.77	16.6 (K_20)	0.11	2.4
Organic Matter %	46.9	938	51.6	1,032	44.3	886
pH	8.4		7.6		7.1	
C:N ratio	17 : 1		13 : 1		9 : 1	
Bulk Density	351 kg/m^3	21.9 lbs/ft^3	455 kg/m^3	28.41 lbs/ft^3	563 kg/m^3	35.2 lbs/ft^3
Sulphur (ppm)	3,106	6.2	3,966	7.9	4,731	9.5
EC (conductivity) (ms/cm)	6.3	8.0	15.68	20.1	2.51	3.2
Sodium %	0.57	11.4	0.86	17.2	0.10	2
Aluminum (ppm)	3,785	7.6	1,726	3.5	150,171	300
Boron (ppm)	17.7	0.04	20.4	0.04	3.4	0.007
Calcium (%)	3.68	74	3.98	80	2.17	43.4
Copper (ppm)	37.4	0.07	41.3	0.08	259	0.52
Iron (ppm)	6,404	13	1,970	3.9	7,122	14.2
Magnesium (%)	0.61	12.2	0.43	8.6	0.74	14.8
Manganese (ppm)	199	0.40	90.9	0.18	128	0.3
Zinc (ppm)	109	0.22	385.5	0.77	640	1.3
	Available N - P_20_5 - K_20 (lbs/acre)					
N-P_20_5-K_20 @ 10 ton/ac	**~ 103 – 184 – 210**		**~ 194 – 228 – 166**		**~ 167 – 590 – 24 ****	

[1] assumes spring application to corn, incorporated within 24 hours

** Application limit (?)
P availability with high Aluminum??

Table 2 (continued)

	AIM Environmental		Miller Compost		Try Recycling Compost		Peel Region Compost	
	Analysis	**Available (lbs/ton)**	**Analysis**	**Available (lbs/ton)**	**Analysis**	**Available (lbs/ton)**	**Analysis**	**Available (lbs/ton)**
								
Description:	Uncured - In-vessel process ~ 30 days start to finish		Leaf-yard + SSO? composted/ cured in windrows outdoors		Leaf-yard waste composted/ cured in windrows outdoors		In-vessel ~ 7 days then cured in covered windrows	
Dry Matter %	48.0	960	49.5	990	61.7	1,234	57.9	1,158
Total Nitrogen %	1.55	8 + 4 = 12	0.89	5.34 + 0.03 = 5.4	0.98	5.8 + 0.2 = 6.0	1.43	8.6 + 1.3 = 10
NH_4-N (ppm)	2,250		16		142		840	
Phosphorus %	0.33	12 (P_2O_5)	0.24	8.8 (P_2O_5)	0.21	7.7 (P_2O_5)	0.36	13.2 (P_2O_5)
Potassium %	0.47	10 (K_2O)	0.46	9.9 (K_2O)	0.53	11.4 (K_2O)	0.64	13.8 (K_2O)
Organic Matter %	38.0	760	21.2	424	30.2	604	42.3	846
pH	4.9		8.1		7.6		8.2	
C:N ratio	14 : 1		17 : 1		13 : 1		16 : 1	
Bulk Density	340 kg/m^3	22 lbs/ft^3	630 kg/m^3	39.3 lbs/ft^3	596 kg/m^3	37.2 lbs/ft^3	349 kg/m^3	21.8 lbs/ft^3
Sulphur (ppm)	3,106	2.5	1,073	2.1	1,171	2.3	1,313	2.6
EC (conductivity) (ms/cm)	6.25	8.0	3.83	4.9	3.15	4.0	5.86	7.5
Sodium %	0.21	4.0	0.09	1.8	0.07	1.4	0.34	6.8
Aluminum (ppm)	600	1.2	2,267	4.5	2,183	4.4	670	1.3
Boron (ppm)	11	0.02	10.4	0.02	15	0.03	24.7	0.05
Calcium (%)	1.65	33	3.45	69	3.70	74	2.48	50
Copper (ppm)	50	0.1	37.9	0.08	35.5	0.07	14.9	0.03
Iron (ppm)	1350	2.7	5,584	11.2	5,644	11.3	1,492	3.0
Magnesium (%)	0.2	4.0	0.29	5.8	0.79	15.8	0.23	4.6
Manganese (ppm)	100	0.2	218.5	0.44	219.2	0.44	68.6	0.14
Zinc (ppm)	50	0.1	93.9	0.19	251.0	0.50	51	0.10
	Available N - P_2O_5 - K_2O (lbs/acre)							
N-P_2O_5-K_2O @ 10 ton/ac	**~ 120 – 120 – 100**		**~ 54 – 88 – 99**		**~ 60 – 77 – 114**		**~ 48 – 132 – 138**	

[1] assumes spring application to corn, incorporated within 24 hours

Metric Conversions: (ton/ac x 1.11 = tonne/ha); (lbs/ac x 1.11 = kg/ha); (lbs/ton x 0.5 = kg/tonne)

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Effect of different treatments on bacterial communities associated with corn plants

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Introduction

A & L Biologicals received 70 corn plants from 13 different plots treated with 6 different treatments. The following is the list of the samples received:

1. Strathmere Lodge – check 130 lbs N (5 plants)
2. Strathmere Lodge – Try compost + 72 lbs N (5 plants)
3. Strathmere Lodge – Orga compost + 36 lbs N (5 plants)
4. Strathmere Lodge – Check 130 lbs N (5 plants)
5. Strathmere Lodge – Orga compost 0 N (5 plants)
6. Strathmere Lodge – Try compost 0 N (5 plants)

7a. Strathmere Lodge – Check 0 N (5 plants)
7b. Strathmere Lodge – Check 0 N (5plants)

8. Strathmere Lodge – try compost + 72 lbs N (5plants)
9. Strathmere Lodge – Orga compost + 36 lbs N (5 plants)
10. Strathmere Lodge – Check 130 lbs N (5 plants)
11. Strathmere Lodge – Orga compost 0 N (5 plants)
12. Strathmere Lodge – Try compost 0 N (5 plants)
13. Strathmere Lodge – Check 130 lbs N (5 plants)

Sap and root-associated bacterial communities were analyzed using fingerprinting technique known as terminal restriction fragment length polymorphism (TRFLP).

TRFLP is a popular high-throughput fingerprinting technique for monitoring changes in the structure and composition of microbial communities. The DNA extracted from soil or tissue samples is used to amplify a gene fragment common to the general population or for a specific gene that regulates a specific function using the polymerase chain reaction procedure (PCR) with fluorescent labelled primers. The amplicons, (fragments amplified) are then digested with restriction enzyme that cuts the fragments at a very specific site. As a result, the ends of the cut fragments are labelled with a fluorescent coloured dye. The size and quantity of the fragments are then determined using capillary electrophoresis. The banding pattern obtained provides a fingerprint of the microbial soil community similar to a barcode. The relationship of these fingerprints to one another can be identified using a multivariate statistical technique called Principle Component Analysis (PCA). Principle Components (PC) are statistical values generated to best explain the variation in a set of samples. In addition to taxonomic profiling, T-RFLP can also be used to characterize functional diversity in a bacterial community. Primers are used to amplify conserved sequences present in functional genes and in this manner we can differentiate the functional genetic diversity present in the community such the extent and types of genes involved in nitrogen fixation (*nif*H), antibiosis, etc. (Mengoni *et al*. 2007). The data can also be used to identify shifts in abundance of microorganisms and identify the presence or absence of different microorganisms among samples. TRFLP can be used track spatial and temporal shifts in microbial populations throughout the growing season in the soil and in plant tissue and can also be used to track any changes due to different treatments.

Objectives

- To determine the effect of the different treatments on the sap and root-associated bacterial populations.

Materials and Methods

Wash roots were cut into small pieces and homogenized using a Kleco machine. Total DNA was extracted from 250 mg of homogenized roots from each sample using a Norgen Genomic DNA Isolation kit (Norgen Biotek Corp. ON) following the manufacturer's protocol. Five ml of corn sap were spun down and DNA was extracted from the remaining pellet as described above.

A PCR master mix was made with a final reaction volume 50 µL. The two primers that were used in the bacterial PCR were 63F primer with sequence CAGGCCTAACACA TGCAAGTC and 1389R primer with sequence ACGGGCGGTGTGTACAAG. A 1% agarose gel was run to check the reaction products. The PCR products were purified using a DNA clean and concentrator (Zymo Research Corporation, Irvine, CA, USA). 12 µL of purified PCR product was added to 13 µL of restriction mixture (*Hha*I) and incubated in darkness at 35ºC for 3 hours before sequencing gel analysis using a 3730 DNA Analyzer alongside GeneScan 1200 LIZ Size Standards (Applied Biosystems, USA). TRFLP results were analyzed using Gene Marker (SoftGenetics LLC) with default settings and a modified fragment peak intensity cut-off of 50. The forward and reverse fragment size plus intensities are exported to Microsoft Excel and the data analyzed using principle component analysis (PCA) with the software, XLStat. For PCA analysis the TRFLP results are transformed into binary data (is a certain size signal there or not?) and clustered on the basis of similarity of peak presence or absence.

Intensity graphs using the fluorescent values of each peak were also generated to better illustrate the microbial profiles of each sample. The fluorescent intensity of each peak can be related to the relative abundance of the organism or organisms associated with each peak. For example peaks that have really high intensity values represent a high abundance of that particular organism in the sample. Intensity graphs can uncover patterns and shifts in abundance in community profiles that could be missed by principle component analysis which mainly focuses on presence or absence.

Results

Root-associated bacterial communities

Samples consisted of 10 plants per treatment except for Check + 130 lbs N treatment that had 20 plants. Unfortunately we were unable to obtain useful TRFLP data from 4 plants treated with Check + 130 lbs N, two plants from Try compost + 72 lbs N, one plant from Orga compost + 36 lbs N, one plant from Orga compost + 0 N and 3 plants from Check + 0 N. We performed the analysis with the remaining data.

Terminal restriction fragment analysis generally can identify about 1-2% of the microbial population in a given sample. This however, represents hundreds or thousands of observations. In order to compare the profiles generated from such data we utilize a statistical analysis method termed principle component analysis (PCA). PCA turns all present or absence data into 0s or 1s, where 0 means absent and 1 means present. The data can then be summarized as single data points which are then plotted two dimensionally; the distance between dots indicate the degree of differences among treatments. Dots within the same circle are considered statistically similar. PCA also can be performed based on the intensity of bacterial peaks found through 0 bp and 1200 bp.

To confirm the reproducibility of these experiments, we first compare the root-associated bacterial communities of corn plants from different plots within the same treatment. We based the PCA of bacterial TRFLP on peak intensity. As shown in Figure 1, we did not find statistically significant differences between bacterial populations of plants within the same treatment (as demonstrated by dots contained within the same circle), confirming the reproducibility of the experiment. Next, we compared by PCA the bacterial TRFLP of all the samples. As showed on Figure 2, root-associated bacterial communities did not change on a statistically significant manner after different treatments were applied.

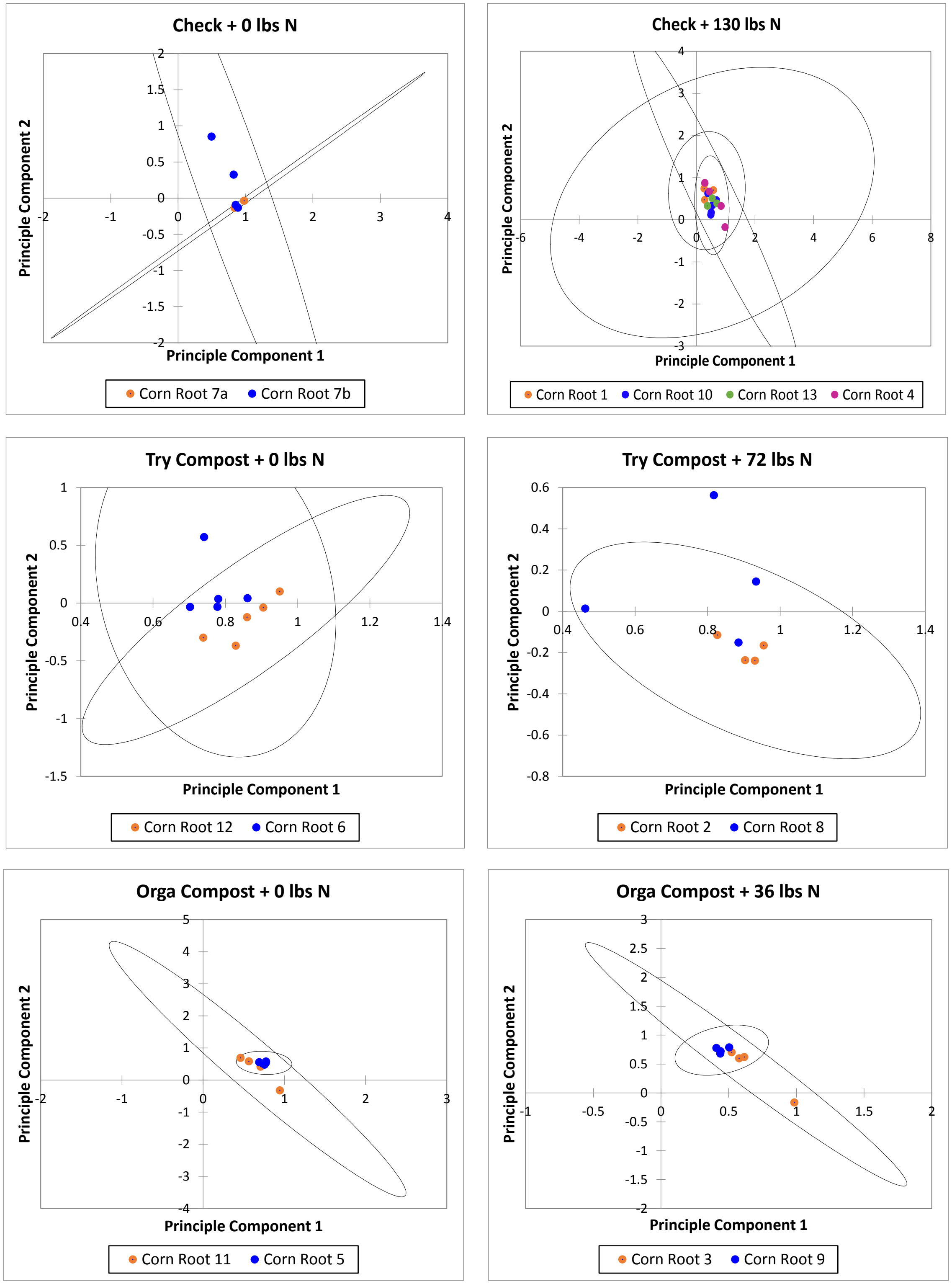

Figure 1: Principle component analysis of the bacterial communities associated with roots from corn plants grown in different treated soils. Each dot represent the results from 1 plant. Dots within the same circle are considered statistically similar. Numbers on the legends of each graph refer to the sample number (see list on page 2).

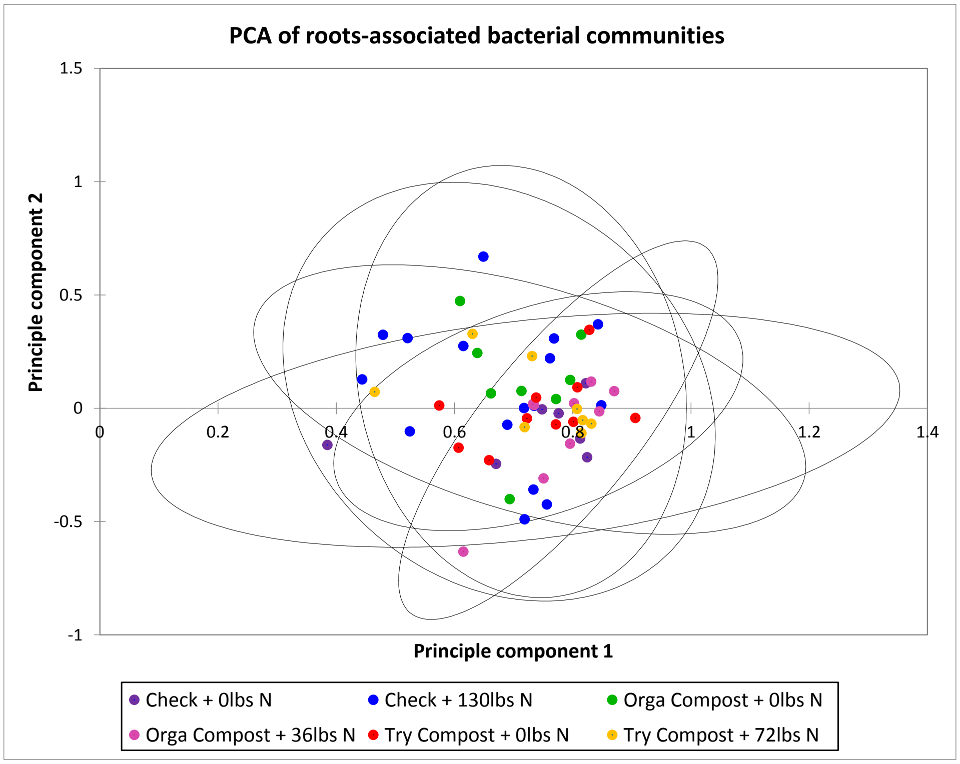

Figure 2: Principle component analysis of the bacterial communities associated with roots from corn plants grown in different treated soils. Each dot represent the results from 1 plant. Dots within the same circle are considered statistically similar.

The peak intensity profiles of the bacterial communities provide a snap shot of the diversity and abundance of the organisms that make up the populations in each sample. Each peak may represent a unique species or a family of related species and it is possible to identify the bacterium or bacteria responsible for each peak. Although the same bacterium may be represented by multiple peaks.

The graph presented on Figure 3, clearly showed that root-associated bacterial communities did not change regardless of the treatment applied and that they are very similar between them. The majority of the peaks are common to all treatments and the most intense peaks were found at 40 bp, 205 bp and 335 bp. This suggest that the bacterial species responsible for those peaks are the most abundant on the corn roots and they are not affected by the treatments. Treatment with Orga compost + 36 lbs N changed the intensity of the peaks at 40 bp, 305 bp and 335 bp, while treatment Check + 130 lbs N changed the intensity of the peak found at 175 bp, suggesting they might favour some bacteria populations. Peaks shown in Figure 3 represent the average intensity of all the replicates available from each treatment.

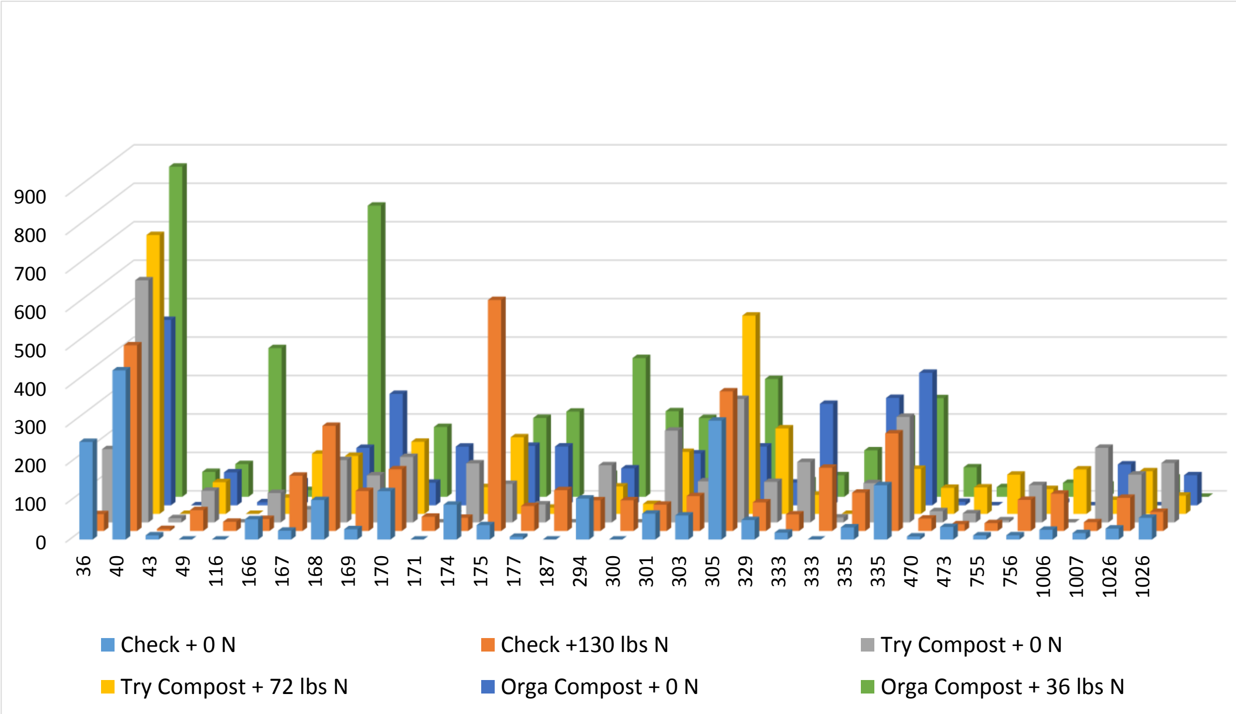

Figure 3: Peak intensity profiles for the bacterial communities present in corn roots. The X axis represents the base size fragments and the Y axis the fluorescent intensity of the peak. The higher intensity peak indicate a greater abundance of certain bacteria. Each peak in this graph represent average of all the replicates available from each treatment.

Sap-associated bacterial communities

From the 70 corn plants we were unable to obtain useful TRFLP data from the sap of 9 plants treated with Check + 0 lbs N and from 3 plants treated with Check + 130 N. We performed the analysis with the remaining data.

As with the root bacterial communities, PCA based on the intensity of bacterial peaks found in the sap confirmed the reproducibility of the experiment. Figure 4 shows that there is no statistically significant differences between bacterial populations of plants within the same treatment (as demonstrated by dots contained within the same circle). Considering that we have just one plant from Check + 0 lbs N, this treatment was not include on Figure 4. Similarly, root-associated bacterial communities did not change on a statistically significant manner after different treatments were applied (Figure 5, including Check + 0 lbs N data).

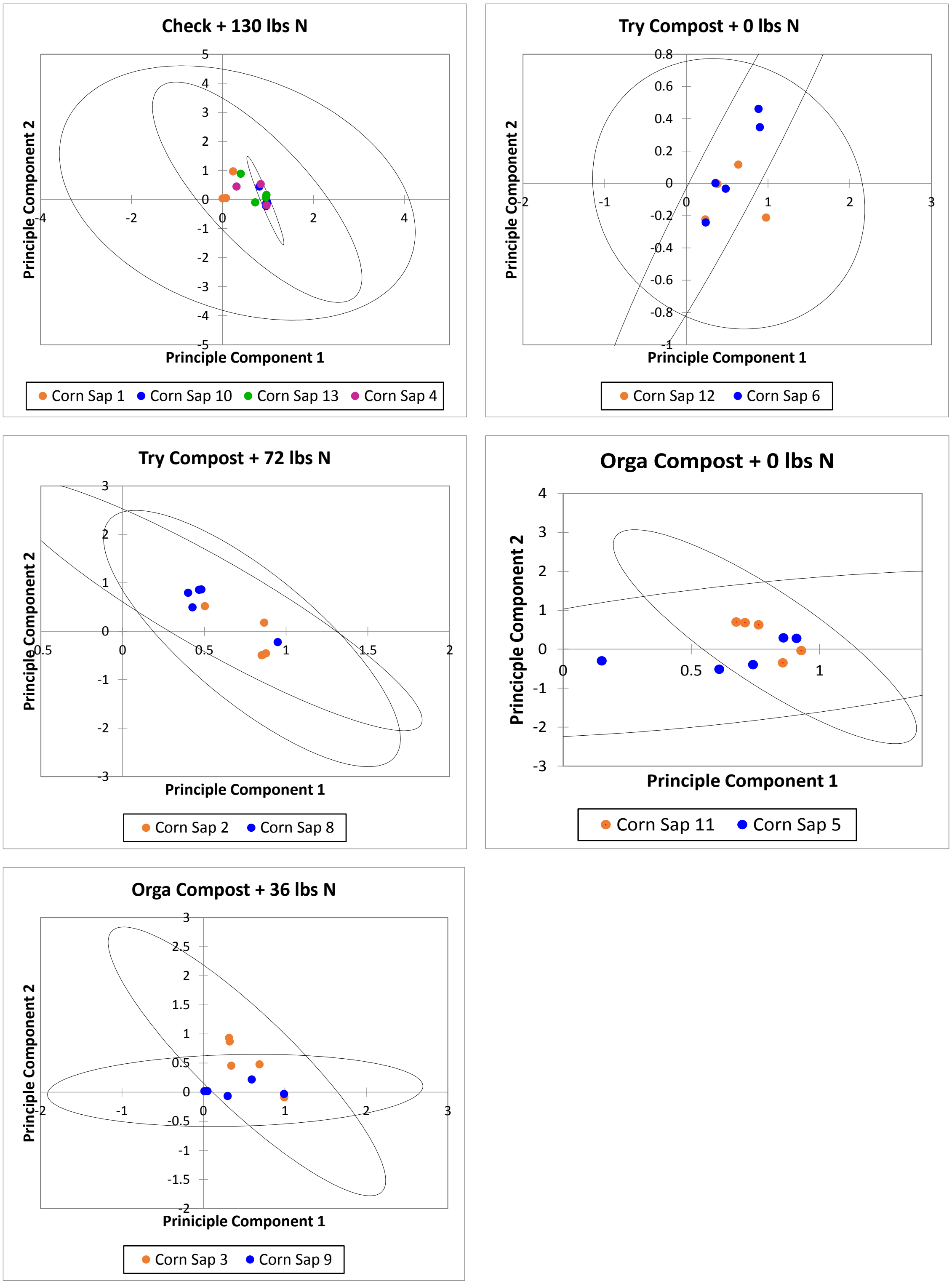

Figure 4: Principle component analysis of the bacterial communities associated with sap from corn plants grown in different treated soils. Each dot represent the results from 1 plant. Dots within the same circle are considered statistically similar. Numbers on the legends of each graph refer to the sample number (see list on page 2).

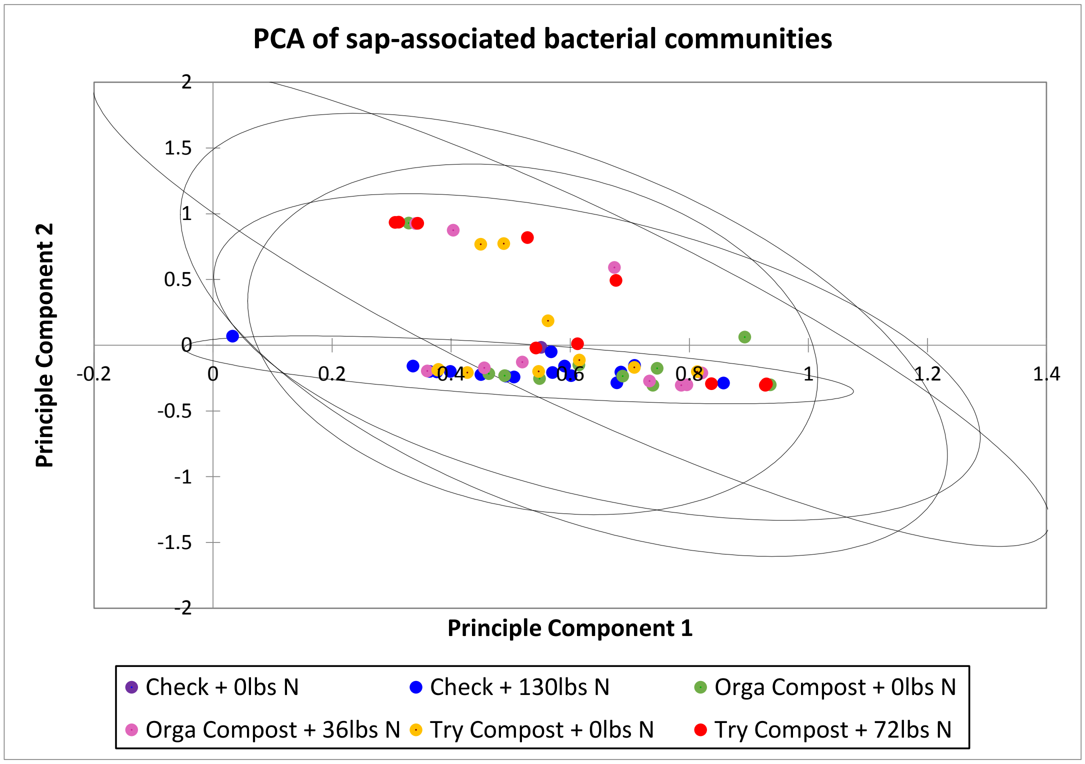

Figure 5: Principle component analysis of the bacterial communities associated with sap from corn plants grown in different treated soils. Each dot represent the results from 1 plant. Dots within the same circle are considered statistically similar.

Figure 6 shows the bacteria peaks intensity profiles from sap extracted from corn grown in different treated soils. It is evident that that corn sap communities are less diverse than the bacterial communities from roots, as indicated by the presence of fewer peaks. The peaks profile are very similar between treatments, confirming that sap-associated bacterial communities did not change regardless of the treatment applied. The majority of the peaks are common to all treatments and the most intense peaks were found at 168 bp, 334 bp and 1005 bp. This suggest that the bacterial species responsible for those peaks are the most abundant on the corn sap. Peaks shown in Figure 6 represent the average intensity of all the replicates available from each treatment.

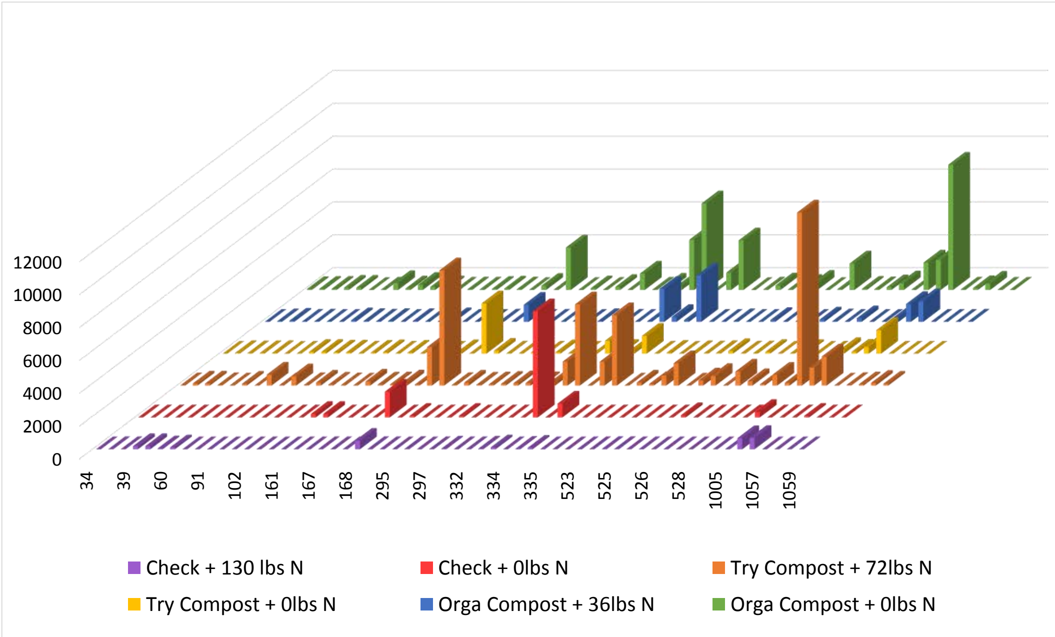

Figure 6: Peak intensity profiles for the bacterial communities present in corn sap. The X axis represents the base size fragments and the Y axis the fluorescent intensity of the peak. The higher intensity peak indicate a greater abundance of certain bacteria. Each peak in this graph represent average of all the replicates available from each treatment.

Conclusions

Our results indicated that the treatments applied did not cause statistically significant changes in bacterial communities associated with roots and sap of corn plants.

In our previous studies we have compare the microbiome of soil and different plant tissues and concluded that corn sap is an excellent source to compare corn-associated microbiome between high and low corn producing sites. We have included TRFLP results of sap-bacterial communities for this reason. It would be interesting to compare the final yields to see whether sap-bacterial communities can be used as good indicators of corn yield.

ABOUT COMPOST APPLICATION EQUIPMENT

Choosing the correct application method is crucial to getting the most economic, nutrient and soil benefits from compost.

The aim is even and predictable distribution of the desired amount at the lowest cost and with the least soil compaction or other damage to the field.

That means using the type of spreader best suited to the type of compost as well as the area and crop being treated.

The cost of buying, maintaining and operating the equipment can be high, so all but the largest farm operators might prefer to contract the work to a custom applicator.

There are four main types of spreaders — rear discharge with horizontal beaters, rear discharge with spinner beaters, rear discharge with vertical beaters, and side discharge.

Each is different in terms of the types of compost it can handle, its spread pattern and consistency, the type of terrain it is best suited for, and its power requirements. Spreaders can be self-propelled or towed, and the compost can be moved into the beaters by gravity, hydraulic pushers or a moving floor.

It's essential to ensure the spreading equipment is compatible with the type of compost being applied, whether dense, fluffy, moist or dry. However, compost can be adapted to some equipment by additional screening or drying.

"I'm a big believer that you should test equipment with your product before you buy," says Ron Alexander, a composting and organics recycling consultant based in North Carolina. The spreader must not only be suited to the material you plan to apply, but also to the scale of your operation, both in terms of the quantity and the amount of room to manoeuvre.

The compost's moisture content is a major consideration, Alexander says. "With a sticky compost, I'm not sure if spreaders can handle it. It might be better to grade it with a blade."

Some crops need a thin compost application; others need more. In all cases, consistency is crucial since a non-uniform pattern can harm germination, and cause crop burn or nutrient deficiency.

1. Rear discharge with horizontal beaters: This is the basic and most common spreader. It requires relatively low power and is simplest to operate. Its spread pattern is narrow, covering little more than the width of the spreader. On one hand, it's useful for farmers who want to spread precisely measured, heavy applications along long fields. But the narrow spread pattern means more trips across the field, which means, in turn, more soil compaction along with greater spreading time and fuel consumption. This type can't spread light applications of compost: In tests of composted manure, conducted by Alberta Agriculture's AgTech Centre in Lethbridge, the lowest rate was about 35 tonnes per hectare. Horizontal beaters are also relatively poor at breaking up clumps of dense or frozen material.

2. Rear discharge with spinner beaters: This type is equipped with spinning "Lazy Susan" disks that use centrifugal force to project compost from the rear of the spreader. It's designed to spread relatively dry, dense, fine-textured materials. Spinning provides a wider, more even spread pattern, for fewer trips across each field, and allows lower application rates — down to 14 tonnes per hectare in the AgTech Centre tests.

3. Rear discharge with vertical beaters: Because of their strong throwing force, this type provides a wide, uniform spread pattern. It unloads quickly and is good at breaking up dense or frozen materials. The fine chopping means less effort is needed to incorporate the compost into the soil, so it's well suited for no-till farming. But this type requires relatively high power and is more complicated than the horizontal designs to operate and maintain. Its ability to throw rocks as far as 20 metres also raises safety concerns. In the AgTech Centre tests it achieved uniform spread rates as low as 4.6 tonnes per hectare.

4. Side discharge: This type uses flails that break up the compost and fling it to the side of the spreader. It creates the widest spread pattern of the four. It can also apply compost along relatively steep side slopes, as long as it's running along level ground. Most analysts say rear discharge is better for compost application; side discharge is more suited to higher-liquid soil.

SUPPLIERS OF COMPOST APPLICATOR EQUIPMENT

The following provides a list of some of the companies which provide compost applicator equipment. This list is not comprehensive nor should be considered as being endorsed by this report.

1. Artex Manufacturing

http://artexmfg.com/manure-spreaders/

Artex makes twin vertical beaters that pulverize the compost material and throw it on a path nearly 20 metres wide, for fewer passes in the field.

2. BEM Industries Inc. (Mohrlang Fabrication)

http://www.spreaderz.com

The “Super Spreader’ is truck-mounted, handles manure, silage and compost, and is offered in three lengths and outfitted standard with an all-hydraulic, smart drive system.

3. FSI Fabrication Inc.

http://fsifab.com/index.php

The “EzSpred Fp” spreader has separate pumps for the floor and beaters. If the beater motor is overloaded, the floor motor stops. When pressure returns to normal, the floor restarts.

4. Global Repair (Sittler Compost Euipment)

http://www.globalrepair.ca/spreader.htm

The “Row Crop” spreader, with extra-wide, multi-speed discharge spinners, features an improved, powerful discharge mechanism that provides consistent, even distribution of a wide variety of materials, wet or dry.

5. GTI Bunning & Sons Ltd.

http://www.gtbunning.com

Products include “Lowlander” vertical augers and a second line with twin horizontal beaters feeding material on to dual spinning disks, all in a wide variety of sizes.

6. Hagedorn

http://hydra-spread.com/

The “Hydra-Spread Series II models feature horizontal beaters with aggressively shaped paddles for better distribution of the material. The “Extravert” models employ vertical beaters that, the company says, can shred even corn and bean stalks to “indistinguishable fineness.”

7 Kuhn Group (Kuhn Knight)

http://www.kuhnnorthamerica.com/us/products.html

The Kuhn Group makes a wide variety of spreaders, including the ProSpread line of rear-discharge spreaders, with several beater options, and the ProTwin side-discharge slinger.

8. New Holland

http://agriculture1.newholland.com/nar/en-us

Products include “100 Series” box spreaders with horizontal beaters, “HydraBox” hydraulic spreaders with vertical beaters designed for wide, thin spreading, and “DuraTank” side spreaders with right-side discharge.

9. Poettinger Canada Inc.

http://www.poettinger.at/landtechnik/download/twist_en.pdf

Twist rear-discharge spreaders include either two horizontal or four vertical beaters, and two or four floor scraper chains. A V-shaped frame helps to keep the spreader box from twisting.

10. Rolland

http://www.remorquerolland.com/?lang=uk

“RollMax” large-volume spreaders use either twin vertical beaters or a spinning deck to distribute compost, sludge or chicken muck.

11. Salford BBI

http://www.bbispreaders.com/foundations/store/scresults.asp?category=185*Compost_Spreaders

“Endurance” compost spreaders come in either pull-type or truck mounted and feature a Poly Floor to increase durability and reduce friction between the floor and conveyor.

12. Tebbe

http://www.tebbe-landmaschinen.de/2-0-Tebbe+Streuer.htm

CROSS-CANADA CONVERSATIONS ABOUT COMPOST-USE-IN-AGRICULTURE

Through conversations with researchers and compost market proponents

in different regions across Canada,

Peter Gorrie describes various initiatives and observations

in the following series of articles:

i. British Columbia: Dr. Tom Forge

ii. Alberta: Brent Hamilton & Dr. Frank Larney

iii. Manitoba: Dr. Lord Abbey

iv. Quebec: Mme Pascale Cantin

v. Atlantic Canada: Joe Brennan, Roger Henry, Gilles Moreau, Dr. Bernie Zebarth

With the support of the

Greenbin Compost Agricultural Growth Trials

Farmers Feed Cities – Cities Feed Farm Soils

BRITISH COLUMBIA – Dr. Tom Forge

In British Columbia, Tom Forge, a research scientist with Agriculture and Agri-Food Canada, originally working at the AAFC Research Station in Agassiz and now based in Summerland, has been working for a decade with a variety of composts on perennial fruit crops, mainly raspberries, apples, cherries and grapes.

He has worked with growers in two parts of the province, each with much different circumstances for compost.

On the lower mainland, compost must compete against the low-cost or free manure available from many poultry and cattle growers and dairy farms.

In the Okanagan Valley, with little livestock production, growers are looking for economical, effective sources of organic matter. They like compost, but producers must build trust in their products and convince growers they are worth the cost.

In both areas, compost is applied in two ways:

i. With fruit trees, canes and vines already in the ground, it can't be incorporated into the soil: Instead, it is applied on the surface.

   Forge has tried the surface application approach with a variety of composts. Most recently, he is applying composted digestate and leaf and yard residues from Harvest Power's two-year-old anaerobic digester and composting facility in the Vancouver suburb of Richmond.

   While it is far too soon for definitive conclusions from the trials with Harvest Power compost, early results seem positive, he says. "We certainly haven't had any negative issues." From experience he knows that "with surface application it takes a few years for the benefits to show up, and the initial improvements in yield are usually pretty modest.

   "We do have documented improvements in moisture retention, organic matter, suppression of parasites, nutrient availability and pH buffering capacity." However the modest yield results and the fact it is more difficult to apply than commercial fertilizer make the technique, "a bit of a difficult sell."

ii. Compost can also be applied when old trees and canes are replaced. At this point, the soil is likely depleted and populated by destructive nematodes and other parasites and pathogens. The usual practice is to fumigate the soil, or add manure, or do both, before planting the replacement stock.

   Forge is experimenting with adding compost at a "high" rate of 50 to 60 tonnes per hectare before the replanting of cherry trees and raspberry canes. He is using Big Horn Natural Compost, made from agricultural residues such as animal bedding and grape pomace by Big Horn Contracting Ltd., in Okanagan Falls, and GlenGrow, composted leaf and yard residues produced by the City of Kelowna.

   In the raspberry trials compost produced dramatic increases in cane growth relative to untreated soil, and nearly as good as in fumigated soil. The experiments with cherry trees were started more recently.

“We’ve only been through two growing seasons since replanting, so it’s difficult to draw conclusions,” he says. “These types of experiments, with woody perennials, take a few years before effects on yields and fruit quality are fully realized. Early tree growth is not as good as with fumigation, but it’s quite acceptable, and certainly better than in untreated soil.”

In other ways, “we’re getting really good results,” he says. “We’re observing all the beneficial changes in soil properties plus some suppression of nematodes that should translate into improved growth and cherry production.

Many questions remain to be answered.

Forge also hasn’t yet fully analyzed the economics of using compost compared with fumigation, although early indications are they could be about equal.

Fumigation costs about $2,000 per hectare.

In the most recent experiment, compost is being incorporated at a rate of 60 tonnes per hectare, but only in the planting rows, which occupy about one-third of the total orchard area. That means 20 tonnes is applied on each hectare. At $100 per tonne, the cost per hectare is, therefore, $2,000.

“So, fumigation and compost are in the same ballpark in terms of up-front cost,” Forge says. “Fumigation is still giving us slightly better first-year tree growth. However, we can't do a true cost-benefit analysis until we start harvesting fruit after three years and beyond.”

In addition, compost costs vary widely, depending in part on how far the material must be hauled from producer to field and how much is to be applied. So the cost part of the equation might change.

The assessment also includes whether any fumigants must be added even when compost is applied. It’s too soon for that result, too, which might significantly alter the calculation, Forge says. “We need to do a few more trials.”

Still, the research is generating a lot of interest from growers, he says. “People in the industry see and appreciate our results.”

And other factors might improve compost’s prospects.
@ Fumigation is coming under tighter restrictions, making it more difficult to use.
@ When applied at rates needed to really improve soil organic matter, manure generally provides more nutrients than crops can consume and, as a result, nitrates from it leach into groundwater, particularly during heavy fall rains. Measures to curb this pollution are, for the most part voluntary. But, Forge says, they are under review. If the use of manure on these fruit crops becomes morerestricted, compost, which does a much better job of retaining moisture and nutrients, will become a more attractive option.

Good results from additional trials will add to the demand for compost, as will publicizing the specific benefits, and educating growers, Forge says.

In the Okanagan Valley, growers will pay a modest price for compost, he says. “I think this will come with the dissemination of our results” and further education. Expansion of the Compost Quality Alliance standards would also help, by building trust in the product. “We need a systematic evaluation of it.”

On the lower mainland, because manure is so available, “it’s a different scenario.” Regulators would have to “really clamp down on raw manure use.”

ALBERTA – Brent Hamilton & Dr. Frank Larney

With a massive livestock industry and two major cities, Alberta has plenty of feedstock for compost.

The province's sprawling grain farms and pastureland should be good markets for organic soil amendments.

But, as elsewhere in Canada, compost producers face challenges; in particular, with hauling their product to where it's needed.

The City of Edmonton produces about 50,000 tonnes of compost annually from its municipal solid waste collections. It sells only one-fifth of it. The rest is being stockpiled.
Most of the sales are to farms that grow canola or forage crops, or are kept in pasture. A small amount is used as an absorbent at oil-well sites.

The major roadblock to farm sales is price due to trucking costs, says Brent Hamilton, president of Edmonton-based Inglis Environmental Ltd., which specializes in compost sales and marketing, compost brokerage services and commercial organic waste collection, and is contracted to move the compost produced at the city's Waste Management Centre.

Farmers continue to compare the cost of compost's nutrients with those provided by chemical fertilizers. They can buy it for just $6 per tonne — or $8 if ground wallboard is added to supply gypsum. That price is far below the production cost, Hamilton says. "This is not a situation where you can make something and recoup the cost. It's only a support for waste diversion."

At $6 per tonne, the compost's cost is equivalent to fertilizer.

But add trucking and it's a different story, Hamilton says. The composting facility is in Edmonton. Most of the farms are a couple of hours away. Trucking typically costs about $580 per load, which is far more than the value of the product. That charge brings the price, delivered and spread, to between $30 and $34 per tonne.

"It's always the same discussion," Hamilton says. "Compost is seen as not competitive with fertilizer. Even though they're not the same thing, it doesn't matter. At the end of the day it's a competition with fertilizer. So we're only selling the product based on nutrition. That's unfortunate, but that's the way it is."

In addition, Edmonton gives away raw biosolids from its sewage-treatment plant. The free supply includes transportation and spreading, Hamilton says. "At the end of the day, they're only concerned with moving biosolids out of the system.

"I can't compete with free."

All the compost would be taken if it, too, were free, including transportation. But city officials won't allow that.

"The city's Number One goal is to get something for the compost; to not give it away for free," Hamilton says. "That's the primary goal. The $6 price doesn't bother anybody, even though it's well below their cost. They're happy with $6."

Hamilton says he wins some agriculture sales by letting farmers split the cost over two years. Most farms operate on a two-year rotation, so each field gets compost every second year. That means the farm needs the same amount of compost each year. Still, even though the total expense is the same, farmers like the two-year payment plan.

Sales would get a boost if fertilizer prices rise, but that's unlikely in the foreseeable future, Hamilton says.

Reducing contamination would also help, he says. The compost feedstock is a mixed waste stream containing organics and non-organics destined for landfill: Only recyclables are collected separately. While most of the non-organics are removed before composting, the product still contains contaminants.

"Farmers don't want to pick out plastic and glass," Hamilton says. The Canadian Council of Ministers of the Environment (CCME) sets a regulatory standard for contamination, but it's what farmers see that counts. "Even if it's within the (CCME) numbers, they won't take it."

The compost goes through a quarter-inch screen. Reducing the size to one-eighth inch would eliminate the visible contaminants, but that move is considered too slow and expensive.

The potential big selling point, though, is that compost makes a difference that fertilizer can't.

"Farmers keep seeing the benefits," Hamilton says. "They know it's working. They see different numbers in their soil tests and different results, regardless of weather and other conditions in a growing season. That's starting to get noticed.

"The composted fields are surviving more extreme climatic conditions. Whether drought or excessive moisture, they do better. It's something we talk about a lot, but how do you quantify it and put it in a marketing program."

In last summer's drought, the composted fields held up well, he says. "We might see sales impacts from that next year."

Ultimately, the agriculture market might not matter for compost producers, like Edmonton, that are relatively close to the tar sands and other major oil-production facilities that need to undertake land reclamation once the resource is exhausted.

The oil companies aren't required to use compost, so they don't. But if provincial regulations demanded it, that would be a huge market. "You can figure it out," Hamilton says. "All it would take is one oil and gas company to be interested. They'd eat up all our volume, and that of any other composting facility in the area."

He hopes to have talks with the new Alberta government about measures to promote compost use for reclamation.

In Southern Alberta, the vast feedlots packed with beef cattle generate large quantities of manure and bedding; a combination ideal for composting, says Frank Larney, a specialist in composting and soil reclamation with Agriculture and Agri-Food Canada, who has researched compost for two decades.

Much of the manure is spread raw on farm fields, but that material is associated with odours as well as the spread of weed seeds and pathogens. Since it's heavy, manure can only be trucked short distances, so most farms near the feedlots are over-loaded with it, which leads to problems with nutrient leaching.

Larney's work has shown that composting the manure not only cuts odours but also kills the seeds and, in a typical study, eliminated 99.9 per cent of e-Coli bacteria in just a week. By cutting moisture content from manure's 70 per cent down to around 30 per cent, it also makes it possible to transport compost to more distant farms.

Another advantage: Compost releases its nutrients more slowly, reducing run-off and leaching.

Larney, who is based in Lethbridge, and others have used compost, as one of several conservation-management practices in a 12-year study on irrigated land with a rotation of potatoes, sugar beets and beans. "There are definite benefits to soil health and quality from compost," he says.

Feedlot operators are starting to compost. "Twenty years ago, no one was doing it in the industry," Larney says. Now, although formal statistics aren't available, it appears one-quarter to one-third of the manure is at least stockpiled and allowed to start to mature before it is land applied.

In most cases, independent contractors do the composting on the feedlot site: There are no central facilities. They manage the process, and own and sell the compost. A few large feedlot operators handle it themselves.

The compost sells for about $25 per tonne, including hauling and spreading, for farms within a reasonable distance, and that up-front cost is an issue, especially if farmers can get manure for free. "The work we're doing now is showing the increase in soil health with compost," Larney says. "It's very difficult to put a dollar figure on. You need to buy into soil health and management, as an alternative to fertilizer."

Compost is helped by a change in farming practices. In the past, most farms were mixed, combining livestock and crops. The manure could be used on-site. Now, feedlots and cropland are widely separated. The land that could benefit from manure is too far away. Compost can be hauled longer distances.

A shift in dry areas from leaving fields fallow every second year to continuous, no-till cropping could also provide an opportunity for compost. Provincial regulations require that manure be incorporated into the soil. Compost faces no such rule so it can be surface applied, to help to build soil organic matter and conserve precious moisture.

Still, convincing farmers to use compost is a big challenge, Larney says. "They have to buy into the bigger picture in terms of overall improvement in soil quality, the thing that's difficult to put a value on."

MANITOBA – Dr. Lord Abbey

Lord Abbey's work is mainly involved with vegetable crops.

The assistant professor in the Department of Plant and Animal Sciences at Dalbousie University has tested manure from of wide variety of feedstocks for quality, how they support plant growth and what amount of compost produces the best results.

"Compost has a lot of benefits," he says. It promotes a high degree of biological activity. It helps to keep soil pH in the range of 6.5 to 7.5 that is suitable for plants to take up nutrients. But, "if you apply too much, it can harm the plants and the environment."

He has investigated whether compost should be applied every year, every second or third year, or not at all; which schedule is most beneficial to crops, soil and the environment, as well as most profitable.

He has just completed the first of a five-year study of beets, lettuce, carrots and peas on a farm near Brandon, Manitoba, applying "very mature" compost made from the city's green bin organics and leaf and yard waste. The soil in the test plot was exhausted. "I asked for that," Abbey says. "That's what you need for trials."

The compost was applied at a relatively light rate of four tonnes per acre. While final data aren't yet available, the yield was reasonable, Abbey says. "We were happy with the result."

This fall, compost was applied at 10 tonnes per acre. The grower will plant a different mix of vegetables in the spring.

The value of the nutrients in the compost, when the moisture is subtracted, is about $75 per tonne. And with the other benefits — increased soil health, environmental protection, soil microbes and organic matter — "compost has very high value compared with chemical fertilizer," Abbey says.

If, in the first year of compost application, farmers also used 30 to 40 per cent of their usual fertilizer rate, "they would see amazing results," he says. In the second growing season, they could reduce the fertilizer or use none at all because compost builds up nutrients over time.

Word of mouth is the best marketing tool, Abbey says. "Whatever growers will say, other growers will believe, more than a scientist like me." That's why he plans to run farm tours during the third year of the Manitoba trial. For the fourth year, he'll expand the tests to other farms.

Abbey suggests transportation costs could be cut by drying compost, to reduce its bulk density and concentrate the nutrients. He has done tests that show the microbes that provide so much of its value aren't destroyed the drying process as long as temperatures aren't allowed to get too high. "They survive and come back."

His study didn't include an economic or energy analysis, but with solar power the process would have minimal environmental impact, he says.

<u>Quebec – Mme. Pascale Cantin</u>

Pascal Cantin is an agronomist with the Quebec Ministry of Agriculture, Fisheries and Food. These are some of her comments, by email, in response to my questions, translated from French:

Compost isn't widely used in Quebec despite its known benefits. In general, cost is a major issue for compost in agriculture, especially since it is difficult to calculate the costs and benefits from increasing organic matter in the soil.

So far, the ministry does not promote the use of compost or other organic amendments. It does, however, organize activities to inform agronomists and farmers of the importance of soil health and good environmental farm practices. It also provides financial support for the education and measures to reduce pesticide use and improve water management.

Recyc-Québec and the provincial Ministry of Agriculture, Fisheries and Food are collaborating on the development of a tool that will help farmers and agronomists to determine the appropriateness of using various amendments on their farms.

Current Impediments to Farmers using Compost:

- Manure and non-composted organic amendments are readily available.
- They face regulatory and administrative rules.
- Because of the investment required, only a few farmers use compost they produce with plant residues from their own farms.
- Compost containing or made from human waste can't be applied on food crops.
- Farmers are reluctant to pay for compost.

Impediments to Compost Manufacturers:

- The agricultural market is not usually their first sales target since Quebec farmers have access to organic amendments that are mostly available free. As a result, producers sell much of their output as bagged products for horticulture.
- The organic farm market is small, and many organic farmers make their own compost.

ATLANTIC CANADA – Joe Brennan, Roger Henry, Gilles Moreau, Dr. Bernie Zebarth

Scientists in New Brunswick, Canada are conducting tests to determine whether applying compost on farmland is an affordable way to strengthen the province's struggling potato industry — a mainstay of the economy for more than a century.

Although the New Brunswick Potato Board says the East Coast province has "the perfect climate and topography" for growing the tubers, acreage is declining and yields are stagnant while production elsewhere in North America expands.

The industry must cope with depleted soil, increasingly uncertain weather, a relatively short growing season and the impact of local changes in agriculture: New Brunswick's potato farms no longer include the livestock operations that provided manure to maintain soil organic matter.

Competition comes from areas such as Idaho, Washington State and Wisconsin, where growers operate on much larger, flatter farms; precisely delivering moisture, fertilizer, fungicides and other inputs through sophisticated irrigation systems. These regions produce up to 600 hundredweight (60,000 pounds) of potatoes per acre; nearly double the yield in New Brunswick and Canada's other major Atlantic coast producer, Prince Edward Island.

Those involved in the industry are convinced compost has long-term benefits. They also know the relatively high cost of buying, transporting and spreading it. The tests — being conducted at both commercial field and small research plot scales — aim to determine whether, and how, compost could provide enough of a yield increase and other financial benefits to offset those costs.

The trials are among several measures — including improved seed quality and crop rotations and the use of technology such as GPS and yield monitors — being studied with the goal of increasing the average annual potato yield by 45 hundredweight per acre over four years. That improvement, combined with the province's proximity to the large American eastern seaboard market, could help to ensure a healthy industry.

The competitive challenge is clear, says Joe Brennan, project leader with Potatoes New Brunswick, the industry advocacy group.

"In the western regions the sun is a given. They know they won't get enough rain, so irrigation is needed every year. It's like an outdoor greenhouse. There's enough sun and they control moisture and nutrients.

"Here, there's little irrigation and we depend on rainfall. With rainfall, you sometimes see a deficit of water, or it doesn't always come when you need it, and you can't turn it off. Good healthy soil with good organic matter can absorb and retain moisture. It's not perfect, but with more organic matter it will do a much better job. Organic matter is our major way to manage water."

But that crucial soil ingredient has been declining, Brennan says. "We know we have an organic matter crisis. The land has been farmed hard. Organic matter numbers are not where they should be."

Potatoes "work the land pretty hard," says Roger Henry, a composting technician with the federal department Agriculture and Agri-Food Canada, based on Prince Edward Island. They draw in a lot of nutrients. They're grown on a short rotation with other crops, leaving little opportunity for the soil to be replenished. And they take a long time to grow, which means they're harvested in late fall when fields are typically wet. That situation leads to soil compaction, which destroys its structure and, in turn, increases water and wind erosion.

The field-scale tests are funded in part by McCain Foods, the New Brunswick-based international giant that processes about 60 per cent of the province's potato crop into frozen French fries. They employ compost produced by Envirem Organics out of manure from nearby poultry producers and sawdust, wood chips and bark from the province's forest industry.

Compost applications, at a rate of 27.5 tons per acre for three consecutive years, began in the fall of 2013. To date, a total of 300 acres on 10 sites has received at least one treatment. "The average yield has increased by 15 to 20 hundredweight per acre, with considerable variation from field to field and between the initial two years of testing, depending on soil conditions, weather and other factors," says Gilles Moreau, who heads the research into soil and water issues for the New Brunswick Potato Industry Transformation Initiative.

The application rate amounts to a "shock treatment," Moreau says. So far, the best results have come from loamy soils with higher organic matter, rather than from sandy or gravel soils with low organic content. "Some of those poor areas would probably need a lot more compost to make a difference," he says.

"The early yield gains aren't high enough to compensate for the cost of buying, transporting and spreading the compost," Moreau says. The trials will show whether results improve with two or three years of compost, but, in any case, "as an industry we have to look at it in a different way. We can't expect the cost of an amendment will pay for itself the year of application. We need a change of mindset."

"Compost should be viewed in the same way as lime, which is applied to regulate a soil's pH level," Moreau says. Years of production data show potatoes thrive at a pH of around six. Growers know that when pH drops to 5.6 or 5.7 it's time to add enough lime to get a little above the optimum level. These treatments are expensive, but last three or four years and are budgeted for over that period.

"There's no similar data for organic matter," Moreau says. "That is a serious lack of knowledge." Growers need to know the original organic matter, what level is required for the best yield, and at what point more should be applied, and in what quantities, for optimum results.

Such knowledge might let growers apply compost only when and in the amount needed, with a substantial cost reduction. The benefit could be increased by adjusting crop rotations and other farm practices to improve the soil's health.

Moreau hopes for an extension to his four years of funding, since compost impacts are long-term. "You don't change soil very rapidly. It's a very complex physical, chemical and biological system. Things don't happen quickly, especially when you're working with organic matter."

Meanwhile, scientists from Agriculture and Agri-Food Canada, as well as Dalhousie University, in Halifax, Nova Scotia, are conducting the small-plot-scale tests, assessing the impacts of composts from a variety of feedstocks, including:
@ Forestry residues including bark, paper mill residue and wood-ash, with about 5 per cent manure.
@ Poultry manure, with paper mill residue and wood ash
@ Hen and sheep manure, with bark.
@ Municipal source-separated organic waste.
@ Marine shells, with bark, farm waste, manure, perlite, peat and lime.

These trials are intended to measure, for each type of compost, their effect on potato productivity, the availability of nutrients, impact on soil quality and the ability to suppress soil-borne diseases — a key issue for potato producers.

While it's too soon to report data, "we're seeing some beneficial results, depending on the compost feedstock," says Bernie Zebarth, a soil scientist at the department's Fredericton Research and Development Centre, in the provincial capital. "It's pretty early on, we're reluctant to say, but it looks promising."

Compost is being studied for its potential to improve soil health and structure, Zebarth says. "We're not applying it for nutrients. We're after it as a way to increase soil organic matter." In fact, they are focusing on mature, stable compost to avoid a flush of nitrogen and other nutrients when it's first applied.

The researchers expect the most important benefit of the additional organic matter will be to aid the soil's ability to hold moisture. That would not only reduce stress on the potato crop in dry periods but also, by reducing run-off and leaching in heavy rains, give growers better control over the nutrients they provide through commercial fertilizers. It's also "food for good bugs, which keep bad bugs in check," Henry says.

Research for these stories was part of a study on the impacts of compost on farmland, conducted by the Compost Council of Canada; the Ontario Ministry of Agriculture, Food and Rural Affairs; and the Region of Peel, and supported by Canada's Green Municipal Fund.

APPENDIX VII

Meeting Notes from introductory meetings with select Ontario Agricultural Organizations

i. Certified Crop Advisors Initial Meeting

Date: Tuesday February 17, 2015 2:00 pm – 3:00 pm
Location: 1 Stone Road, Guelph
Attendees:

- Susan Fitzgerald – Certified Crop Advisors
- Susan Antler – Compost Council of Canada
- Merissa Bokla – Region of Peel

Discussion

- Spring & Fall newsletter
    - Goes out in March – can put in an article – follow up with Susan F in the fall
- Certified crop advisors – 2 year cycle – at least 40 CEUs, minimum in soil, water, pest and nutrient management (5 from each category) and 20 in any other area
- National and some provincial boards, various boards in the USA
- Website has a standards document that falls under the different categories
- CCA has an AGM and 2 day conference – only day they do
    - Can send a CEU request to CCA to evaluate to be part of their conference
- Funding is membership based – no government money
- 2 exams – Ontario and International exam, credential form to become a CCA
    - Usually a consulting business by growers and suppliers
- CCA do nutrient management plan, seed types
- CCA advise on how to make more money and increase yield
- Conference sponsorship available – logo on sponsor page
    - $500 bronze
    - $1000 Silver
    - $2000 Gold
- 535 Certified Crop Advisors
    - Exams held annually – first Friday in February, multiple choice
    - 50% that write, usually pass exam
    - Pass is 67% - more pass the international exam more so than the Ontario exam
- Agenda for conference finalized by the end of April
    - Presentations around 50 minutes
- Can put events offering CEUs on their list serve and event calendar
- Timing for events
    - Non-summer and free are best options
    - Recommend winter season

ii. Christian Farmers of Ontario Initial Meeting

Date: February 17, 2015 – 10:00 am – 11:30 am
Location: 642 Woolwhich Street, Guelph
Attendees:

- Lorne Small –President, Christian Farmers of Ontario
- Jenny Denhartog – Interim General Manager, Christian Farmers of Ontario
- Susan Antler – Compost Council of Canada
- Merissa Bokla – Region of Peel

Discussion

- Plastic is an issue in compost after first rain
- Used on clay soil to add N P K and organic matter
- Cost is also a factor
  - Fertilizer easy to spread and easily available
- Needs to be easy to apply and use as well as cost competitive
- Narrow window for application
  - Fertilizer available within an hour when required
  - Consistency important
- Equipment requirements for spring and fall, otherwise it sits idle for majority of the year
- Play up the organic matter side of compost plus the N P K which is not available in commercial fertilizer
- Christinaan Farmers are conducting study with University of Guelph Dr. Martin, looking at sustainability of soil – if current practices are sustainable
  - Availability of manure spreaders at dealers – not as readily available as it used to be
- Communicate with members via quarterly newsletters
- Jenny to send Susan Dr. Martin's information
- Susan to add Jenny to Compost Council of Canada's email list

iii. Ecological Farmers Association of Ontario Meeting

Date: February 18, 2015 - 12:15 pm – 1:15 pm
Location: 5420 Highway 6 North, Guelph – Suite 370
Attendees:

- Alexandra English – Director of Programs, Ecological Farmers Association
- Susan Antler – Compost Council of Canada
- Merissa Bokla – Region of Peel

Discussion

- Have 500 members – membership is $60
- Focus on soil health
  - natural farming practices
  - Unsure if our compost would qualify as an organic product – would look into it with the governing body
- Would be beneficial product for farmers
- Mainly focused on smaller scale farmers
- Potential for speaking opportunity at workshops
- Farmer to farmer training
  - Field days
- Used to offer courses but now focus more on workshops
- Compost has applicability with their farming practices and would definitely have interest among their members

iv. Ontario Agri-Business Association Initial Meeting

Date: Wednesday February 18, 2015 10:00 am – 12:00 pm
Location: 160 Research Lane, Suite 104, Guelph
Attendees:

- Dave Buttenham – Chief Executive Officer, Ontario Agri-business Association
- Susan Antler – Compost Council of Canada
- Merissa Bokla – Region of Peel

Discussion

- Farmers are looking for just-in-time delivery – minimal on-site storage
- Needs to be economically feasible – cover crops become feasible because offers additional benefits
- Spring is the ideal time for application
    - Requires just in time delivery
    - Farmers cannot buy and hold the product
    - Some move to no-till using organics already on soil
- Small window for planting etc.
    - Effectively applying large volumes of compost
- Affordability of transportation
    - Less retail opportunities on fringe of rural-urban space
    - Communities growing around agricultural operations and pushing out businesses due to odour, smell, noise, dust
    - Use of TSC stores for example to distribute compost
- Integration into cropping system - have to show economic benefit not financial burden
- Has to be a benefit to the bottom line
- Soil health and soil conditions
    - Can be part of integrated soil management plan
    - Get it into a commercial storage
    - High volume potential
- Will there be enough product to supply market if it goes to a commercial scale
    - Perhaps zone in on one crop
- How do we commercialize the compost industry in Ontario?
    - Benefits – time, money, cost structure, efficiency, ease of application
    - Small scale with results that are scalable
    - Look at large scale farms, ie: 30 acres vs 3000 acre farms
    - Consistency and quality product that customers are happy with
    - Assess markets on best return on investment
    - Scalability – best return based on infrastructure to service certain markets
    - Commercial application mainly driven by bottom line costs – what is market potential
- What can we supply
    - What is a viable market based on demand
- Technical information important
- Need relationship between government and private business to grow the market of the product
- Looking at plots are different than real life
    - Needs to go from good idea into marketplace

    - Limitation on supply – need to be able to have a certain amount of supply
- Third party accreditation program that looks at process as well as end product, ie: third party audit
- How do you differentiate CQA producers
    - Want lower level producers to strive to be CQA certified
    - Give better market to those CQA certified
    - Build credibility to those producers who strive to reach those CQA accreditations
    - Create a standard of compost that gives better view in the industry
    - 20% of bad producers can ruin it because no differentiation between good and bad compost
    - Needs consistency in product that is the same day in and day out
    - Needs to be a value proposition as to why to use compost
        - Industry needs constantly evolving
- AGM in December, Toronto, 2 days
- Summer Conference at Deerhurst
- Crop updates every December

v. <u>Ontario Soil and Crop Association Meeting Minutes</u>

Date: Monday December 8, 2014 9:30 am

Attendees:
Merissa Bokla – Region of Peel
Larry Conrad – Region of Peel
Christine Brown - OMAFRA
Susan Antler – Compost Council of Canada
Peter Gorrie - Writer
Andy Graham – OSCIA

- Crop production and soil group
  - Focus on education
- Limited funding for county and regional level for 1-3 year studies
- 50 local associations that act separately but report to provincial office
- Link between OMAFRA and University of Guelph
- Also receive funding from MOECC, Environment Canada, Agri-Food Canada
- 12 ongoing programs ranging from 1-5 years
- 20 full time staff – 18 working towards studies/local projects
- Deliver a wide range of workshops
  - Not technical experts
  - Technical experts are provided by the funding or go out and retrieve experts from public and private sectors
- Soil is dominant feature
  - Main area is program delivery
- How can we ensure availability and consistent product
  - Opportunity to create a market
- Need for education and understanding of compost in industries
- How predictable is quality from one load of compost
  - Facility is consistent within 10% for phosphorus and nitrogen
  - Nutrient value differs from producer to producer depending on feedstock
  - Consistency with phosphorus and potash is not as important as nitrogen
- Greatest area for improvement
  - If N P K can pay for transportation and application it will work well with cash crops
  - If limited supply – horticultural growers can use – high price
  - Important to keep prices reasonable
- Try and foster interest at the local soil association levels
  - OSCIA only provides information, doesn't dictate interest of local associations

<u>Challenges</u>

- Plastics; Manufacturers all have different screening techniques
- Important to educate residents to help keep product contaminant-free
- Evident plastic residue in compost plots vs pure field
- Bread tags, fruit stickers and other foreign materials that are challenges in the field

- Farms getting larger and planting has to be planted quickly – challenging
    - Possibly applying compost later

APPENDIX VIII

Marketing Outreach Activities

#	Date	Event	Comments
1	April 19, 2011	OMFRA - Guelph	1-day event to promote compost in agriculture
2	January 21/2012	Farm Smart – Guelph	Joint participation with Compost Council of Canada
3	January 23/2012	Peel Soil & Crop Improvement Association Annual Meeting - Caledon	
4	January 19/2013	Farm Smart - Guelph	Joint participation with Compost Council of Canada
5	January 30/2013	Peel Soil & Crop Improvement Association Annual Meeting - Caledon	
6	August 20 & 21/2013	Manure Expo - Guelph	Joint participation with Compost Council of Canada
7	January 18/2104	Farm Smart - Guelph	Joint participation with Compost Council of Canada
8	January 29/2014	Peel Soil & Crop Improvement Association Annual Meeting - Caledon	

The 2013 North American Manure Expo

Agriculturalists from all over the continent came out on August 21st, 2013 for the 11th annual North American Manure Expo held at the Arkell research station in Guelph , Ontario. This is the first manure expo to be held in Canada and naturally the Region of Peel was present amongst over 70 exhibitors in order to help make the North American Manure Expo a success.

Region employees Terry DiNatale, James Smit, and Jodi Crawford , along with Susan Antler of the Compost Council of Canada spent the day educating and promoting Peel compost.

Region of Peel
Working for you

Conseil canadien du
COMPOST
Council of Canada

NorthAmerican
MANUREEXPO
Professionalism in Nutrient Management
Arkell, Ontario 2013 Canada

The 2014 Farm Expo

On Thursday July 17th 2014 the Region of Peel participated in the Farm Expo at the University of Guelph's Elora Research Centre in Ariss, ON. Over 150 farmers attended the event in order to discuss the latest research and discoveries regarding crop health and productivity. As the expo guests traversed between different speakers they could visit the Region of Peel compost exhibit where representatives were available to talk about the benefits of applying compost as a soil amendment.

Along with important knowledge about compost, guests who attended the expo also received a free sample bag of compost to apply on their plants at home.

The day ended by extending a big thank you to each of the speakers at the expo with a large bag of Peel Region compost and a pair of gardening gloves. A honourable mention also goes out to Susan Antler from the Composting Council of Canada and the Region of Peel Employees; Terry DiNatale, James Smit, Karyn Hogan, Megan Moore, and Jodi Crawford for helping to make the day such a success.

Appendix IX Presentations and Contributing Articles

i. Ontario Berry Grower

ii. COMPOST - Article from Better Farming January 2013

iii. *Presentation:* The City to Farm Initiative

iv. *Presentation:* From City to Farm: Greenbin - Derived Compost Agricultural Trials

v. *Presentation:* Cities Feed Farm Soils

vi. *Presentation:* Selling Organics to Farmers

Municipal greenbin compost

Have you considered the value of land applying Municipal greenbin compost to your fields?

Municipal greenbin compost is composed of food waste, yard waste, and soiled and non-recyclable paper. The number of growers who land apply municipal compost has been on the increase in last 5 years - diverting over 1 million tonnes of organic waste from Ontario landfills. Composting is a process in which organic material is broken down into simpler substances by microorganisms such as bacteria and fungi. The end product is a food-safe amendment that can be applied to fresh crops for human consumption, such as fruit and vegetables.

Are you looking for ways to get more organic matter into your soil?

Organic amendments such as greenbin compost help maintain your soil organic matter levels. Increasing soil organic matter improves several soil qualities like 1) structure or tilth, water-holding capacity of coarse-textured sandy soils, improves drainage in fine-textured clay soils, reduces wind and water erosion, promotes growth of earthworms and other beneficial soil organisms, and provides a source of slow release nutrients for crops.

Are you interested in a free source of slow release fertilizer?

Municipal greenbin compost provides nutrients essential to plant growth, such as potassium, phosphorus and nitrogen. Most of that N is in a stable organic form. Organic N is unavailable for crop uptake until microorganisms degrade the organic compounds, meaning compost is a form of slow release fertilizer. Growers should be aware, because of the slow Nitrogen release nature; municipal greenbin compost alone may not be enough to supply adequate Nitrogen during rapid growth phases of crops with high nitrogen demands.

Are you interested to learn more from local on-farm trial results?

In 2013, an on-farm research trial was established on day-neutral strawberry field near London, Ontario in collaboration with Christine Brown from the Ontario Ministry of Agriculture and Food and the Ministry of Rural Affairs. This trial is focused on comparing the yield and marketable fruit quality to spring applied municipal greenbin compost. For more information, or if you are interested in participating in future municipal greenbin compost on-farm research trials, please let us know.

Application of greenbin compost to strawberry beds

For more information:
Toll Free: 1-877-424-1300
E-mail: ag.info.omafra@ontario.ca

Author:	Deanna Nemeth, - Nutrient Management Program Lead Hort Crops/ OMAF and MRA
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COMPOST from green-bin waste gaining traction

Farmers are using it and field trials are measuring effectiveness and testing for the best application rates

by MIKE MULHERN

The growth of municipal green-bin waste composting programs has created a new source of soil amendment for farmers that some believe has big benefits at a lower cost.

For farmers without livestock, manure can be hard to come by and as commercial fertilizers are going up in price, growers are eyeing alternatives. Compost producers can't keep up with demand from farmers, but there is a mountain of potential in Canada's waste stream if farmers show enough interest. In addition, Ontario's compost rules are changing and two new grades are being added, something which may boost future compost options for farmers.

Four years ago, Jarvis-area cash crop farmer Mike Lishman started buying compost from AIM Environmental Group of Stoney Creek. It worked so well for him, he started selling it to his neighbours. In 2012, he used and distributed about 15,000 tonnes of the stuff – produced from green bin waste from the municipalities of Hamilton, Halton Region, County of Simcoe, City of Guelph and Waterloo Region.

One compost application, at 10 to 12 tonnes an acre every four years, is enough to allow Lishman to cut way back on commercial fertilizers.

"We buy very little commercial fertilizer now," Lishman says. "The only commercial fertilizer we buy for our operation is just for our starter source."

Lishman has applied compost after wheat in a rotation in which corn is followed by two years of soybeans before wheat. Without annual fertilizer applications, he's making fewer passes over his fields, seeing better soil health and improved yields.

Compost costs in Ontario range from $5 to $35 a tonne (some products are sold by the cubic yard), depending on the producer, but transportation can cost

Mike Lishman spreads compost on his farm near Jarvis.

more than the compost. Lishman's brand retails for $6 a tonne but can cost twice that or more, depending on the distance it has to travel.

"Trucking is the biggest issue," Lishman says. "The product is quite light." In five-axle, 80-yard trailers, they are getting just 35 to 36 tonnes a load.

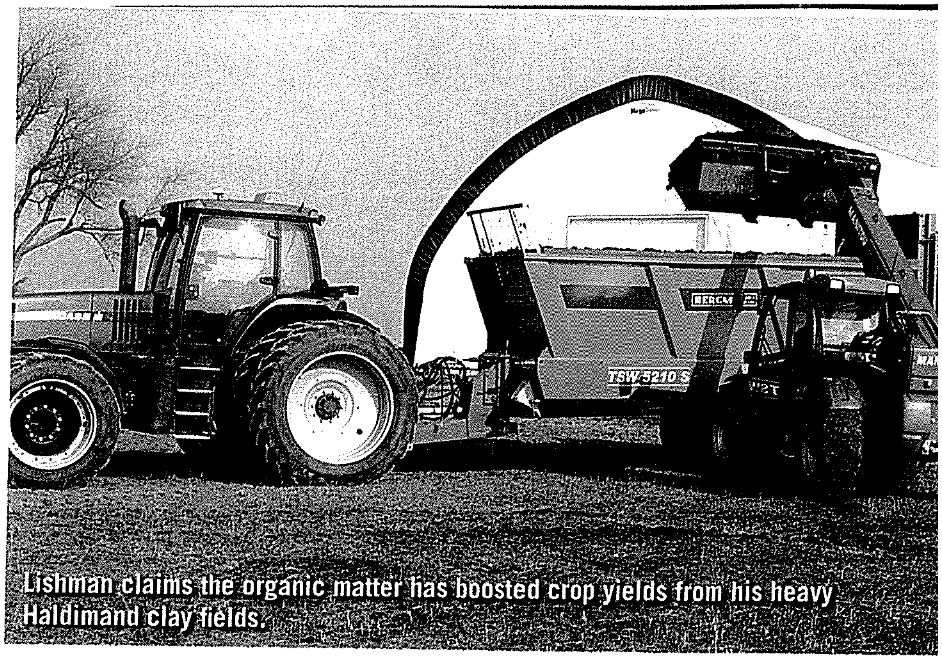
Lishman has three spreaders to help his customers get a "controlled, even spread" on their fields.

"We started with a leased spreader the first year," Lishman says, "now we're running three spreaders." His latest acquisition – he buys the spreaders now – is a German-made, 25-tonne Bergmann.

Most of Lishman's customers add three to five tonnes of compost per acre, but some are applying 10.

Lishman, a cash crop farmer, started participating in a study by researcher Christine Brown, nutrient management field crop lead for the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), to help quantify compost's benefits and establish best-practices for its use.

Surprisingly, it was livestock farmers who were the fastest to volunteer to participate in her in-field testing of compost made from municipal green bin waste. "They don't have enough manure for their land base and they know the value of manure." says Brown.



Lishman claims the organic matter has boosted crop yields from his heavy Haldimand clay fields.


Christine Brown

"The objective," Brown says, "is to show farmers the benefits of organic matter and to a smaller extent nutrient potential."

She is working with a number of compost producers under the umbrella of the Compost Council of Canada, the Soil and Crop Improvement Association, the Fertilizer Council of Canada and OMAFRA.

Using compost donated by producers, Brown is testing what is the best rate and timing. She is including fields that had applications as early as 2010 and she expects to continue the research for three more years, or a full crop rotation,

Manure more valued, not as available

Fewer small herds spread throughout the countryside are creating the perception of a manure shortage in Ontario. And, with livestock producers putting more value on the manure their animals produce, cash crop farmers may have trouble sourcing the product they need.

Christine Brown, nutrient management field crop lead for the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), believes it's not that there is less manure in the province, it just feels that way. Some farm neighbourhoods have lost manure sources. Larger producers tend to have a bigger land base and they can use everything they produce on their own land.

"Before," Brown says, "you had a lot more small farms distributed through the countryside. There's less of that, so the perception is there is less manure around." She also believes, in the past, there was more trading between farmers and manure wasn't valued as a resource as much as it is now. "Now that fertilizer prices are going up," Brown says, "people are looking at manure and saying, 'Oh, it's got micronutrients and it's got organic matter benefits.' I think people are starting to make better use of it so they are not as interested in selling it or giving it away."

Brown says the exception may be areas of the province where a concentration of livestock operations means farmers may have more manure than they can use. "That's the only place you're going to see people a little more interested in selling or sharing manure," she says.

Looking at the numbers, the beef cow herd has declined 19.4 per cent since 2003 and currently stands at 321,000 beef cows in Ontario. Between 2006 and 2011, there was also a decline in the number of dairy cows in Ontario, down 3.5 per cent to 318,158.

The number of pigs has declined 22 per cent to 3.1 million since the population peak of four million in October, 2005. Between the 2006 and the 2011 Statistics Canada census, the number of Ontario farms where pigs were raised dropped from 4,070 to 2,556.

On the other hand, Ontario's goat herd grew 52.7 per cent between 2006 and 2011. Ontario now has the country's largest goat herd at 116,260 head. Ontario's sheep herd also increased 13.4 per cent to 352,807 head. **BF** and beyond, if funding is available.

"Part of it is, 'What are the yield benefits over a rotation?' so not just the year it's applied but the year after the year after that," she says.

The economics are important too. Brown says they are trying to figure out whether there is more cost benefit to a 10-tonne-per-acre application once very three years or five tonnes, two out of three years.

Because 2012 was a dry year, Brown says she saw benefits regardless of the rate of application.

"In trials where we tried 10 tonnes or 20 tonnes, it didn't look like there was a significant difference in the 20 tonnes over the 10 tonnes but there was significant difference between any compost compared to none," she says.

Brown cautions that nutrient levels vary from product to product. She says farmers should always know what they're dealing with. "You should always be asking for an analysis," she says. "What's in the material? What kind of fertilizer credits can I give this?"

Using the right spreader also is an issue Brown has identified. She is working with the Ontario Soil and Crop Improvement Association to set up a page on their website to identify and list a network of custom application equipment for either rental or custom work, although it is not ready yet. Because of the light weight of the material, Brown says you need spreaders designed more for poultry litter than heavy beef pack.

Brown also wants to work out a logistics system that could reduce transportation costs.

"Transportation has been the budget item that has caused us problems," Brown says. So far, she says, transportation has been covered by the compost companies donating the material or by the farmers receiving the material. Brown hopes to try compost in every growing region of the province, and she has 15 side-by-side trials in progress so far.

While they have used product from London's OrgaWorld, Brown says the primary participants in the trial are AIM Environmental Group, Peel Region and the Miller Group out of Markham.

One of the initial problems Brown had with products coming into the trial was the level of plastic in the compost. "The first plot, you wouldn't believe how much plastic was in it. We complained and said, 'You know farmers aren't going to take this on a continuous basis.'" The improvement, she says, has been remarkable.

While Brown says results are three years away, she can see the potential for green bin waste as a nutrient source for soil.

"When you think about it, you've got all this food waste that is potentially going to landfill and we've got less and less livestock farms supplying manure to agriculture so here is a win win where we can take basically the waste food and take it back to the land and supply organic matter and nutrients," Brown says.

Farmers who want to try green-bin compost in some areas of the province have to get in line behind buyers in the landscape market.

Mike Koplansky, manager of Miller Compost, says they have very little material to offer farmers.

"We're involved in the trials," Koplansky says, "to support the whole compost industry . . . For our sector, if we can help create more demand for the compost product produced by some of our competitors who don't have as high a quality, then it just helps create more demand." Like the other producers, Miller sources its feedstock from municipal green bins. Their feedstock material comes from the Durham Region. Unlike other producers, however, Miller puts incoming material on a conveyor where workers pick out offending items such as plastic and glass before it is composted.

Koplansky says demand is starting to exceed supply, partly because there hasn't been a lot of incentive to increase supply until recently.

"If the agriculture industry can realize the value of it and pay for it," he says, "then people can put together business plans where companies like ours can increase our production of compost." Miller advertises premium compost, a finer screened product, for $30 a cubic yard. Standard compost goes for $20 a cubic yard.

Two of Ontario's green-bin compost producers, AIM and OrgaWorld, do

Most municipalities don't bother to recycle organic material, which makes up half of the waste stream.

produce primarily for the agricultural sector. However, production is not huge. OrgaWorld produces about 25,000 to 30,000 tonnes of compost a year at each of its facilities in London and Ottawa; both are sold out for the next year. Their product line includes a finer, dryer compost produced in the Ottawa facility and sold for animal bedding.

OrgaWorld compost sells for about $12 to $15 a tonne. The bedding is sold for $10 a yard.

AIM produces 24,000 to 30,000 tonnes of compost a year for the agricultural market. Frank Peters, AIM's business unit manager, says there is not enough compost to cover the agricultural market in Ontario, partly because of the decline in the availability of livestock manure.

The Region of Peel, which produces 60,000 tonnes of compost a year through its own green bin and yard waste program, sells a lot of its product to the landscape industry and to Peel residents. In November, Peel's website showed the order book for 2012 was closed. Peel was offering places on the waiting list for 2013.

Matthew Stevens, technical analyst for Peel's compost program, says they offer a range of products and services. Material screened to a half an inch is $35 a tonne but coarser, 1.5-inch-plus material can be had for $5 a tonne and that sometimes finds its way into the agricultural market, based primarily on price. He says the coarser material, derived from a more open screening process, has more wood waste but does not contain plastic or glass. He says Peel is working with Brown on the project to see whether there is a supply window that might suit everyone. "Maybe we can supply the compost (to farmers) every three years compared to every year." He also says more supply might be found if there is more demand from the farming community.

In fact, there is a mountain of potential in Canada's so-called waste stream. Susan Antler is the executive director of the Compost Council of Canada. She says organics make up to 5(per cent of the "waste stream" but most of the compost potential is lost, partly because most Ontario communities deal with blue box programs alone.

Susan Antler

"More than 200 communities are focused on the blue box program only," she says. "The 93 or so communities that have the combined blue box and organics (programs) almost achieve the same amount of (waste) diversion as the

Ontario Compost Categories as of Jan. 1, 2013

The three new categories of compost (AA, A and B) have replaced the former single set of compost standards for unrestricted use compost in Ontario.

Standards for metals (feedstock and finished compost), pathogens, sharps (glass, metal bits) and other foreign matter (including plastics) and maturity apply for each category. This allows Ontario to align with nine other provinces.

Category AA has the highest quality standards. They are similar to former Ontario standards but with some modifications. Category AA continues the use of former zinc and copper standards, which are more stringent than the Category A standards and does not allow use of sewage biosolids, pulp and paper biosolids or septage as feedstock. Category AA may be used without restrictions or approvals, both on and off farm.

Category A (new) compost standards meet the Canadian Council of Ministers of the Environment (CCME) Category A quality guidelines. They allow slightly higher concentration of zinc and copper than Category AA and allow the use of biosolids as feedstock (maximum 25 per cent of total feedstock), but feedstock must meet the metals standards on inputs. Category A must include labeling information including maximum application rates, identification of any biosolids and domestic septage used as feedstock, and a warning that the product should not be used on soils with elevated copper or zinc concentrations.

Category A compost may be used without an Environmental Compliance Approval (ECA) or a NASM Plan (both on and off farm).

Category B (new) compost standards meet the CCME Category B quality guidelines plus Ontario's Cadmium and Copper standards. The standards are less restrictive for metals and foreign matter standards than Category AA and A, and the compost may contain biosolids. It must meet the same metals standards for feedstock as Category A. Category B compost requires government approval for use and transportation (i.e., ECA off-farm or an approved NASM Plan on-farm).

Source, Ontario Ministry of the Environment over 200 (municipalities, combined) on the blue box. The key for waste diversion is to get the organics collected, so there's a long way to go and certainly a long way to go to make sure we are sustainable."

However, Antler believes the time is right for an increase in compost production and she says the regulatory climate in Ontario is also creating new opportunity.

In Ontario, there was just one grade of compost before 2013. However, on Jan. 1, 2013, the Ontario Ministry of the Environment updated Ontario's compost framework to allow for three grades of compost: AA, which equals the current, high standard of compost from green bin and yard waste; A, which can include 25 per cent sewage biosolids, pulp and paper biosolids and domestic septage in the feedstock blend; and B compost which is less restrictive for metals and foreign matter than Category AA and A. B may also contain biosolids but it must meet the same metals standards for feedstock as Category A.

No one currently produces Category B compost in Ontario. However, when it is produced, it will be listed as a Non-Agricultural Source Material (NASM) and require government approval for use and transportation (Environmental Compliance Approval off farm or an approved NASM Plan on-farm).

Antler says the updates put Ontario's regulatory framework in line with other provinces and gives the organics recycling business in Ontario new options.

"It's really important for the right compost to be put to the right use," she says. "There are different qualities like any product and the absence of flexibility in the standard prior to the recent changes really restricted the potential of organic recycling in the province."

If Mike Lishman's experience holds up in field trials, Ontario kitchens could be a huge source of soil amendments for Ontario farmers. Using the right grade, in the optimum amount at the right time in the rotation could be a win-win for farmers and waste diversion.

"I think every farmer has a budget for soil fertility and what they can re-invest in the land," Lishman says. "Obviously with commodity prices the last couple of years, guys are really starting to look to put something back." **BF**

> **"Bottom line, there is a cost...and I can't give our compost away."**
> — Larry Conrad

Tour organizers were positively overwhelmed with participant response, admitting that the high level of interest in green bin compost right now was key to their tour success.

"You have to pick a topic that has a very high interest level," says Tim Armstrong, president of the Peel Soil and Crop Improvement Association.

He also says strong partnerships, whether with the municipality, local agri-business suppliers and organizations, such as Credit Valley Conservation (CVC), are also important to make sure there is buy in from all stakeholders.

"It is great to see the Region of Peel and the local agricultural community take such a proactive role in waste management. A sustainable local environment is one that uses wastes from one process and utilizes them as a resource in another," says Mark Eastman, CVC's agriculture extension program coordinator.

Compost attracts farmer interest

BY ANNE HOWDEN THOMPSON
Ontario Farmer

Interest is strong in green bin compost material for agriculture land application and Christine Brown, the nutrient management field crops program lead with OMAFRA) is excited by the opportunities this presents for the agricultural community.

"If you have side-by-side comparisons and a dry year, it doesn't take very long to see which side got the compost and which side didn't," she says.

But some challenges have to be resolved.

Brown has some co-operator trials underway in several municipalities but says initial work indicates the application economics are key.

"The hard part is getting it form point A to point B – easily, cheaply and exactly when the farmer needs it before planting," she says.

"We have to be able to buy, transport and apply the material...and we need to be able to get these costs covered by the fertility value...or it won't go to very many farms," she cautions.

She recommends the most economic way of applying finished compost is to apply it once in the rotation at a fairly high rate.

Wayne Cunningham of Wellington County asked Brown if there was any preference to timing of the application, such as spring or fall application.

Brown said there is no quickly available nitrogen left in cured compost and the ammonium nitrogen has already been converted to organic nitrogen.

"When you apply it in the late fall when the microbial activity is basically slow, you are not going to get much of the nutrient cycling happening until the next spring anyway," she said.

From an "environmental perspective" she recommends application of cured compost after wheat harvest.

"If we can use the organic matter in the nutrients so it doesn't have to be land filled, than it is a win-win for everybody. But the logistics are the part where we have to figure out some simplicities," says Brown.

Maple Leaf profits down sharply

Profits were down for the first quarter at Maple Leaf Foods Inc., dropping 47 per cent to $10.5 million.

But the company said it's pleased with its progress, highlighting a 67 per cent increase in operating income to $50.7 million.

Profits were down because of "restructuring" costs and losses on market hedges.

Sales declined by four per cent to $1.15 billion, mainly because of the sale of the hog-slaughtering plant at Burlington. Counted on the basis of divisions that were not sold, sales increased by four per cent.

The City to Farm Initiative

Developing Agricultural Markets for Compost

Compost Matters in Ontario

March 7 & 8, 2012

Ministry of Agriculture,
Food and Rural Affairs

Ontario

The Organic Matter Challenge

Soil Bank Account

Crop residue and roots from rotation of corn – soybean – wheat with straw returns about 1000 lbs/ac “stable” carbon to the soil (no-till)

~ 10 ton/ac green bin compost added once per rotation will add about 1000 lb/ac “stable” carbon to the soil

What is Organic Matter Worth?

How much value is given to organic matter depends on:

- Current organic matter levels
  - Sandy tobacco farm vs dairy farm with manure and forages
- Interest in water-holding capacity (1 inch in drought = ↑ yields)
- Erodibility of land base
- Crop residue removal for bio-energy
- Interest in sustainability
- Opportunities vs cost

Municipal Green Bin Compost

- high O.M. product - good balance of available N-P-K and micros
- bulk density range of 13 to 37 lbs/cubic foot (ave 20)
- Uniform application is easier with compost than solid cattle manure
- odour and consistency less offensive
- fits well when applied once in the rotation

(ie after fall cereal harvest) at ~ 15 ton/ac

REPORT NO. C10125-8004
ACCOUNT NO. 01213

A & L CANADA LABORATORIES INC.

2136 Jetstream Road, London, ON, N5V 3P5 (519) 457-2575 (519) 457-2664

A manure analysis is best test to show available crop nutrients

LAB NUMBER: 125808
SAMPLE ID: GREENBIN COMPOST - SMITH

DATE RECEIVED: 5/6/2010
DATE REPORTED: 5/11/2010
PAGE: 7

PARAMETER	ANALYSIS RESULT	POUNDS PER TON	ESTIMATED AVAILABILITY PER TON
Nitrate Nitrogen	3.1 ppm		
Sulfur	1272 ppm		
Dry Matter	45.2 %		
Nitrogen (Total)	1.44 %	28.8	
NH4-N	2194 ppm	4.4	
Conductivity (@ 25 deg C)	4.57 ms/cm		
Phosphorus (Total)	0.18 %		
Phosphate (P as P205) **	0.41 %	8.3	3.3
Potassium (Total)	0.41 %		
Potash (K as K2O) **	0.49 %	9.9	8.9
Organic Matter *	35.7 %		
pH	4.80		

PARAMETER	ANALYSIS RESULT	POUNDS PER TON	ESTIMATED AVAILABILITY PER TON
Carbon:Nitrogen Ratio (C:N)	14 : 1		
Sodium	0.255 %	5.1	
Aluminum	539 ppm		
Boron	9 ppm		
Calcium	1.47 %	29.4	
Copper	37 ppm		
Iron	926.9 ppm		
Magnesium	0.15 %	3.1	
Manganese	55.2 ppm		
Zinc	47 ppm		

* All Parameters are reported on an as is basis.
**Available nutrients are reported as total available. Only a portion of these nutrients will be available the year of application.
For information on nitrogen availability, see reverse side of page.

Municipal Green Bin Compost
Material used for 2010 Halidmand plots

Analysis:		Total Nutrients	Available Nutrients
Dry matter:	48.7%		
Total N:	1.53 %	30.6 lbs/ton	
Ammonium N	2100 ppm	4.2 lbs/ton	~ 3 lbs/ton
Organic N	1.32 %	26.4 lbs/ton	~ 8 lbs/ton
Phosphorus	0.22 %		~ 8 lbs/ton P205
Potassium	0.36 %		~ 8 lbs/ton K20
Calcium	1.49 %		~ 30 lbs/ton
pH	5.0		
C:N rotio	14:1		
Organic Matter	38.5 %		

~ $18.50 fertility value per ton

Peel Region Compost sample analysis

~ 10-45-17 N-P_20_5-K_20 available ~$37.00/ton value

Green Bin Compost Plots Results – Smith

2010 Haldimand S&C Project

Treatment	Moisture %	Test Wt lbs/bu	Yield Dry bu/ac
140 lbs N	18.6	56.3	221
30 lbs N	18.8	56.1	185
High Compost	18.5	56.9	219
8 Tonne Compost + 72 lbs N	18.5	56.3	220
8 Tonne Compost	18.7	56.9	198

Green Bin Compost Plot Results – Ricker

2010 Haldimand S&C Project

Treatment	lbs N	P_2O_5	K_2O	Moisture	Test Wt	**Yield Dry**
	Applied – all sources (lbs/ac)			%	lbs/bu	bu/ac
Compost only	204	139	139	20.5	56.1	189.9
Compost + Biosolids	317	300	147	21.0	56.0	191.5
Turkey Manure (spring) + Biosolids	307	460	230	20.2	56.7	197.6
Turkey Manure (winter) + Biosolids	296	460	230	19.2	---	202.5
Turkey Manure only	194	300	222	19.3	---	199.7

Uniformity of Application Is Essential

Calibration takes time

Green Bin Compost Application
Knight Side-slinger 5th gear (application goal = 8 ton/ac)

30	25	20	15	10	5	0 ft	distance (feet) from spreader
2	**3**	**2 .5**	**21**	**32**	**5**		**tons/ac measured**

Average Rate Applied = **12.5 ton/ac**

Comparison of Organic Amendments

	Solid Cattle	Biosolid Pellets (Toronto)	N-Viro (Sarnia)	Municipal Greenbin Compost AIM - Hamilton	Red Clover plowdown	Digestate Solids (Niagara)
Dry Matter	35.9	95.1	77.0	47.8	26	37.5
lbs per ton						
Total N	14	92	11.4	31	12	17.8
Available N	4	47	4	10	12	7
P_20_5	2.2	**91** (high)	15	11	3	13
K_20	4	**3** (low)	**79** (high)	10	12	13
Total Salts	---	5	**32**	8	---	1.4
Carbon added	**280**	**644**	**240**	**434**	**156**	**338**
Total added				**3,819**	**---**	**4,056**

Composition of Organic Amendments

		Solid Cattle	Biosolids Pellets (Windsor))	Biosolids Pellets (Toronto)	N-Viro (Sarnia)	Municipal Greenbin Compost Org –Ottawa	Municipal Greenbin Compost Aim - Hamilton	Worm Castings	Digestate Solids (Niagara)
Dry Matter	%	35.9	94.8	95.1	77.0	69	47.8	44.8	37.5
pH			6.3	6.8	12.6	6.0	4.9	5.3	8.3
Bulk Density	kg/m^3	--	588	795	836	~338	~338	--	--
	lbs/ft^3	--	36.7	49.6	52.2	~21	~21	--	--
C:N Ratio		50:1*	9:1	7:1	21:1	25:1	14:1	18:1	19:1

What is the significance of pH, bulk density and C:N ratio?

Approximate Densities of Various Products

Manure Type	lbs per Cubic Foot	lbs per Bushel	kg per m^3
Liquid	62.4	80	1000
Semi-solid	60	76	961
Thick solid	50	64	801
Light solid	35	45	560
Dry poultry	25	31	400

1 bushel = 1.25 ft^3, 1 lb/ft^3 = 35.31 kg/m^3

Municipal Green Bin Compost – Challenges

- Temporary field storage can cause some compaction damage
- Contaminants – plastics (process for removal is constantly improving)
- Timing of product availability and application
- Some variability in product – time of year input availability

Municipal Green Bin Compost

- Win-Win – cash crop land and land fill diversion
- Hamilton, Peel, London, Ottawa Thorold and Durham all have municipal compost programs in development.
- Logistics for application in progress – cost??

Municipal Green Bin Compost

The N-P-K fertilizer equivalent value should be able to cover cost of the material, transport and application.

Logistics of Application

Is the material at the farm (temporary storage) at the time of planned application?

Equipment:

- Transport from facility to farm?
  - volume transported per load
  - Transport loaded both ways (cost efficiencies)
  - field compaction during unloading
- Loader efficiency
  - Is the application equipment waiting
  - Additional labour requirements?
- Spreader size and spread width
  - Bulk density of compost? How much can one load cover?
  - How many acres can be covered per hour?
  - Labour - custom applied or owned - most expensive in planting season

Questions?

Christine Brown

Nutrient Management Lead – Field Crops

OMAFRA – Woodstock

519-537-8305

christine.brown1@ontario.ca

From City to Farm:
Greenbin-derived Compost Agricultural Trials

Compost Council of Canada Workshop – January 22, 2013

Ministry of Agriculture, Food and Rural Affairs

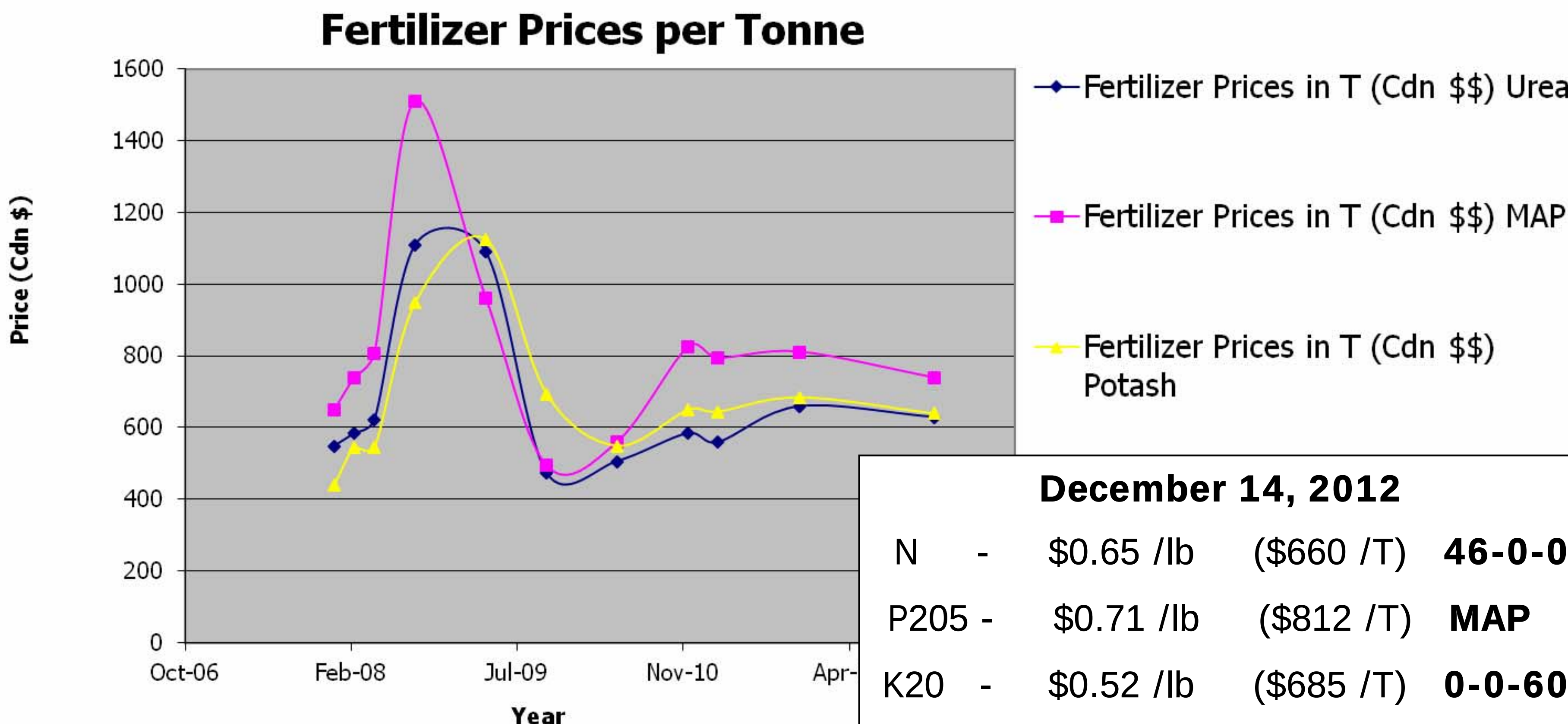
Ontario

From City to Farm: Greenbin Derived Compost Agricultural Trials

- Fertilizer value
- Organic matter value
- What products are available
  - Best fit for each product
- Importance of analysis
- Economics

The Fertilizer Challenge

Fertilizer Price Trends - As fertilizer prices increase "manure" is treated more as a resource than a waste - management improves

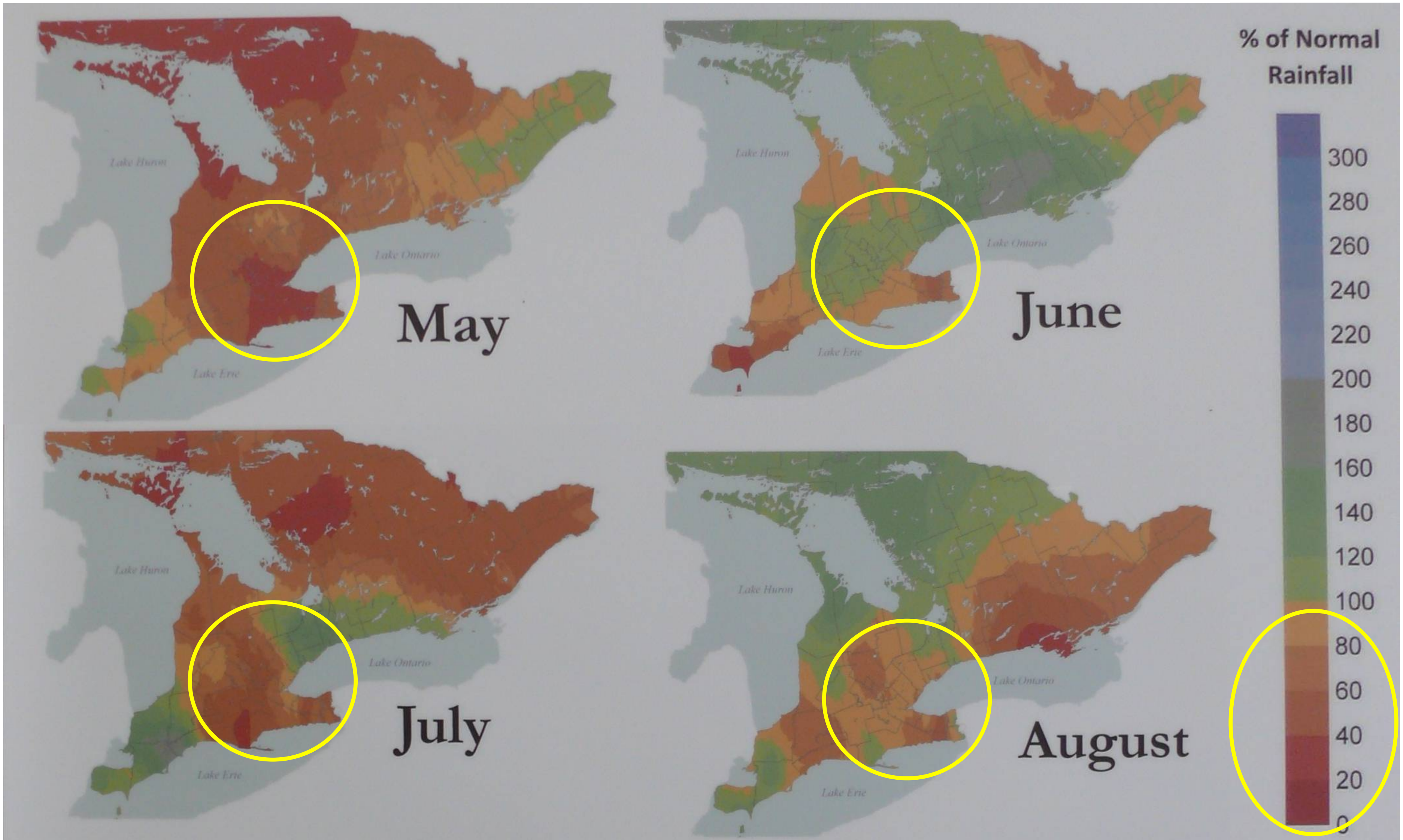


December 14, 2012

N	-	$0.65 /lb	($660 /T)	**46-0-0**
P205	-	$0.71 /lb	($812 /T)	**MAP**
K20	-	$0.52 /lb	($685 /T)	**0-0-60**
S	-	$0.68 /lb		

Organic amendments have fertilizer va

Why Consider "Manure"?



The Organic Matter Challenge

Soil Bank Account

Crop residue and roots from rotation of corn – soybean – wheat with straw returns about 1000 lbs/ac “stable” carbon to the soil (no-till)

~ 10 ton/ac green bin compost added once per rotation will add about 1000 lb/ac “stable” carbon to the soil

What is Organic Matter Worth?

Value is given to organic matter depends on:

- Current organic matter levels
  - Sandy tobacco farm vs dairy farm with manure and forages
- Interest in water-holding capacity (1 inch^{+} H_20 in drought yr = ↑ yields)
- Crop residue removal for bio-energy
- Erodibility of land base
- Interest in sustainability
- Opportunities vs cost

Sources of Organic Matter (& Nutrients)

- Cover crops
- Manure
- Biosolids
- Biosolids Pellets
- N-Viro
- Biochar
- Digestate
- Compost (manure & municipal)

Compost

What Is It?

•Material with specific C:N ratio and moisture content that goes through a process of heating, turning and curing provides nutrients and organic matter with reduced volume and odour compared to the original material

Benefits:

•provides many of the required macro and micro nutrients (ration based)

•Low odour and pathogen content

•Low risk of nitrogen loss (leaching or volatilzation)

•supplies organic matter which will help maintain or improve soil health

Challenges:

•Higher labour requirement than with manure

•Could have odour issues if C:N ratio or moisture content is too high or low

•Un-incorporated, surface applied compost - risk of soluble P runoff

Municipal Greenbin Compost

What Is It?

- Municipal food waste mixed with high carbon materials (ie wood chips) and composted in-vessel under specific conditions to meet MOE un-restricted compost guidelines
- Analysis will vary for each facility, depends on process and length of curing.

Benefits:

- High OM product with good balance of available N-P-K and micro nutrients.
- Cured compost = low odour & low risk of N loss (leaching, volatilization)
- Uniform application is easier than with most solid manure types
- Ideally applied once in the rotation (after cereal harvest) at ~10-15 ton/acre

Municipal Greenbin Compost

Challenges:

- Low bulk density of about 20 lbs/cubic foot, makes transport expensive
- Temporary field storage can cause some compaction damage
- Contaminants – plastics
- Timing of product availability and application
- Some variability in product – time of year input availability
- Consistent availability of product
- Odour - Un-cured or green compost can have a distinct odour that re-occurs when wetted if material is not incorporated
- Un-incorporated, surface applied compost - risk of soluble P runoff

REPORT NO. C10125-8004
ACCOUNT NO. 01213

A & L CANADA LABORATORIES INC.

2136 Jetstream Road, London, ON, N5V 3P5 (519) 457-2575 (519) 457-2664

A manure analysis is best test to show available crop nutrients

PAGE: 7

PARAMETER	ANALYSIS RESULT	POUNDS PER TON	ESTIMATED AVAILABILITY PER TON
Nitrate Nitrogen	3.1 ppm		
Sulfur	1272 ppm		
Dry Matter	45.2 %		
Nitrogen (Total)	1.44 %	28.8	
NH4-N	2194 ppm	4.4	
Conductivity (@ 25 deg C)	4.57 ms/cm		
Phosphorus (Total)	0.18 %		
Phosphate (P as P205) **	0.41 %	8.3	3.3
Potassium (Total)	0.41 %		
Potash (K as K2O) **	0.49 %	9.9	8.9
Organic Matter *	35.7 %		
pH	4.80		

PARAMETER	ANALYSIS RESULT	POUNDS PER TON	ESTIMATED AVAILABILITY PER TON
Carbon:Nitrogen Ratio (C:N)	14 : 1		
Sodium	0.255 %	5.1	
Aluminum	539 ppm		
Boron	9 ppm		
Calcium	1.47 %	29.4	
Copper	37 ppm		
Iron	926.9 ppm		
Magnesium	0.15 %	3.1	
Manganese	55.2 ppm		
Zinc	47 ppm		

* All Parameters are reported on an as is basis.
**Available nutrients are reported as total available. Only a portion of these nutrients will be available the year of application.
For information on nitrogen availability, see reverse side of page.

Comparison of Organic Amendments

	Solid Cattle	Biosolid Pellets (Toronto)	N-Viro (Sarnia)	Municipal Greenbin Compost AIM - Hamilton	Red Clover plowdown	Digestate Solids (Niagara)
Dry Matter	35.9	95.1	77.0	47.8	26	37.5
lbs per ton						
Total N	14	92	11.4	31	12	17.8
Available N	4	47	4	10	12	7
$P_2 0_5$	2.2	**91** (high)	15	11	3	13
$K_2 0$	4	**3** (low)	**79** (high)	10	12	13
Total Salts	---	5	**32**	8	---	1.4
Carbon added	**280**	**644**	**240**	**434**	**156**	**338**

Composition of Organic Amendments

		Solid Cattle	Biosolids Pellets (Windsor))	Biosolids Pellets (Toronto)	N-Viro (Sarnia)	Municipal Greenbin Compost Org –Ottawa	Municipal Greenbin Compost Aim - Hamilton	Worm Castings	Digestate Solids (Niagara)
Dry Matter	%	35.9	94.8	95.1	77.0	69	47.8	44.8	37.5
pH			6.3	6.8	12.6	6.0	4.9	5.3	8.3
Bulk Density	kg/m^3	--	588	795	836	~338	~338	--	--
	lbs/ft^3	--	36.7	49.6	52.2	~21	**~21**	--	--
C:N Ratio		**50:1**	9:1	7:1	21:1	25:1	14:1	18:1	19:1

What is the significance of pH, bulk density and C:N ratio?

Approximate Densities of Various Products

Manure Type	lbs per Cubic Foot	lbs per Bushel	kg per m^3
Liquid	62.4	80	1000
Semi-solid	60	76	961
Thick solid	50	64	801
Light solid	35	45	560
Dry poultry	25	31	400

1 bushel = 1.25 ft^3, 1 lb/ft^3 = 35.31 kg/m^3

Uniformity of Application Is Essential

Calibration takes time

Green Bin Compost Application
Knight Side-slinger 5th gear (application goal = 8 ton/ac)

30	25	20	15	10	5	0 ft	distance (feet) from spreader
2	**3**	**2 .5**	**21**	**32**		**5**	**tons/ac measured**

Average Rate Applied = **12.5 ton/ac**

“Manure” for Cash-croppers

In an ideal world, the N-P-K fertilizer equivalent value should be able to cover cost of the material, transport and application.

Considering Compost Value

There are many “manure”options, but value is specific to field needs

- Consider current fertility/organic matter levels of field
- Economics of applying commercial fertilizer, micro nutrients
- Yield benefits

•Using NMAN3 software to compare timing and rate options for maximum economic value

•Comparing nutrient balance and economics:

1 application of 15 ton compost/ac for a 3-year rotation (ahead of corn)

to

5 ton/acre/year for each year of a 3 year rotation

http://apps.omafra.gov.on.ca/NMAN/NMAN3.html

Field Input Description	Production Recommendations (lb/ac) N	P2O5	K2O	Crop Removal (lb/ac) N	P2O5	K2O
Corn year of rotation						
15 t/ac Compost	196	82	151	196	165	151
Corn, grain @ 170 bu/ac	-157	-45	-71	-141	-71	-49
Liquid Starter	4	16	4	4	16	4
Nutrient Balance September 1, 2012 - November 7, 2013	42	54	83	58	110	105
Soybean year of rotation						
Previous Material N Credit	40	0	0	40	0	0
Soybeans @ 45 bu/ac	0	-27	-54	-175	-38	-63
Nutrient Balance November 8, 2013 - September 25, 2014	40	-27	-54	-135	-38	-63
Wheat year of rotation						
Previous Material N Credit	20	0	0	20	0	0
Liquid Starter	4	16	4	4	16	4
Spring N	90	0	0	90	0	0
Wheat, winter @ 90 bu/ac	-99	-18	-18	-108	-53	-32
Nutrient Balance September 26, 2014 - July 31, 2015	14	-2	-14	5	-37	-29
Multi-Year Nutrient Balance September 1, 2012 - July 31, 2015	96	25	15	-71	36	13

Compost applied at 15 t/ac 1st year of 3 year rotation

Considering "Manure" Value

Economic Summary [Fall 2012 - Fall 2013]

Application Cost

Cost of Liquid Application:	0.015	$/gal
Cost of Solid Application:	26	$/ton

Value of Material

Value of Nitrogen:	0.7	$/lb
Value of Phosphate:	0.75	$/lb
Value of Potash:	0.6	$/lb

Use defa

Economic Summary	Value This Year	Maximum Value
Cost of Solid Application ($26.00 /ton)	$-390.00 /ac	$-390.00 /ac
Value of Useable N ($0.70 /lb)	$107.50 /ac	$184.38 /ac
Value of Useable P2O5 ($0.75 /lb)	$21.43 /ac	$123.89 /ac
Value of Useable K2O ($0.60 /lb)	$40.72 /ac	$90.54 /ac
Net Value After Spreading	$-220.35 /ac	$8.81 /ac

Micro-nutrient Value?

Per acre:

0.5 lb Copper

0.5 lb Zinc

0.15 lb Boron

53 lbs Calcium

21 lbs sulphur ~$ 14 (long term)

39 lbs magnesium ~$ 55

1.75 lb manganese ~$ 2.5

Organic Matter Value?

Net Value (15 t/ac in yr 1 over 3 yr Rotation) $8.81/ac + Micro nutrients & Organic Matter

plus value of increased yield

2011-2012 Greenbin Compost Project Plot design

Depending on availability: full compost rate of between 10 and 15 ton/acre

Fertilizer check treatment
Compost treatment
Compost treatment + Nitrogen treatment
Fertilizer check treatment
Compost treatment
Compost treatment + Nitrogen treatment
Fertilizer check treatment

For soybean crops: compost full rate compared to compost half rate

Evaluation of Greenbin derived compost to improve soil health on cropland

- This project will evaluate municipal compost by characterizing the nutrient and OM value of green bin and municipal compost and by describing logistical solutions to timely, cost effective transport and application of these materials. This project will increase awareness of the value of these products and if they are valuable it will encourage adoption of their use among crop producers.

- This study will highlight these benefits and create awareness amongst horticulture and cash crop producers of the value of organic matter from various municipal greenbin sources. The logistics of getting municipal compost from production site to farm including transportation, storage and application will be investigated so that barriers for acceptance and use of greenbin waste are reduced or eliminated.
- 3 years
- 25 sites

Wainfleet – Niagara
July 26, 2012

Greenbin Compost applied spring 2012

Ministry of Agriculture, Food and Rural Affairs

Ontario

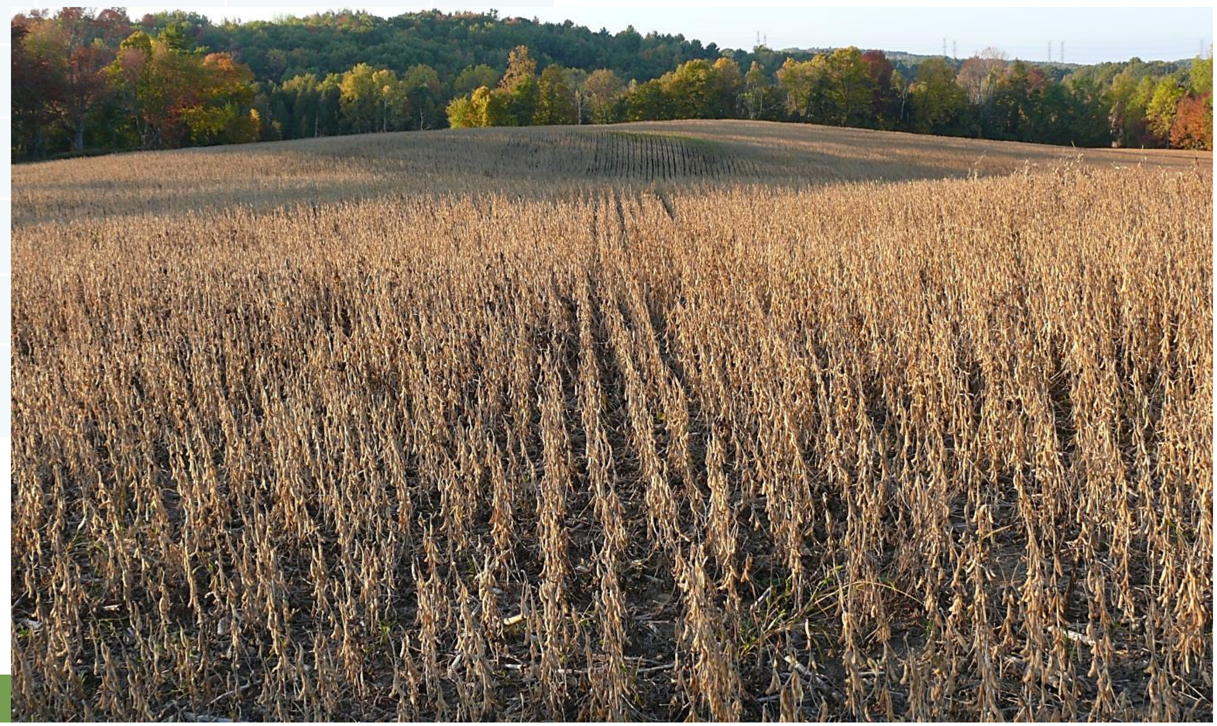
Considering “Manure” Value

Yield Comparison

Brighton – Miller Greenbin Compost- Applied ahead of soybeans on sandy soil

Application	Yield (bu/ac)	**Compared for Variability**	**Average**	
Check	36.23	36.23	Check	31.12
20t/ac	34.67	37.26	10t/ac	33.88
10t/ac	37.03	39.79	20t/ac	33.41
Check	30.65	30.65		
20t/ac	32.84	32.34		
Check	30.64	30.64		
10t/ac	30.23	27.98		
20t/ac	33.08	30.62		
Check	26.95	26.95		

~ 2.75 bu ave yield advantage



Green Bin Compost Plot – **Wayne Cunningham**
6007 5th Line – Orton (Wellington County)
Harvest Date: Oct 22, 2012 (compliments of Holmes Agro – Orangeville)

Treatment	Weight (lbs)	Field Length (ft)	YIELD (bu/ac @ 15.5%)	Moisture (%)	Test Weight (lbs/bu)	Comments
Fertilizer – no compost	---	---	< 100	---	---	• Weedy (grasses) • Sandy soils – evidence of moisture stress in several spots in field • High amount of smut (black dust from combine)
14 T compost	4390	2056	103.4	21.1	56.0	
10 T compost (+ N)	4540	2056	105.7	22.0	53.9	
10 T compost (+ N)	4450	2056	104.7	21.2	55.3	
14 T compost	4430	2056	105.6	20.1	55.3	
Fertilizer – no compost	3950	1884	102.0	20.7	55.4	
Chicken Manure + compost + 119 lbs N	3580	1884	91.8	21.3	54.7	

Treatment	Moisture	Yield
Compost	21.1	104.75
Fertilizer – no compost	20.7	< 102.0

~ 2.75 bu average yield advantage

Logistics of Application

Is the material at the farm (temporary storage) at the time of planned application?

Equipment:

- **Transport from facility to farm?**
  - volume transported per load
  - Transport loaded both ways (cost efficiencies)
  - field compaction during unloading
- **Loader efficiency**
  - Is the application equipment waiting
  - Additional labour requirements?
- **Spreader size and spread width**
  - Bulk density of compost? How much can one load cover?
  - How many acres can be covered per hour?
  - Labour - custom applied or owned - most expensive in planting season

Questions??

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Additional information:

www.fieldcropnews.com

Category: Manure Management
Title: Let's compare organic amendments

Cities Feed Farm Soils

Greenbin-derived Compost Agricultural Trials

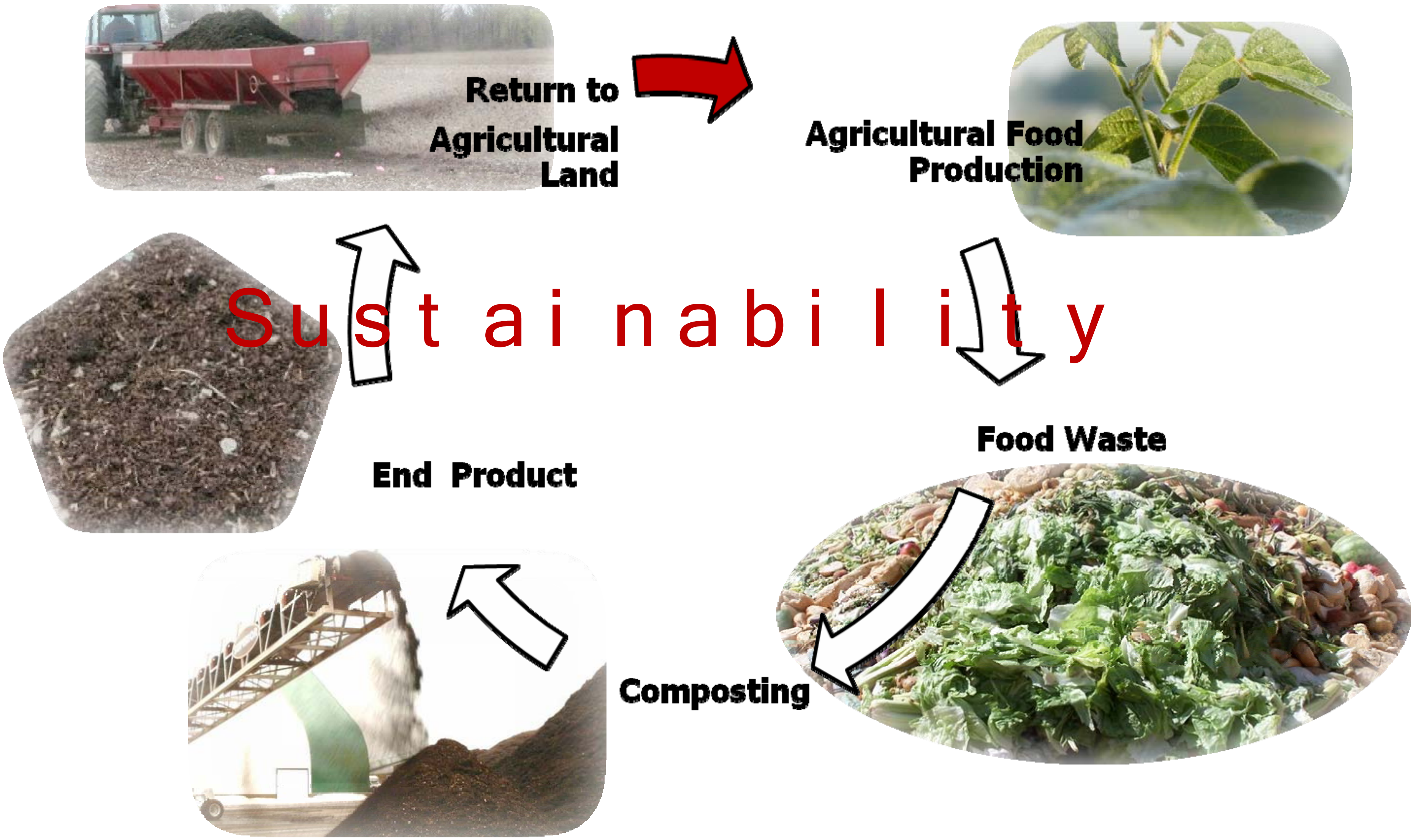
Compost Matters Conference

London – March 5, 2014

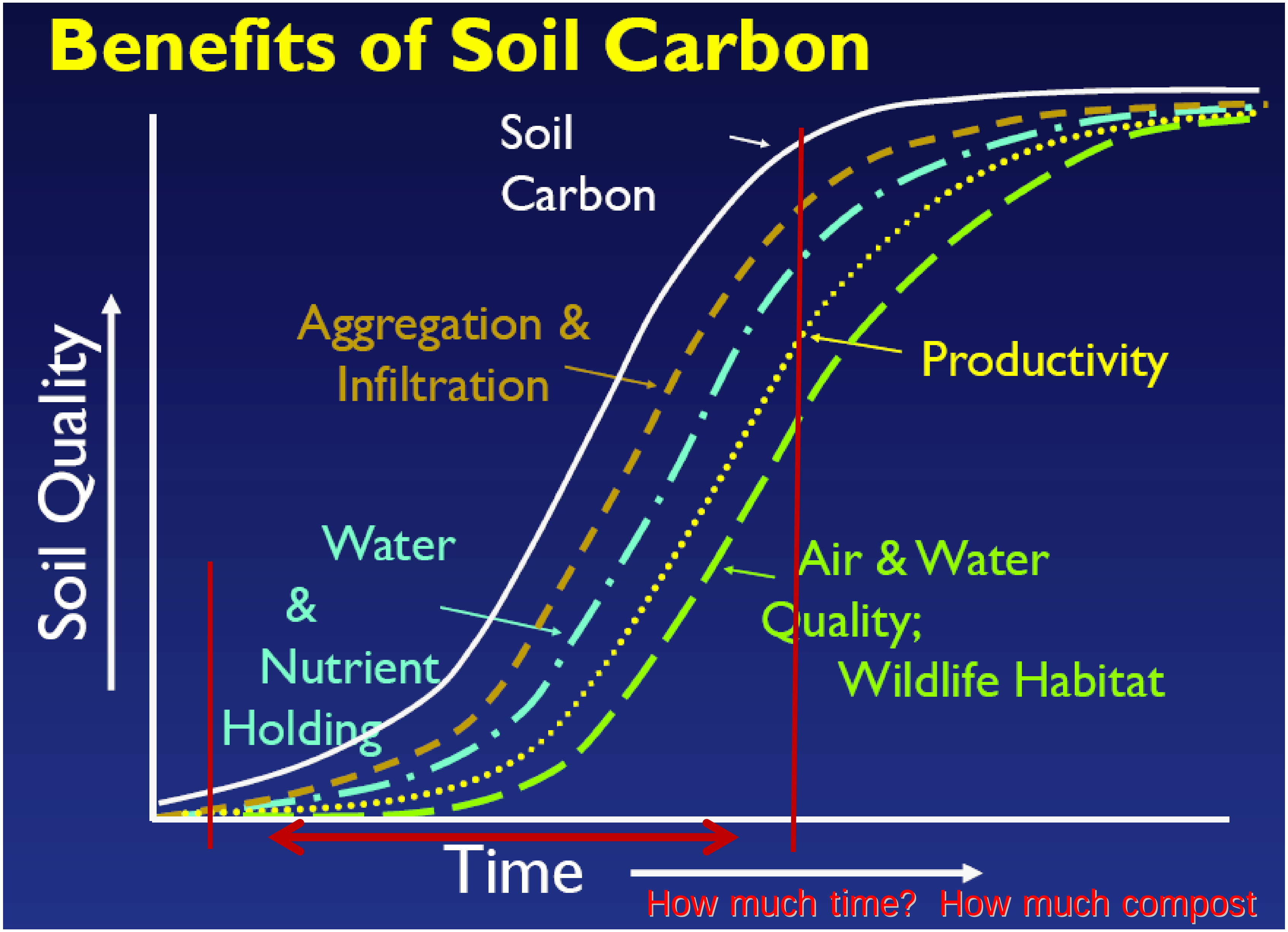
Ministry of Agriculture,
Food and Rural Affairs

Ontario

Greenbin to Agriculture – Completing the Cycle

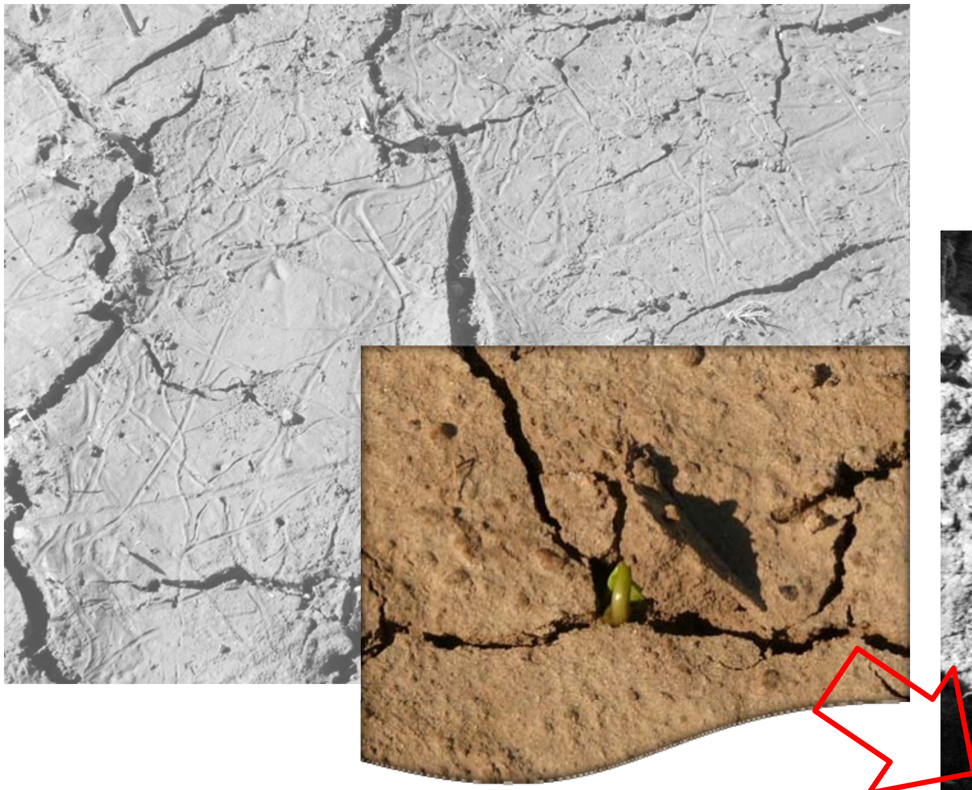


Why?



Benefits of Soil Carbon
Soil Carbon
Aggregation & Infiltration
Productivity
Water & Nutrient Holding
Air & Water Quality; Wildlife Habitat
Soil Quality
Time
How much time? How much compost

The Result:



- Over tilled
- Eroded
- Low organic matter

- Forage based rotation
- Residue management
- Regular organic matter additions

= Improved Sustainabi

Which soil would you prefer in your garden?

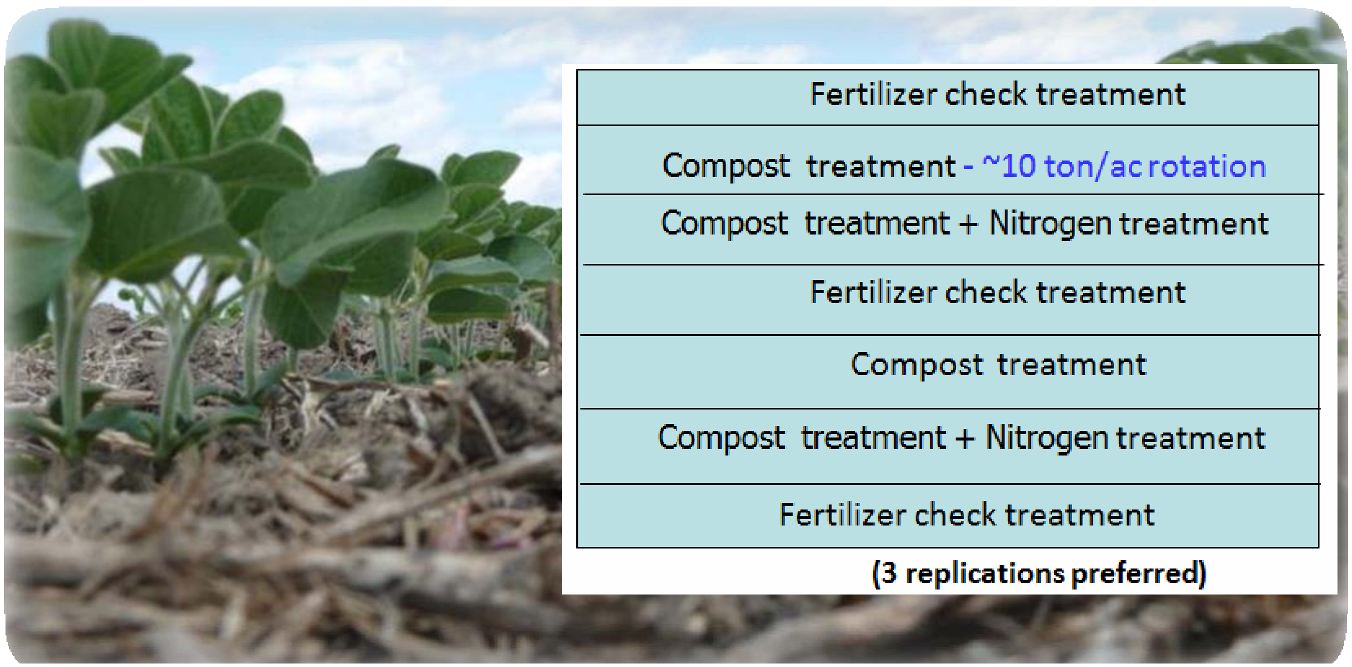
The Project: **Evaluation of Greenbin Derived Compost to Improve Soil Health on Cropland**

Evaluate municipal greenbin compost by:

- characterizing nutrient & OM value
- describing logistical solutions to timely, cost effective transport and application

Project will increase awareness of product value and if value is verified it will encourage adoption of greenbin use among crop producers.

- Duration - 3 years
- ~ 15 to 20 sites



Fertilizer check treatment
Compost treatment - ~10 ton/ac rotation
Compost treatment + Nitrogen treatment
Fertilizer check treatment
Compost treatment
Compost treatment + Nitrogen treatment
Fertilizer check treatment

(3 replications preferred)

Greenbin Derived Compost Agricultural Trials – Year 1 Summary

- Establishment of sites
- Applications for funding
- Monitoring, sampling, data collection
- Determined Fertilizer value of compost
- Organic matter content (value?)
- Best fit (rate, frequency)
- Logistics and Economics

What have we learned so far?

Benefits:

- High OM product with good balance of available N-P-K and micros
- Cured compost = low odour & low risk of N loss
- Uniform application - easier than with most solid manure types
- Ideally applied once in the rotation (after cereal harvest ~ 10 ton/ac)
- Unrestricted designation – easier to access and handle than biosolids or manure

10.4 ton/acre (~31 lbs/ft^3)

What have we learned so far?

Challenges:

•Low bulk density (~ 20 lbs/cubic foot) makes transport more expensive

•Temporary field storage can cause some compaction damage

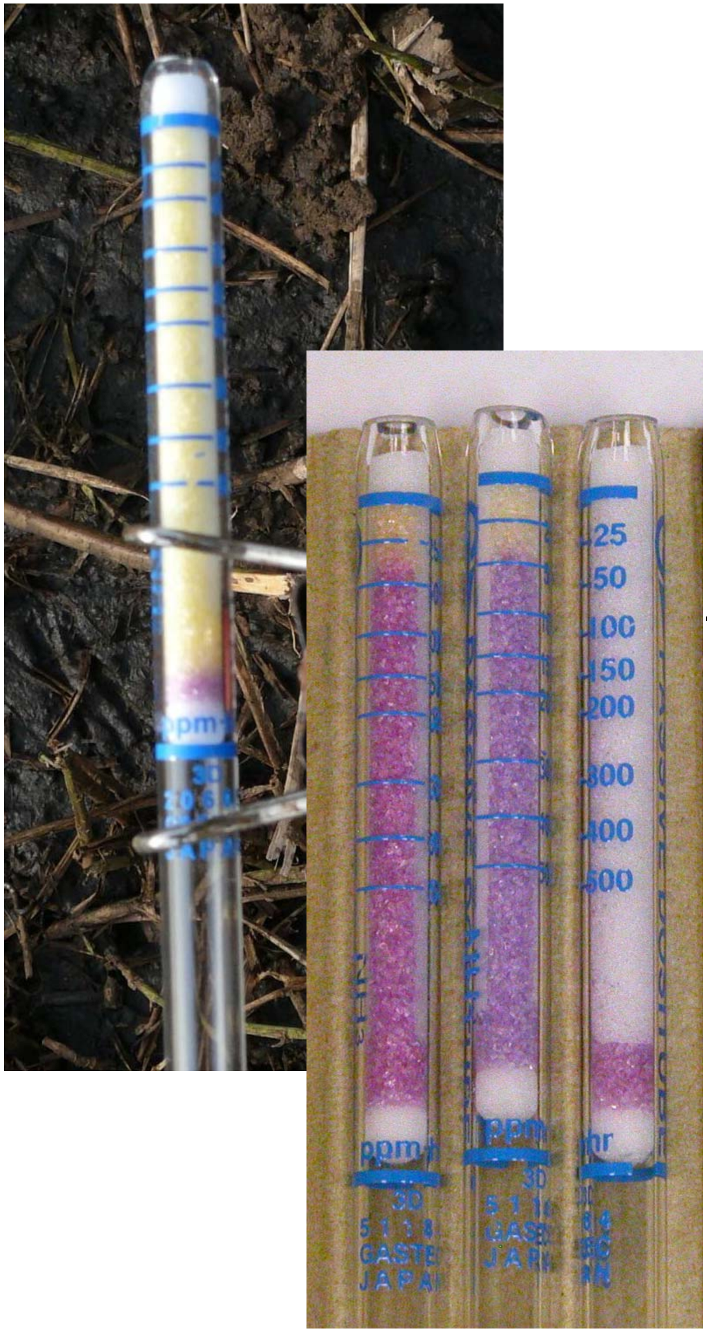
•**Contaminants – plastics and glass**

•Timing of product availability and application

•Consistent availability of product

•Un-cured "green" compost can have a distinct odour that can re-occur when wetted if material is not incorporated

•Unincorporated, surface applied compost -↑ risk of soluble P runoff



Lystek

Precautions:

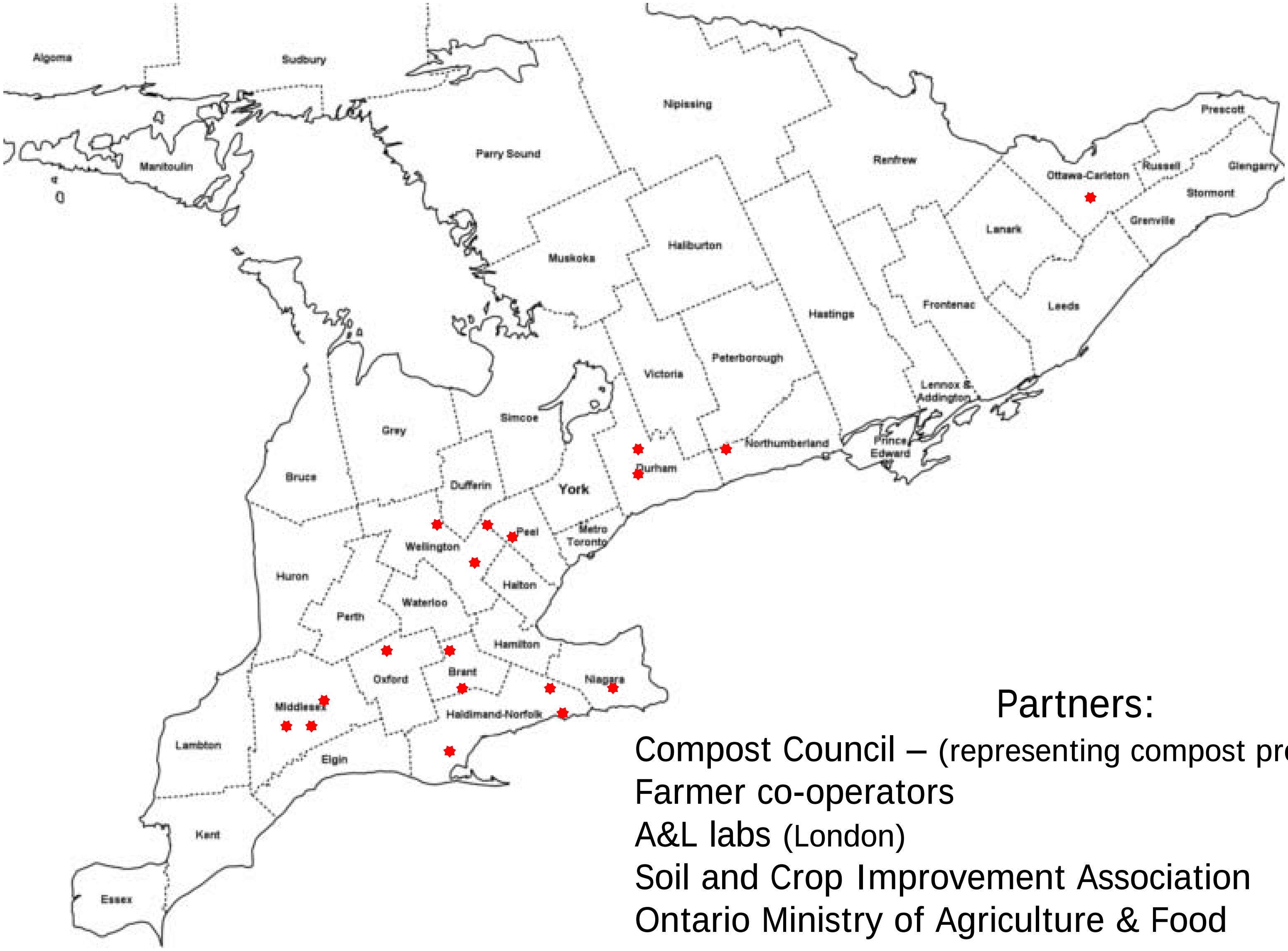
- Relatively low OM content
- no microbial diversity in material (pathogen kill and high pH)
- high pH material with high ammonium-N content requires injection or NH4-N loss is too high.

Bottom Line:

Better nutrient balance than biosolids
Similar in many ways to digestate
Great value (currently)
Some precautions required
Availability of material ?

Side-by side comparisons welcomed

Year 2 of the Project - Site locations



Partners:

Compost Council – (representing compost processors)
Farmer co-operators
A&L labs (London)
Soil and Crop Improvement Association
Ontario Ministry of Agriculture & Food

2013 Compost on Corn - Winchester Research Farm

Treatment	Lodging (0 - 10)	Moisture %	Test wt. (Kg/hl)	Yield (bu/ac)	
150 lbs/ac N (using Urea)	0.8	24.3	64.4	257	a
Biosolid Pellets + 125 lbs/ac N (Urea)	0.3	24.5	63.0	247	a
compost (10 ton/ac) + 150 lbs/ac N (Urea)	0.3	24.8	63.6	235	a
compost (10 ton/ac) + 75 lbs/ac N (Urea)	1.3	24.8	64.3	241	a
(20 ton/ac) compost	3.5	26.0	63.4	182	b
No compost, pellets or N fertilizer	3.8	25.4	62.5	157	b

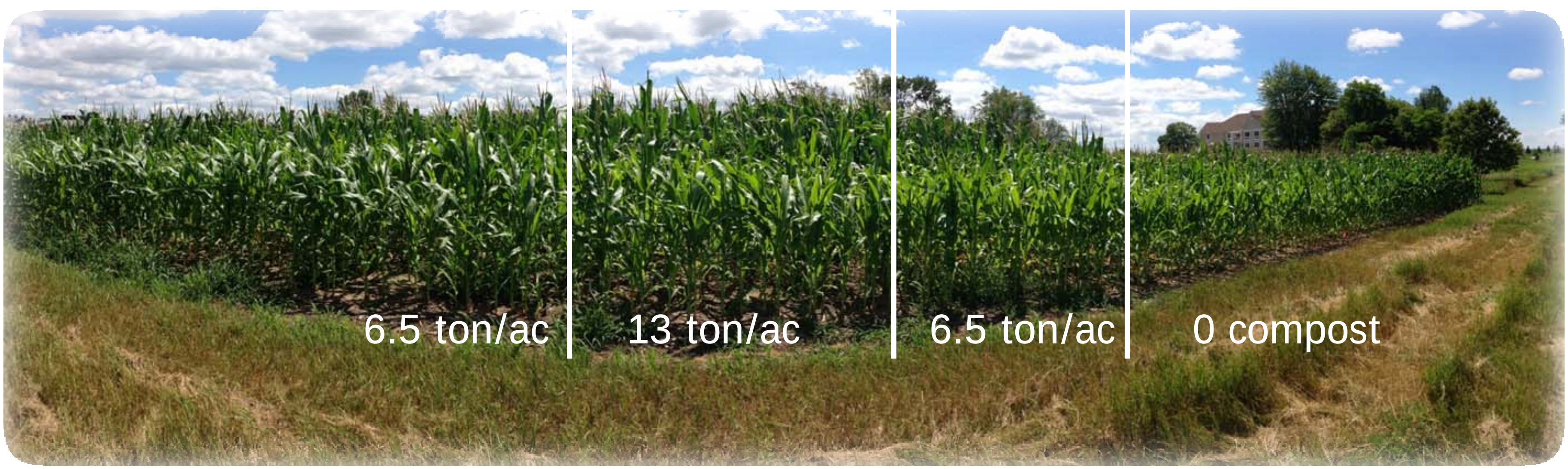
Compost from Orgaworld Ottawa (High C:N ratio)

Picture of soybean plots in year following corn

Year 2 of Project – Strathroy Site

Fertilizer and Economics – Strathroy site

- 124-129-80 lbs/ac N-P_2O_5-K_2O = $ 214 in fertilizer value @ 6.5 ton/ac rate
- Micro nutrients (sulphur, magnesium, manganese, zinc etc)
- ~5,000 lbs of organic matter applied at 6.5 ton rate
- Product cost ~$ 5/ton
- Transportation and application cost - varies with distance
- Increased yield potential? @ $4.00/bu corn; $10/bu soybeans



Soil Health Indicators

Solvita test as an indicator of microbial respiration

- Strathroy site – August 20th
- High respiration (high $C0_2$) = high microbial activity

no compost – commercial fertilizer only

13 ton/ac compost applied in April

Strathmere Lodge Yield Results

Treatment	Yield (bu/ac)	Profit*
Short Plots (April planted)		
6.6 ton	126.2	472
13.3 ton	128.6	448
No compost N Calc	130.9	443
Long Plots (June planted)		
No Compost - Full N	138.1	471
6.6 ton - 0 N	149.4	565
6.6 ton + Calculator N (110 lbs)	183.4	635
13.3 ton - 0 N	151.2	539
13.3 ton + Calculator N (0 N)	156.9	562

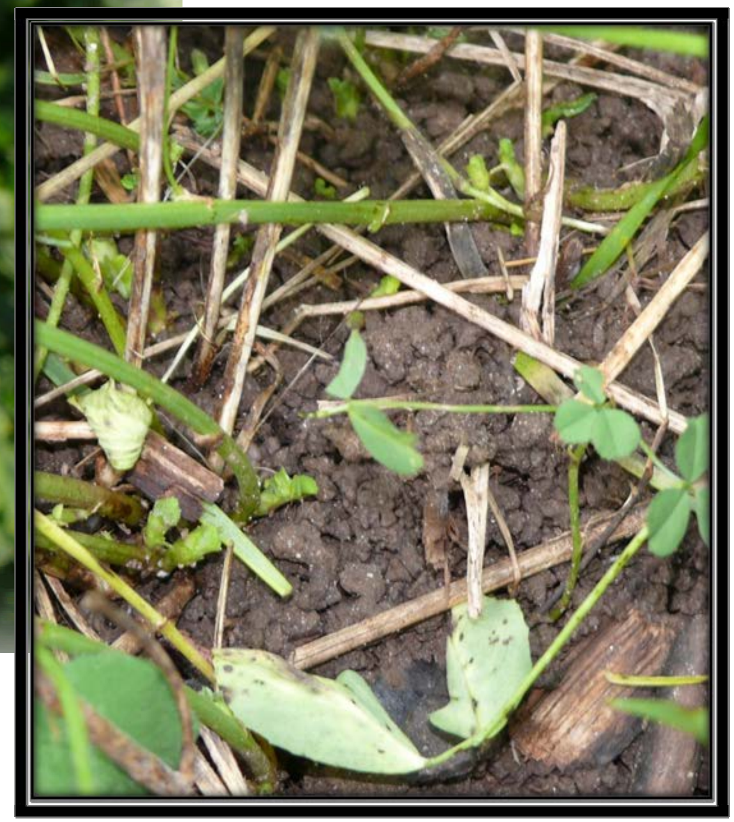
* @ $4/bu corn and $0.60/lb N cost and $5/ton compost cost –all other inputs not considered

April planted corn hit with frost at 5 leaf stage - Long plots were replanted June 15
Short plots were left – had very low population (<20,000 ppa)

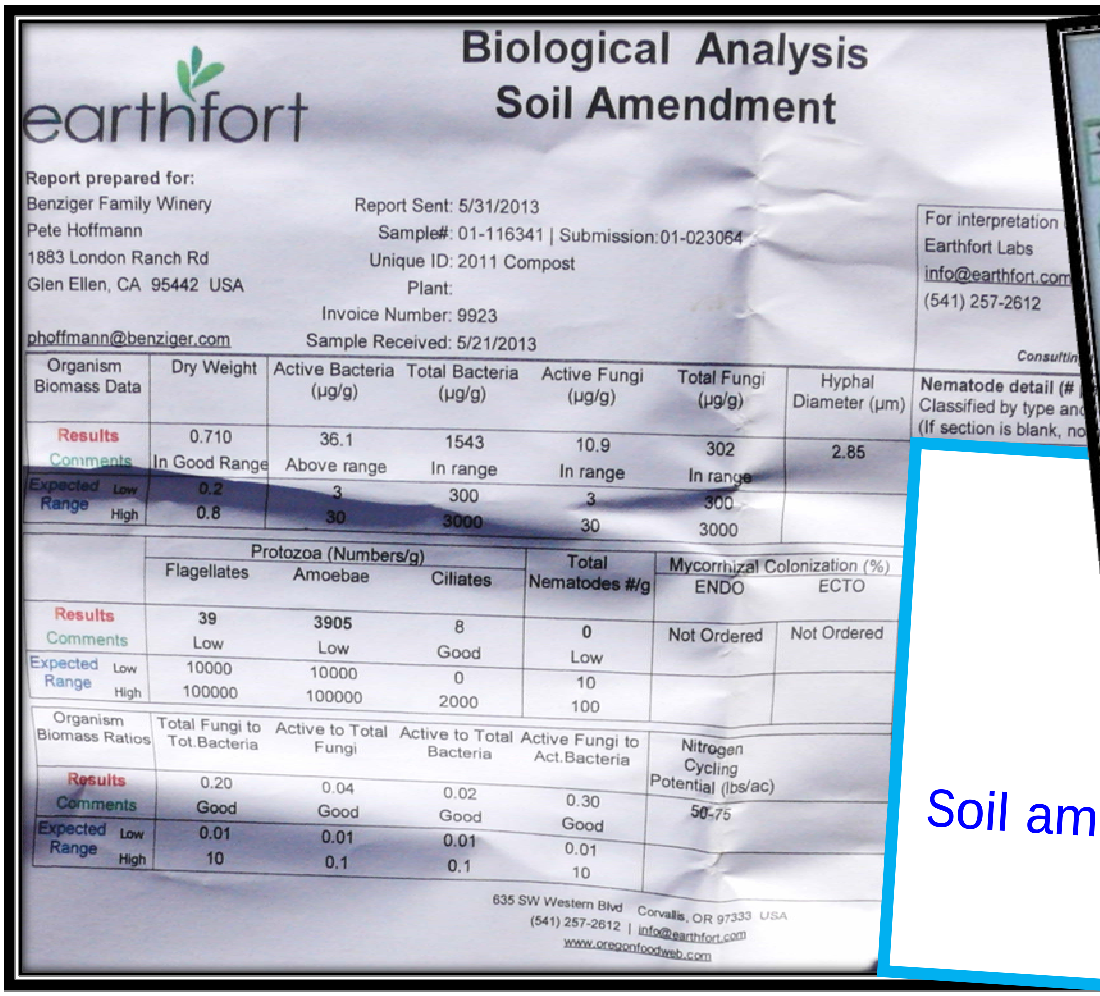
Compost on Forages

Treatment	1st Cut Yield (dry ton/ac)
fertilizer	1.67
compost	1.68
pellets	1.68
fertilizer + pellets	1.63
pellets + compost	1.70
fertilizer + compost	1.78
pellets + compost + fertilizer	1.87

Soil Quality



Compost– more than just a source of nutrients



earthfort

Biological Analysis
Soil Amendment

Report prepared for:
Benziger Family Winery
Pete Hoffmann
1883 London Ranch Rd
Glen Ellen, CA 95442 USA

phoffmann@benziger.com

Report Sent: 5/31/2013
Sample#: 01-116341 | Submission:01-023064
Unique ID: 2011 Compost
Plant:
Invoice Number: 9923
Sample Received: 5/21/2013

For interpretation
Earthfort Labs
info@earthfort.com
(541) 257-2612

Consultin

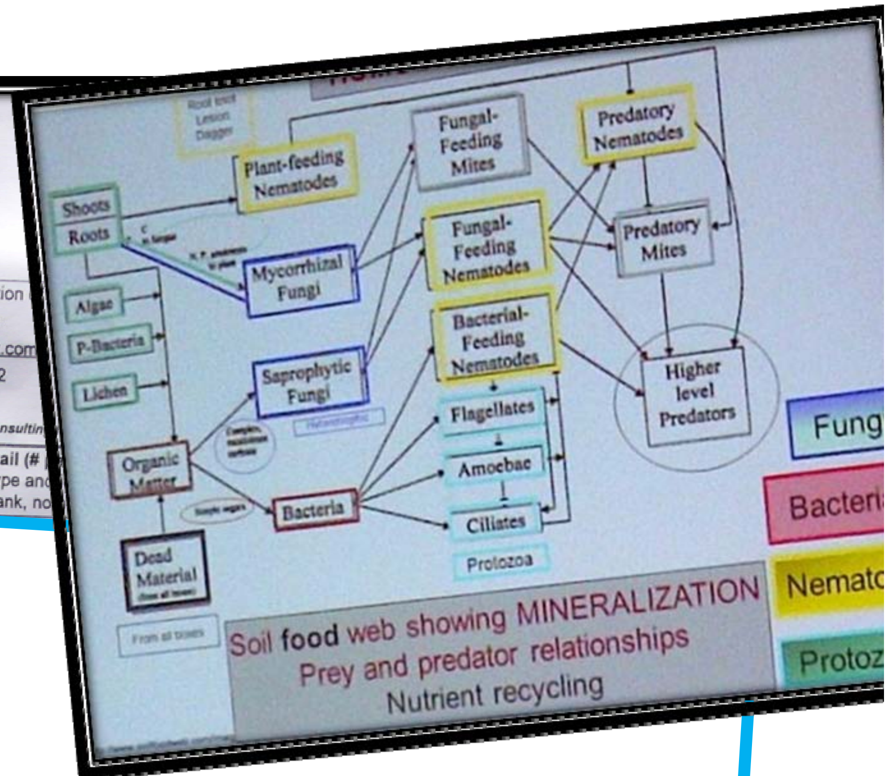
Organism Biomass Data		Dry Weight	Active Bacteria (µg/g)	Total Bacteria (µg/g)	Active Fungi (µg/g)	Total Fungi (µg/g)	Hyphal Diameter (µm)
Results		0.710	36.1	1543	10.9	302	2.85
Comments		In Good Range	Above range	In range	In range	In range	
Expected Range	Low	0.2	3	300	3	300	
	High	0.8	30	3000	30	3000	

Nematode detail (#
Classified by type and
(If section is blank, no

		Protozoa (Numbers/g)			Total Nematodes #/g	Mycorrhizal Colonization (%)	
		Flagellates	Amoebae	Ciliates		ENDO	ECTO
Results		39	3905	8	0	Not Ordered	Not Ordered
Comments		Low	Low	Good	Low		
Expected Range	Low	10000	10000	0	10		
	High	100000	100000	2000	100		

Organism Biomass Ratios		Total Fungi to Tot.Bacteria	Active to Total Fungi	Active to Total Bacteria	Active Fungi to Act.Bacteria	Nitrogen Cycling Potential (lbs/ac)
Results		0.20	0.04	0.02	0.30	50-75
Comments		Good	Good	Good	Good	
Expected Range	Low	0.01	0.01	0.01	0.01	
	High	10	0.1	0.1	10	

635 SW Western Blvd Corvallis, OR 97333 USA
(541) 257-2612 | info@earthfort.com
www.oregonfoodweb.com



Soil amendment biological balance test

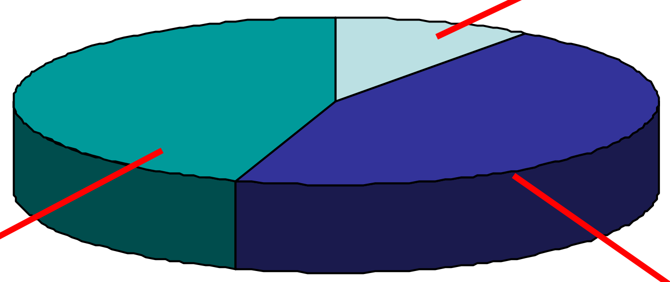
Manure – more than just a source of nutrients

What can it do to help build soil organic matter?

Soil Organic Matter

THE LIVING - 10-15%

Active Nutrient Cycling



THE VERY DEAD - 40-45%

Very stable (Humus)

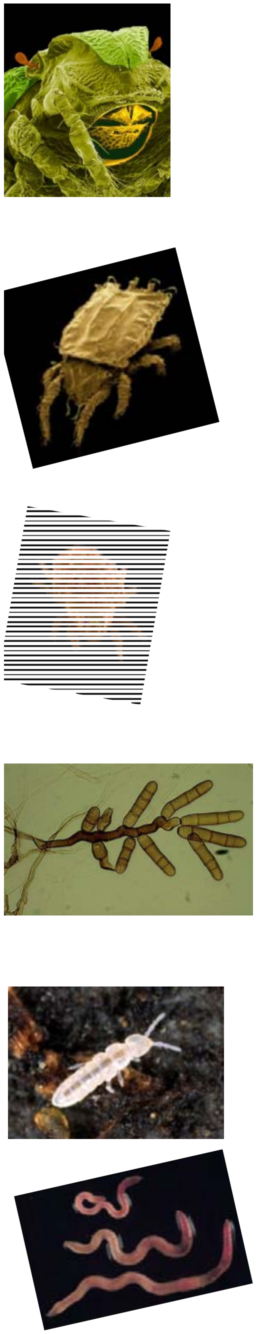
Increase water holding capacity

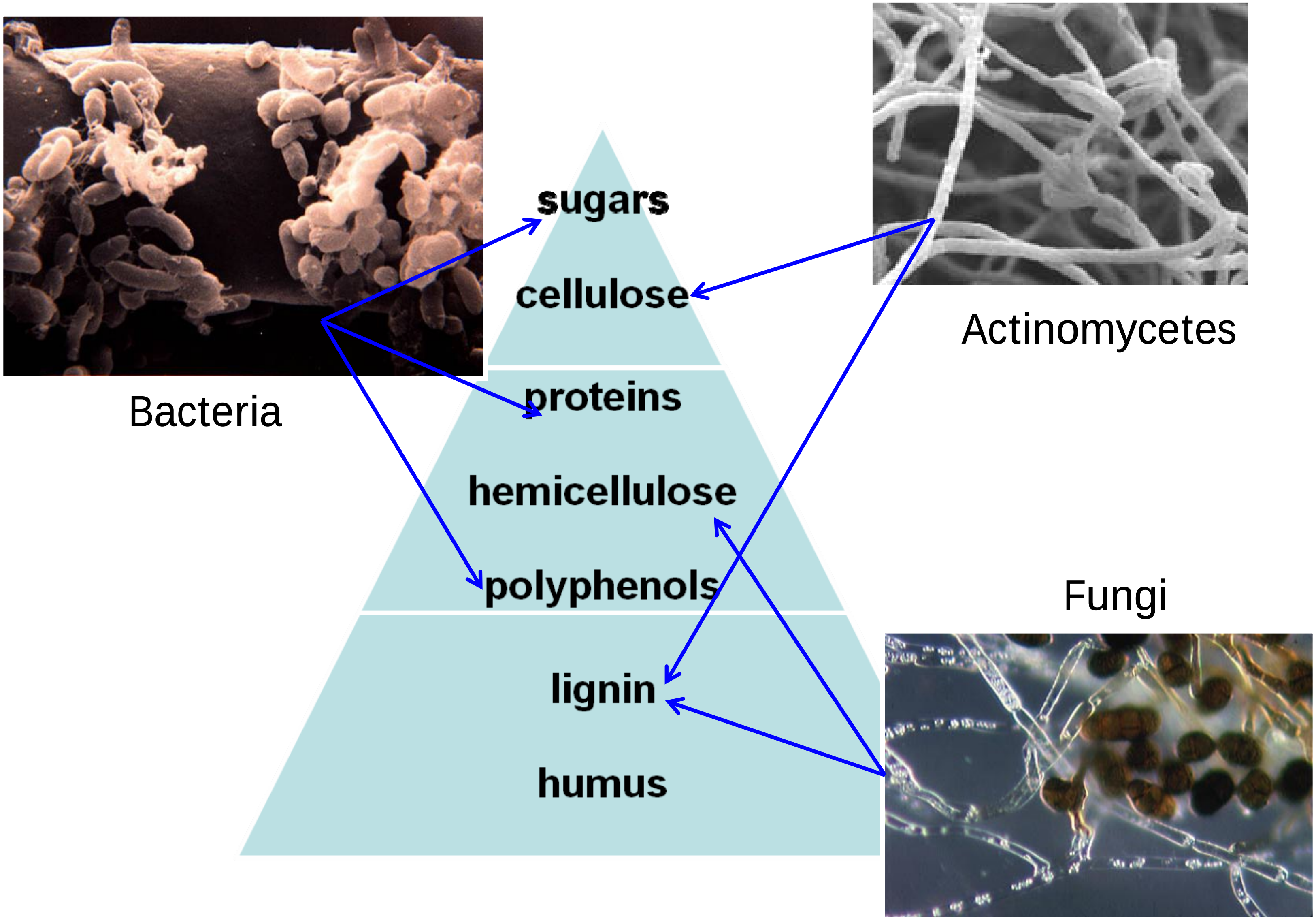
THE DEAD - 40-45%

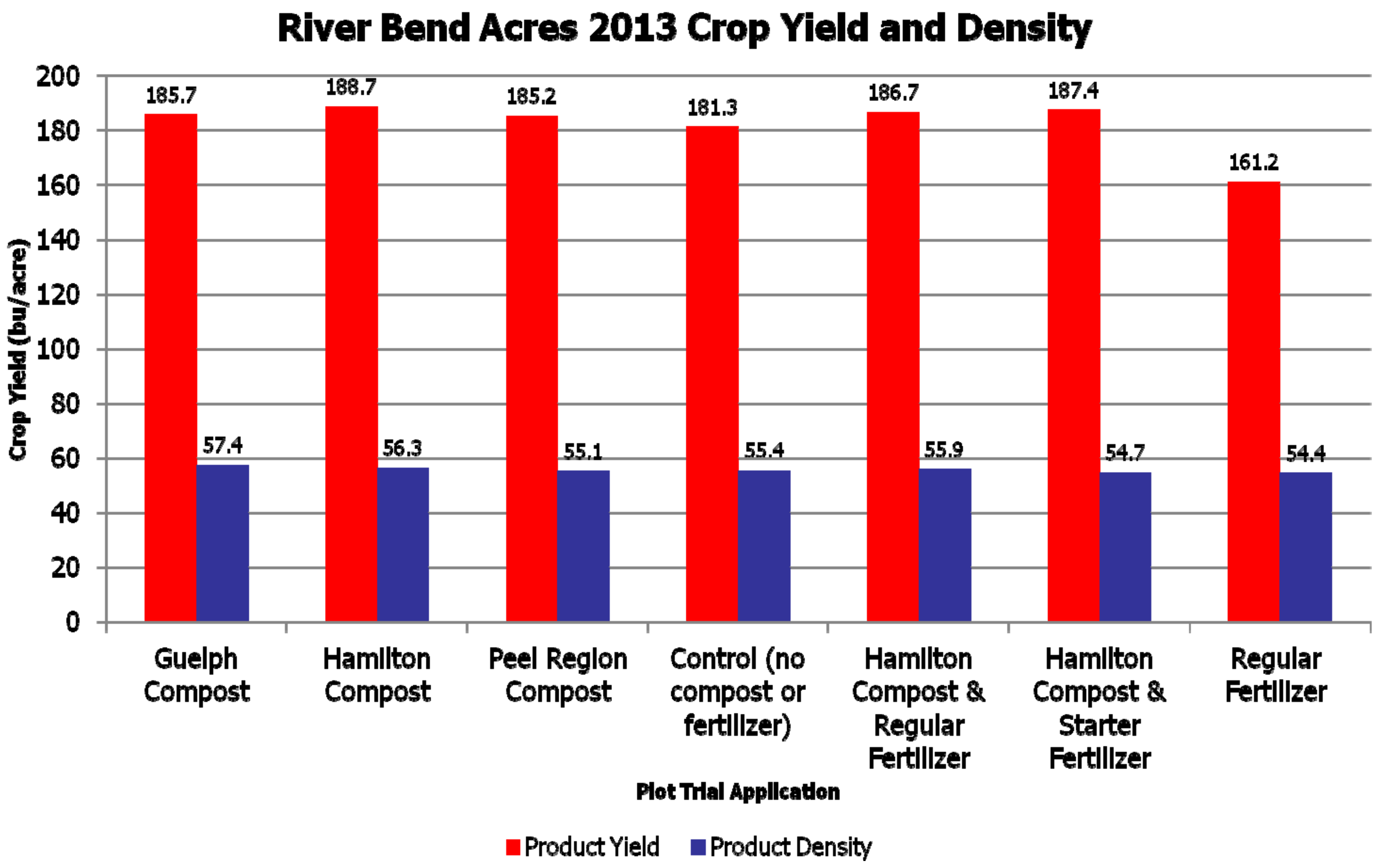
Active Organic Matter

Food for Soil Organisms

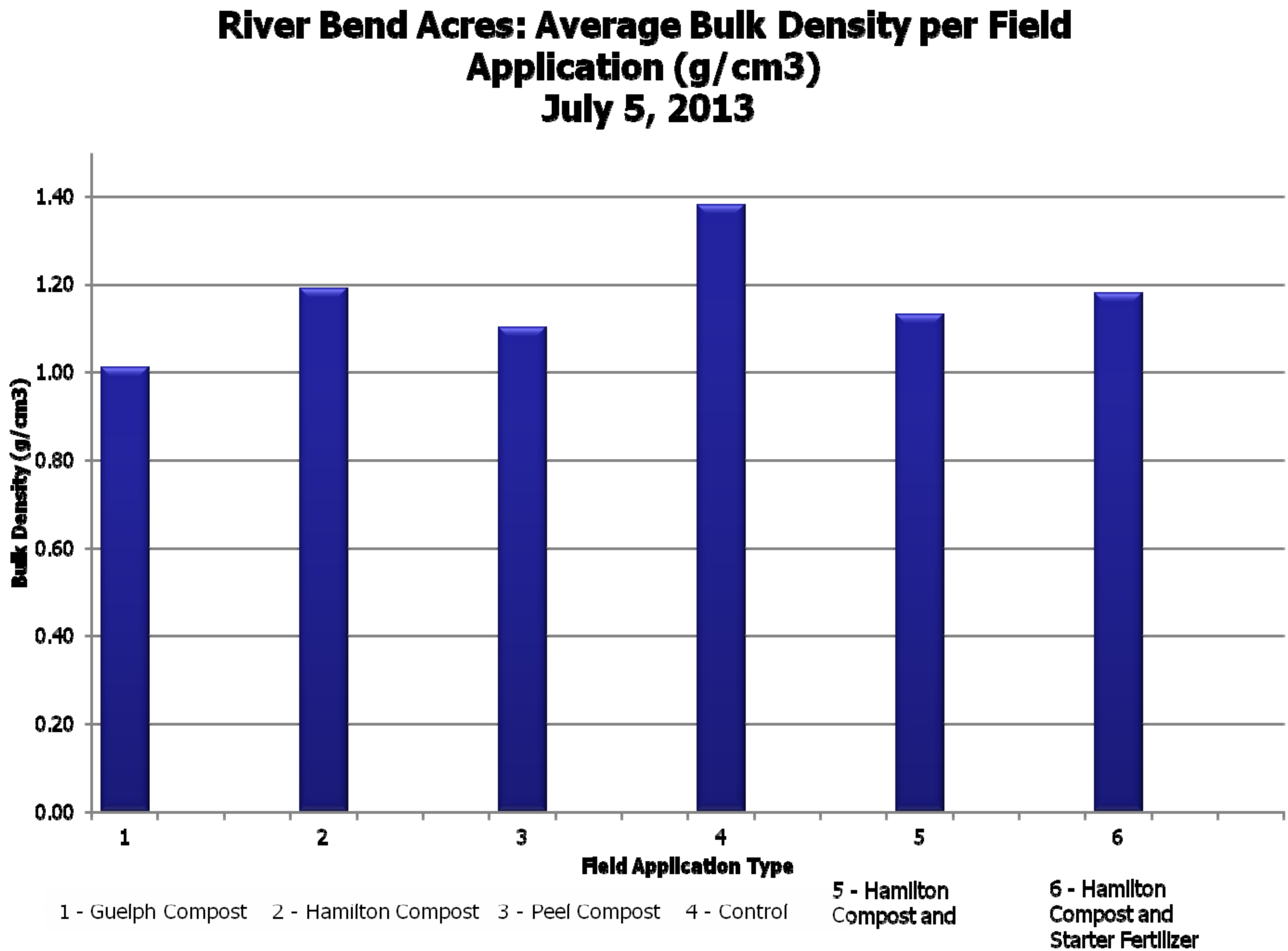
Different amendments have different benefits to soil





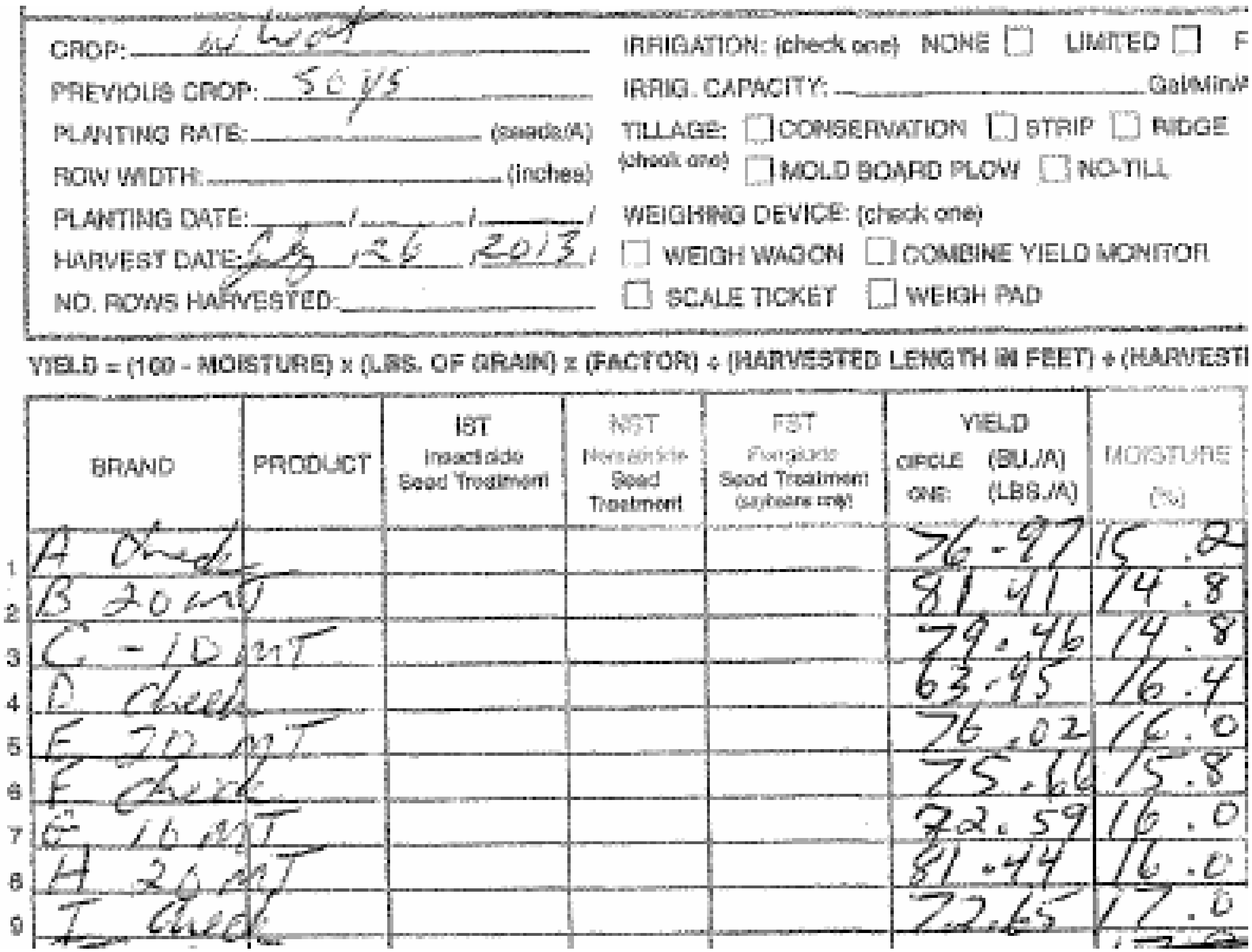


River Bend Acres 2013 Crop Yield and Density
Crop Yield (bu/acre)
200
180
160
140
120
100
80
60
40
20
0
185.7
57.4
188.7
56.3
185.2
55.1
181.3
55.4
186.7
55.9
187.4
54.7
161.2
54.4
Guelph Compost
Hamilton Compost
Peel Region Compost
Control (no compost or fertilizer)
Hamilton Compost & Regular Fertilizer
Hamilton Compost & Starter Fertilizer
Regular Fertilizer
Plot Trial Application
Product Yield
Product Density


River Bend Acres: Average Bulk Density per Field Application (g/cm3)
July 5, 2013
Bulk Density (g/cm3)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
2
3
4
5
6
Field Application Type
1 - Guelph Compost
2 - Hamilton Compost
3 - Peel Compost
4 - Control
5 - Hamilton Compost and
6 - Hamilton Compost and Starter Fertilizer

Yield of 2nd crop after compost application

Soybeans in 2012; Wheat in 2013



CROP: wheat

PREVIOUS CROP: Soys

PLANTING RATE: ______ (seeds/A)

ROW WIDTH: ______ (inches)

PLANTING DATE: ___/___/___

HARVEST DATE: July / 26 / 2013

NO. ROWS HARVESTED: ______

IRRIGATION: (check one) NONE ☐ LIMITED ☐ F

IRRIG. CAPACITY: ______ Gal/Min/A

TILLAGE: (check one) ☐ CONSERVATION ☐ STRIP ☐ RIDGE ☐ MOLD BOARD PLOW ☐ NO-TILL

WEIGHING DEVICE: (check one) ☐ WEIGH WAGON ☐ COMBINE YIELD MONITOR ☐ SCALE TICKET ☐ WEIGH PAD

YIELD = (100 - MOISTURE) x (LBS. OF GRAIN) x (FACTOR) ÷ (HARVESTED LENGTH IN FEET) ÷ (HARVESTI

	BRAND	PRODUCT	IST Insecticide Seed Treatment	NST Nematicide Seed Treatment	FST Fungicide Seed Treatment (soybeans only)	YIELD CIRCLE ONE: (BU./A) (LBS./A)	MOISTURE (%)
1	A check					76.97	15.2
2	B 20 MT					81.41	14.8
3	C - 10 MT					79.46	14.8
4	D check					63.95	16.4
5	E 20 MT					76.02	16.0
6	F check					75.66	15.8
7	G 10 MT					72.59	16.0
8	H 20 MT					81.44	16.0
9	I check					72.65	17.0

Plot Summary

Check	**72**
10 T/ac	**76**
20 T/ac	**80**

2013 – Thames Centre Site
Compost on Strawberries

2013 – Thames Centre Site

Compost on Strawberries

- First project with horticultural crops
- Strawberries are crop most sensitive to salts
- 4 ton compared to 2 ton rate compared to fertilizer applied in early June
- @ 4 ton ~ 50 lbs total salts resulted less vigorous early growth
- All plots look good - harvest started in August

June 14, 2013

September 17, 2013

The effect of municipal solid food waste compost and fertigation on yield and fruit quality in strawberry plasticulture

Mehdi Sharifi
Ben Thomas
John Lewis

First Year Yield Summary

- 100% fertigation increased late season marketable yield by 23%
- 10 Mg FW ha^{-1} compost rate increased late season marketable yield by 10%
- Reduce fertigation to 25% until Sept 1 then 100%
- Likely reduce compost from 25 to 10 Mg FW ha^{-1}
- Total potential saving: $450 (MSFW)+ $226 (Fert.)= $676

What are people saying about greenbin?

- Numerous farm media coverage over the past year

June 2013

January 2013

What are people saying about greenbin?

AVONBANK AG SOLUTIONS
GRANTON • LISTOWEL

TODAY'S FARMER
Tuesday, September 10, 2013
Serving Essex, Chatham-Kent, Lambton, Middlesex, Elgin, and Huron Counties

HURON TRACTOR

Compost offers long-term benefits

BY JOHN PHAIR
Today's Farmer

A Netherlands-based company with a Canadian subsidiary is offering farmers some new options in terms of compost and fertilizer treatments.

Orgaworld Canada Ltd. uses innovative technologies to processes municipal green bin waste at its London, Ontario plant and offers high quality compost, energy, fuels, and other agricultural products.

Speaking at the annual Conservation Tour hosted by the Middlesex Soil and Crop Improvement Association, Orgaworld Canada's marketing manager Trevor Woollings said the company's London plant currently processes 110,000 tonnes of organic material annually.

"We process organic waste at our sites, and at our London site in particular, we process what are called source separated organics, which is essentially muni...

...food waste from private sector companies such as Tim Horton's.

In addition, he pointed out that their London plant's certificate-of-approval also allows them to process diapers and animal waste (kitty litter).

He noted that all the material is received in plastic bags.

"We bring it in and run it through a series of shredders and according to ministry guidelines, we then tunnel compost it," he said, adding that they essentially manipulate the environment to force the composting process.

"Basically, we bring the temperature up to 55 degrees for 72 hours which is the pasteurization point required."

He said beyond that it is run through a series of screens and separators to get the product to its end form.

"We process organic waste at our sites, and at our London site in particular, we process what are called source separated organics, which is essentially municipal green bin waste."

— Orgaworld Canada's marketing manager Trevor Woollings

It's About The Business of Farming

Green bin compost

Green Bin Compost Project

BY JOHN PHAIR
Today's Farmer

It takes more than organic amendments to improve soil health, but trials conducted by Chris Brown, OMAFRA's field crop lead, indicate that on sandy soils with little organic matter a pre-plant application of Green Bin compost not only improved soil quality, but also provided a yield response the first year.

Kaleda Connell, who assisted Brown on the Green Bin Compost project, presented some of their findings on plots conducted at the Strathmere Lodge Farm, which was one of the stops on the Middlesex Soil and Crop Improvement Association's (MSCIA) annual Conservation Tour.

The MSCIA has managed the Strathmere Lodge Farm for the County of Middlesex ...

...here that were a little different," she said.

She noted that compost, which was supplied by Orgaworld Canada, was applied to the plots in mid-April prior to being planted in corn.

"That will tell us how much nitrogen is mineralizing in the soil. If there is a good amount of organic material in the soil it will start respiring and if there is a low level of organic material there will not be a lot of respiration."

"We applied replications in plots with no compost, plots with 6.6 tons per acre, and plots with a double rate application of 13.3 ..."

It's About The Business of Farming
Tuesday, September 10, 2013 • Today's Farmer 15

application increases organic matter and yield

we have micro-organism activity and nutrient cycling going on so it is not all available to the soil, so you won't see that much show up in a soil test," she said.

"However, the benefits from that micro-organism activity in the soil you will see for many years to come."

She noted that she did take a couple of soil tests to get an indication of the soil's CO2 respiration level.

"In the short and sweet version, that tells us how much micro-organism activity is going on in the soil," she said, adding this was ...

If there is a good amount of organic material in the soil it will start respiring and if there is a low level of organic material there will not be a lot of respiration."

Connell noted that the plot with no compost applied showed a rate of 2.5 while the plot with the double application of 13.3 tons of compost per acre showed a rate of four.

"A rate of four is ideal and indicates the soil is well supplied with organic matter," she added.

OMAFRA cereal specialist Peter Johnson noted that due to the sandy nature of the soil at the Stathmere Lodge Farm they adhere ...

just doesn't work," he said.

He noted that the long-term plan is to continue with the compost plots for a number of years.

"The hope is to keep the same treatments in the same location and monitor the improvement over a number of years," he said.

Connell said that some of her observations of the plot was that during thecorn's early development stage dark green strips of corn became highly visible alongside much lighter green strips.

"The darker green strips were the 6.6 and 13.3 ton applications while the lighter green strips were the no compost plots," she said.

"You could really see the difference when the corn started to come up," she said.

were offset by savings in fertilizer costs and an increase in yield.

She noted that cost of applying the compost was about $26 per acre.

Connell added that some of the second year plots she has looked at clearly show an increase in the soil's bulk density.

"This means the soil is more fluffy which makes it easier for roots to grow and the water holding quality of the soil is much better," she said.

However, Connell noted that organic amendments is not the only solution to improving soil health and suggest that the use of cover crops, residue management and growing legume crops are also good practices.

September 2013

- Numerous farm media coverage over the past year
- Several of farmer co-operators are applying additional greenbin to fields this fall
- Several horticultural growers are looking compost

Summary: Greenbin-derived Compost Agricultural Trials

Project Goals:

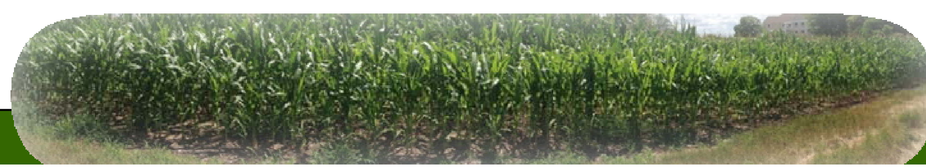
- Divert organic matter from land-fill sites
- Evaluate value of compost compared to other materials (i.e. cattle manure)
- Demonstrate to crop producers that Greenbin is an economic alternative to traditional manure
- Evaluate with municipalities: advantage of diverting SSO as greenbin compost to agriculture
- Establish logistics: from production to field with input from various organizations

The Findings (so far):

- Urban "Greenbin" waste diverted from landfill/yr: equivalent to manure volume from ~26,500 dairy cows (just under 10 % of cows in Ontario)
- Contributes over 55,000 T organic matter and over $5.25 million/year in crop-available fertilizer equivalent

Logistics from production to field

- Product cost ~ $ 5 - 7/T
- Transportation= biggest expense - varies with distance
  - Gravel 13.8 T/load vs Compost at 4.5 T/load
- Application cost $ 3 – 5/T
- Increased yield potential?
  - 2012/13: Ave: 3 bu/ac @ $5/bu corn; $13/bu soys.
- Maximum economic benefit: 1 application (~10 T/ac) per rotation ahead of corn



Questions?

Christine Brown
Nutrient Management Lead – Field Crops
christine.brown1@ontario.ca

2013 Compost on Corn - Winchester Research Farm

Treatment	Lodging (0 - 10)	Moisture %	Test wt. (Kg/hl)	Yield (bu/ac)	
150Kg/Ha N (using Urea)	0.8	24.3	64.4	257	a
2.2 tonne/Ha Biosolid Pellets AND 128 kg/ha additional N fertilizer (Urea)	0.3	24.5	63.0	247	a
22.5 wet tonnes/Ha (10 t/ac) of Orgaworld compost AND 150 Kg/Ha N using Urea	0.3	24.8	63.6	235	a
22.5 wet tonnes/Ha (10 t/ac) of Orgaworld compost AND 76kg/Ha N using Urea	1.3	24.8	64.3	241	a
45.5 wet tonnes/Ha (20 t./ac) of Orgaworld compost	3.5	26.0	63.4	182	b
No compost, pellets or N fertilizer	3.8	25.4	62.5	157	b

Full N no N calc was 135. plots o,p, and q.

Full N calc with no compost –110 lbs sidedress.

N calc with compost, both rates – 0 lbs N sidedress.

I used 450 /t 28%, (wheat time price) actual cost had dropped to 385 /t. Could have put on slightly more N because of that.

Thanks. Nick

6.6 ton	126.2	123.7 + 128.8
13.3 ton	128.6	
No compost N Calc	130.9	
Long Plots		
No Compost - Full N	138.1	150.8 + 118.6 + 139.4 + 143.5
6.6 ton - 0 N	149.4	158.8 + 153.7 + 135.7
6.6 ton + Calc N	183.4	157.6 + 209.1
13.3 ton - 0 N	151.2	155.4 + 147.0
13.3 ton + Calc N	156.9	156.9

The Challenge

- Less livestock
- More cash crop acres with no manure source
- Increasing urban population

The Goal:

- Divert organic matter from entering land fill
- Evaluate value of compost compared to other materials (i.e. biosolids or cattle manure)
- Demonstrate to crop producers that Greenbin is an economic alternative to traditional manure
- Evaluate with municipalities that diverting SSO as greenbin compost to agriculture is a viable alternative
- Work with various organizations to establish logistics from production-to-field

SELLING ORGANICS TO FARMERS

By Larry Conrad, P. Eng.
Region of Peel
Manager, Waste Operations

Region of Peel
Working for you

PRESENTATION OUTLINE

- Background:
  - ➢Region of Peel information
  - ➢Organic Waste Management in Peel Region
- Marketing Compost in Peel Region
- Marketing Compost to the Agricultural Community

Region of Peel
Working for you

The Region of Peel

City of Brampton ~ City of Mississauga ~ Town of Caledon

- Population: 1.3 million
- The Region services 330,000 single family households and 88,000 multi-residential units
- 502,109 tonnes of residential waste managed in 2010
- Including EFW there was a 58% diversion rate in 2010
- Regional goal: to divert 70% of waste from disposal by 2016

Region of Peel
Working for you

DEVELOPMENT OF PEEL'S ORGANIC WASTE MANAGEMENT PROGRAM

- **1995** - **First composting facility**
  - source-separated organic waste collection in Caledon
  - two-phase composting technology
    - Herhof tunnel for one week high-rate phase
    - passive open windrow for 3 to 4 months
  - successfully operated for ten years+
  - design tonnage capacity of 12,000 tonnes
- **2007 – Second composting facility**
  - collection expanded to 285,000 households Region-wide
  - selected similar tunnel/windrow technology (Christiaens) for the Peel Integrated Waste Management Facility (PIWMF)
  - design tonnage capacity of 60,000 tonnes

Region of Peel
Working for you

REGION-WIDE SOURCE-SEPARATED ORGANICS RECYCLING IN PEEL REGION

2011: Collection of source-separated organic waste (kitchen waste) from approximately 330,000 households

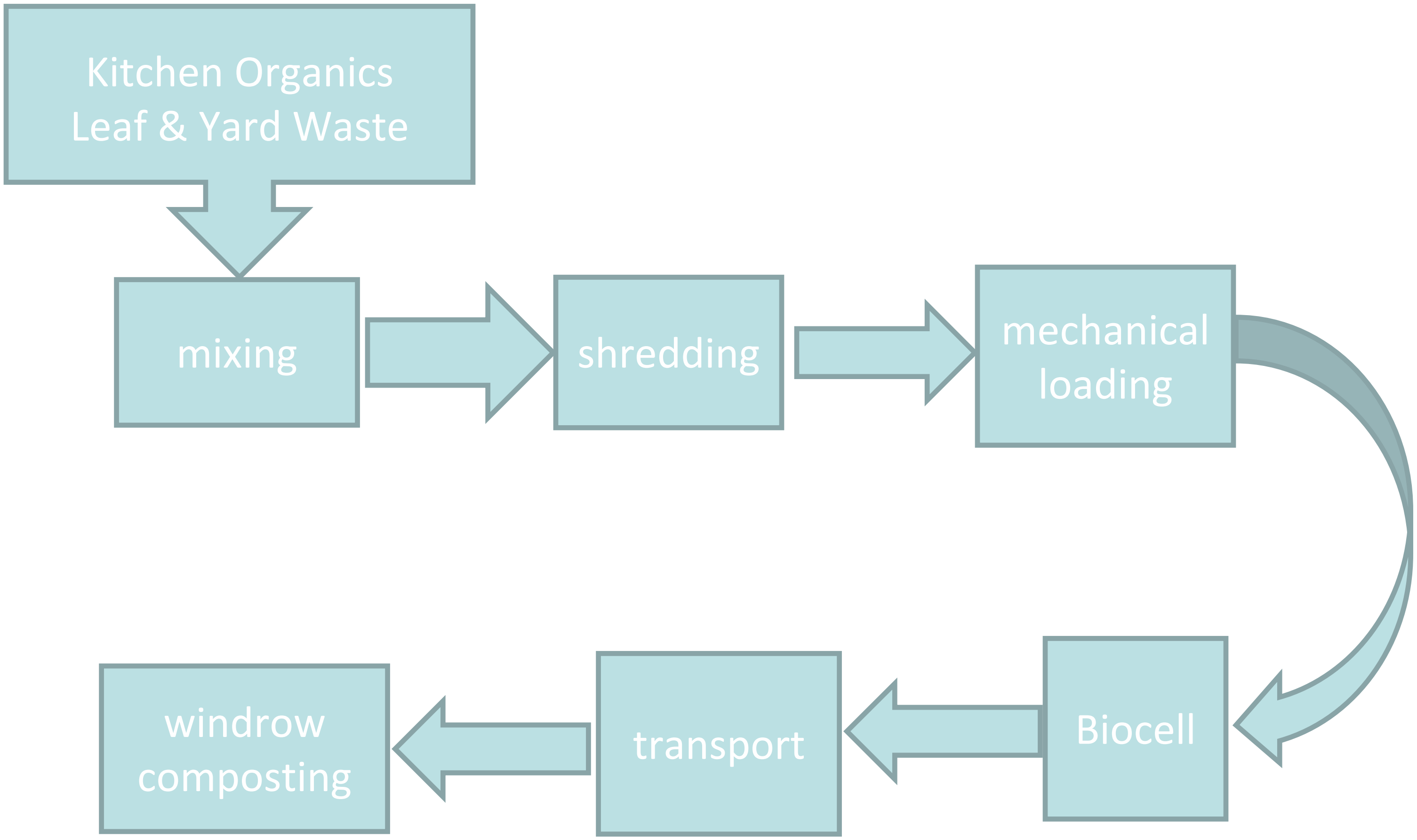
Kitchen waste

Yard waste

Region of Peel
Working for you

SOURCE SEPARATED ORGANICS CO-COLLECTED WITH RECYCLABLES

ORGANIC WASTE PROCESSING IN PEEL REGION



Region of Peel
Working for you

SHREDDING – VECOPLAN SHREDDER

Region of Peel
Working for you

HERHOF COMPOSTING SYSTEM - CALEDON

- Currently 9,000 tonnes/year capacity of combined food & yard waste
- 6,300 tonnes/year immature compost production
- Immature compost transported to the Peel Curing Facility for maturation

CHRISTIAENS COMPOSTING SYSTEM
PEEL INTEGRATED WASTE MANAGEMENT FACILITY

- 60,000 tonnes/year capacity
- 42,000 tonnes/year immature compost production
- Immature compost transported to the Peel Curing Facility for maturation

PEEL CURING FACILITY - GORE® COVER SYSTEM

Region of Peel
Working for you

KOMPTECH SCREENING SYSTEM

Feeding Hopper

First Star Deck

Region of Peel
Working for you

COMPOST MARKETING IN PEEL REGION

Region of Peel
Working for you

COMMUNITY RECYCLING CENTRE NETWORK

Region of Peel
Working for you

TYPICAL COMPOST BUNKER AT A CRC

Region of Peel
Working for you

RESIDENTIAL DELIVERY PROGRAM

TOPSOIL BLENDING OPERATION

Region of Peel
Working for you

FILTREXX

-LOCATION-

Britannia Hills Golf Course
Britannia Landfill
Region of Peel
Region of Peel
September 2003

Directions to Job Site:

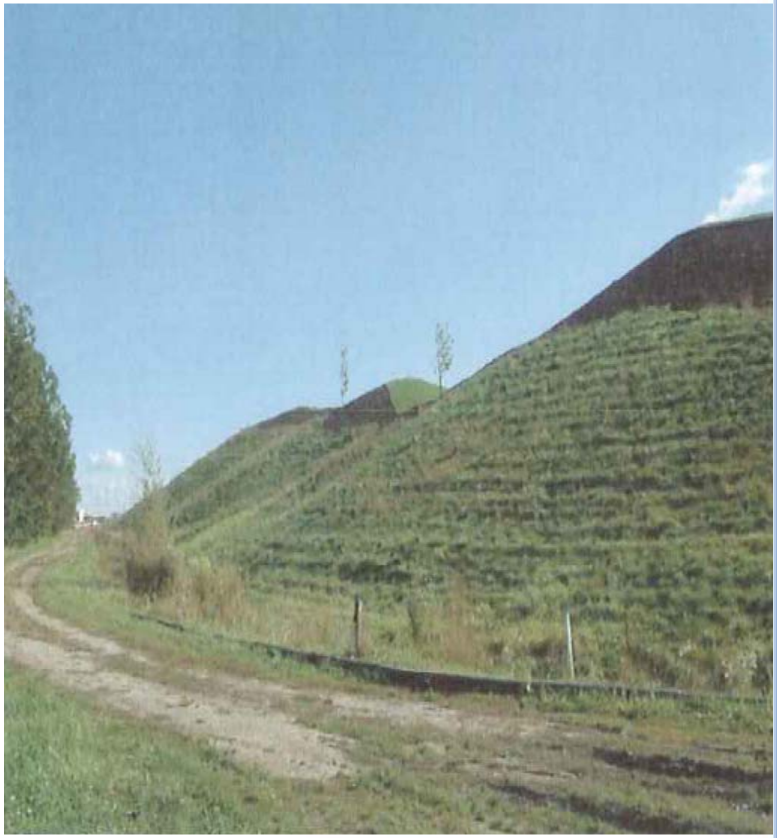
Brittannia Rd & 2nd Line West
Mississauga, Ontario.

-DETAILS-

• Installation of a 3" Filtrexx™ Compost Blanket, with Tuff Turf Seed Mixture and fertilizer injected throughout, to control erosion on a site that was previously used as a landfill location.

• The compost used on this job was supplied by the Region of Peel's composting facility to start
creating a sustainable loop within the region.

• Installation was done in September 2003 and good growth and bank stabilization was evident when site inspected in early November 2003



Region of Peel
Working for you

FILTREXX

-LOCATION-

Winston Churchill Blvd.
Mississauga, Ontario
City of Mississauga
City of Mississauga
November 2002

Directions to Job Site:

From Brantford take 403 East to Mississauga take Winston Churchill turn north to Britannia.

-DETAILS-

• 1.5" Filtrexx™ Compost Blanket mixed with drought tolerant seed and fertilizer.

• Job was done in November after site was sodded twice and did not work. Seed was dormant over winter and grew well in spring regardless of salt and snow.

• Picture taken June 10, 2003

Region of Peel
Working for you

FILTREXX

Location: Mayfield Road
Region of Peel

Details: 18” Filtrexx Interruption Soxx, containing FilterMedia, at top, mid, and toe of slope; and Filtrexx GrowthMedia Erosion Control blown between the Filtrexx Interruption Soxx

18” Filtrexx DitchChexx, containing FilterMedia – to protect the swale and prevent sediment from entering into the stormwater pond

Region of Peel
Working for you

FILTREXX

Location: King Sideroad, Region of Peel

Details: Water Pipe Installation

12" Filtrexx DitchChexx, filled with FilterMedia – sediment protection and preventing the movement of Bentonite

Region of Peel
Working for you

REGION OF PEEL COMPOST SALES STATISTICS

- Compost Sales 2010: 9,094 tonnes
- Compost Sales 2011: 4,186 tonnes (end of June)
  - Residential Sales: 599 tonnes
  - Community Recycling Centres: 1,534 tonnes
  - Topsoil Blending: 766 tonnes
  - Used with Filtrexx Product: 241 tonnes
  - Agriculture: 1,046 tonnes

Region of Peel
Working for you

AGRICULTURAL MARKET FOR COMPOST

AGRICULTURAL MARKET FOR COMPOST

- Issues regarding use of compost in crop production:
  - seasonality
  - never enough material when and where you need it
  - application issues
- Solution to issues regarding use of compost in crop production:
  - producers brought together to establish a working group

AGRICULTURAL MARKET FOR COMPOST

- Plays an important role in the composting program
- Typically the largest potential consumer of the product
- Least amount of revenue returned to a program
- Lack of coordinated field trials at a large scale

Region of Peel
Working for you

PEEL SOIL AND CROP FIELD DAY

Region of Peel
Working for you

PEEL SOIL AND CROP FIELD DAY
COMPOST SPREADER DEMONSTRATION

Region of Peel
Working for you

PEEL SOIL AND CROP FIELD DAY
COMPOST SPREADER DEMONSTRATION

Region of Peel
Working for you

AGRICULTURAL FIELD TRIALS IN ONTARIO WORKING GROUP (AUGUST 2011)

- Producers:
  - AIM Group
  - All Treat
  - Grobark
  - Lafleche
  - Miller Group
  - Orgaworld
  - Ottawa Valley
  - Region of Peel
  - Scott Environmental Group
  - TRY Recycling
  - Universal Resource Recovery
  - Walker Environmental Group
- Scientific Advisors:
  - Compost Council of Canada
  - Dr. Lambert Otten
  - Ontario Ministry of Agriculture and Food
  - Ontario Soil and Crop Improvement Association
  - Regional Councillor Allan Thompson

Region of Peel
Working for you

AGRICULTURAL FIELD TRIALS IN ONTARIO

Objectives:

- Determine the most cost effective way of spreading compost
- Determine the economic value to the farmer
- Determine the value of applicable carbon credits
- Review crop inputs/pesticide costs vs not using compost
- Determine the best application rates for compost in different crops so to maximize economics/carbon credit benefits

Region of Peel
Working for you

AGRICULTURAL FIELD TRIALS IN ONTARIO

Outcomes:

- Establishment of protocols for application and sale of carbon credits
- Establishment of optimum application rates for maximum benefits
- Cost per tonne of compost for farm use
- Cost per acre for application
- Multi-year yield impacts on economics

AGRICULTURAL FIELD TRIALS IN ONTARIO COMPOST PROJECT PLOT DESIGN

- Discussed compost rate of between 10 and 15 tonnes/acre
- Application equipment still to be determined

Fertilizer check treatment
Compost treatment
Compost treatment + Nitrogen treatment
Fertilizer check treatment
Compost treatment
Compost treatment + Nitrogen treatment
Fertilizer check treatment

Region of Peel
Working for you

AGRICULTURAL FIELD TRIALS IN ONTARIO

Region of Peel
Working for you

Frank Dietrich Compost Plot –

SE corner of Roman Line and Fallon Rd near Lucan
Part of field south of house 1650’ long x 40’ per treatment
Equipment – combine and corn planter 8x30 inch rows
2011 soybeans; 2012 corn planned

Region of Peel
Working for you

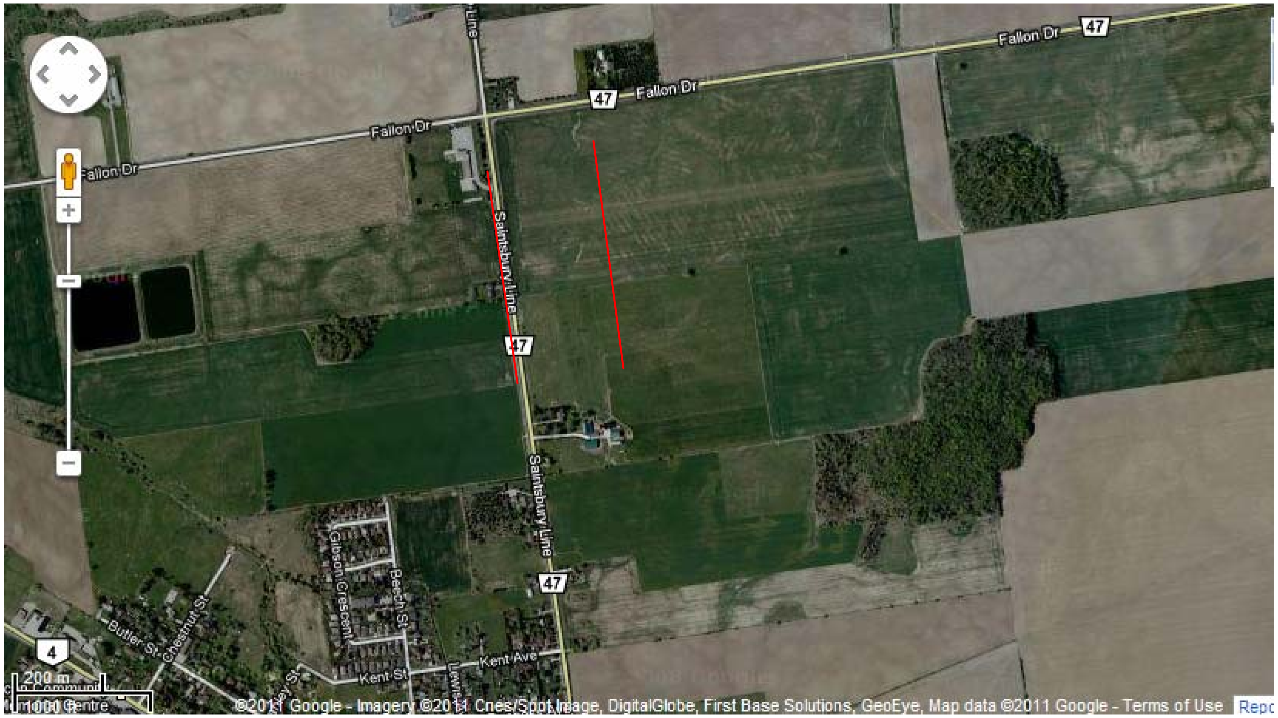
Peter Johnson Compost Plot –

L26 C5 Biddulph – SE corner of Saintsbury & Fallon Rd near Lucan

Part of field south of house 1320’ long x 40’ per treatment

Equipment – combine and corn planter 6x30 inch rows

2011 – soybeans; 2012 wheat planned



Gerry Veldhuizen Compost Plot -

33039 Feeder Rd – West of Wainfleet

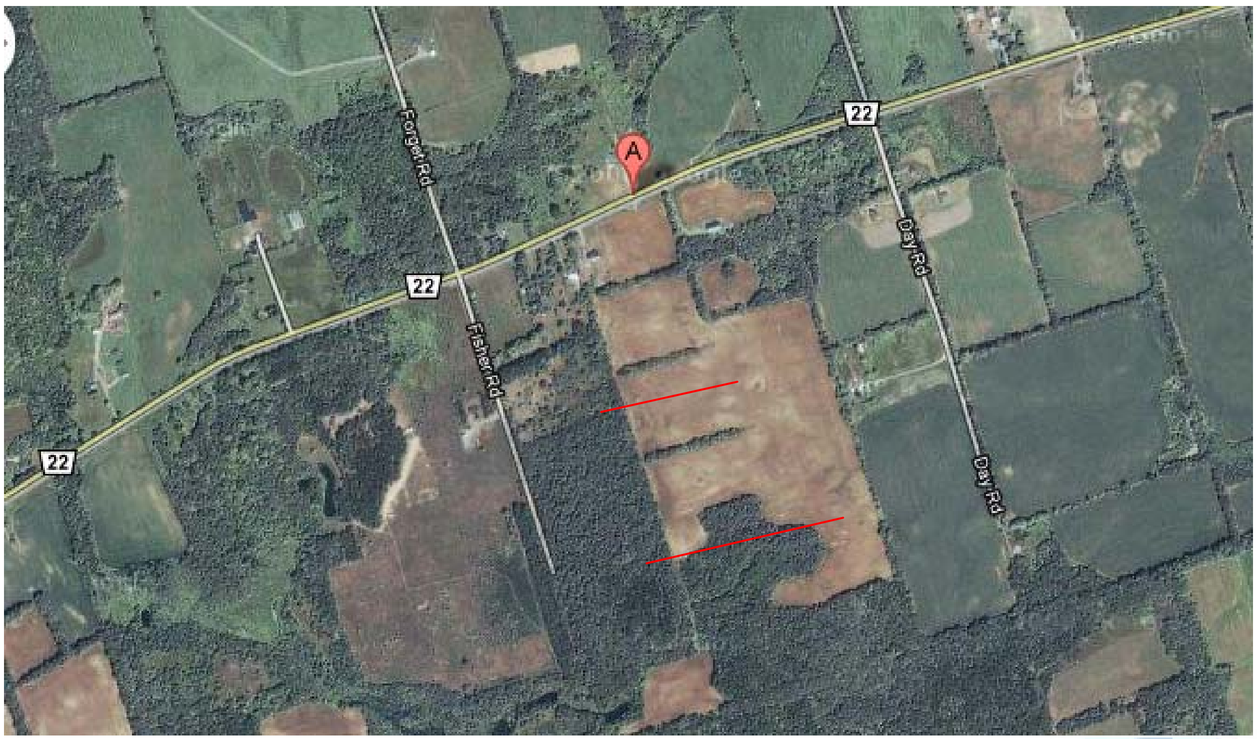
Part of field behind elevator - ?' long x 40' per treatment

Equipment – combine and corn planter 6x30 inch rows

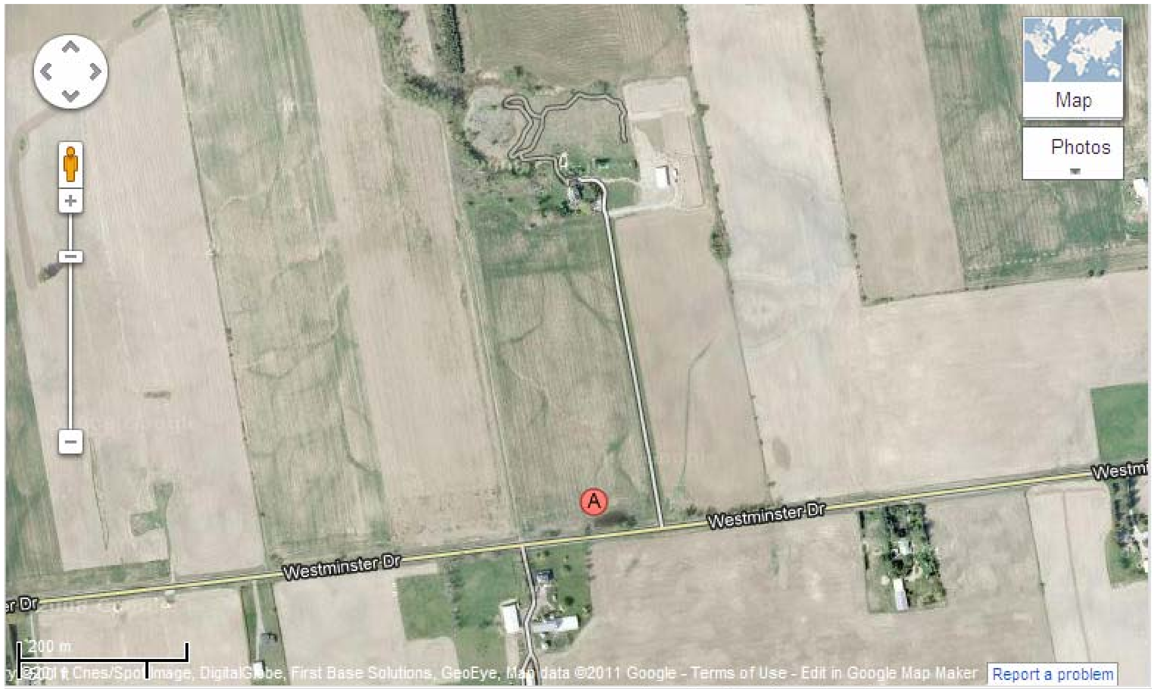
2011 – wheat (disced); 2012 corn planned

Region of Peel
Working for you

Scott Mabury Compost Plot –
2242 County Rd 22 near Castleton
Part of field south of house 1320’ long x 40’ per treatment
or 2nd field from front ~ 620 ft
Equipment – combine and corn planter 6x30 inch rows
2011 – soybeans; 2012 wheat planned

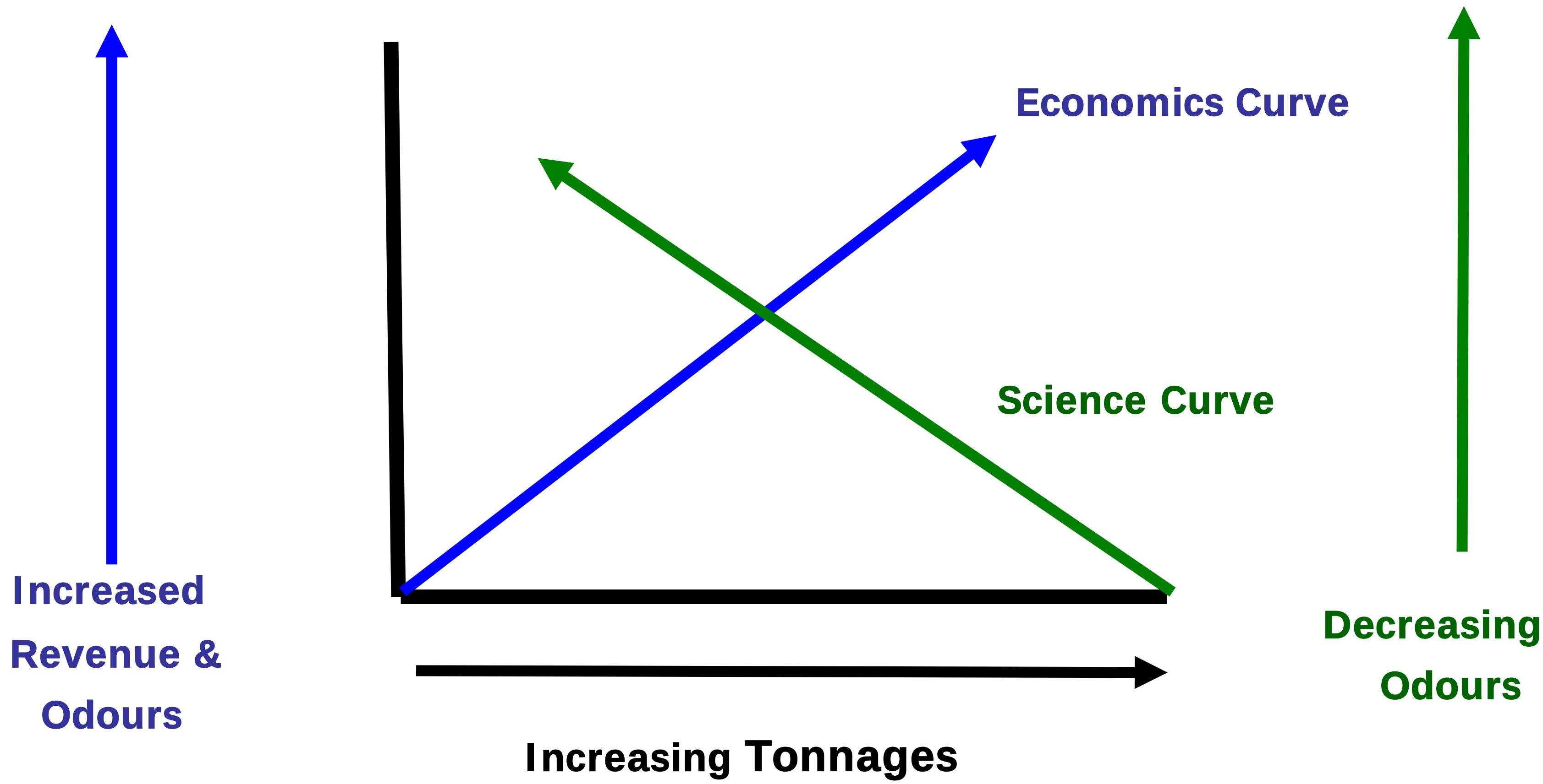


Mark Crinklaw Compost Plot -
6295 Wesminster Drive – near Lambeth



Region of Peel
Working for you

CLOSING THOUGHT:
REMEMBER THE SCIENCE VERSUS ECONOMICS CURVE



Region of Peel
Working for you

SELLING ORGANICS TO FARMERS

- Thank you!
- Questions?

- Contact:

  Larry Conrad

  905-791-7800 ext. 3437

  larry.conrad@peelregion.ca

Region of Peel
Working for you

Growth Matters !
COMPOST in Action

Conseil canadien du COMPOST Council of Canada

ALLIANCE DE LA QUALITÉ COMPOST QUALITY ALLIANCE

Come and be outstanding in our fields of compost research & plant growth!

Join us for a great day of research updates and in-field learning with colleagues at Agriculture & Agri-Food Canada's Potato Research Centre, Fredericton, NB. We are very pleased that colleagues from McCain Foods will also be contributing to the discussions.

Our day will include classroom learning, visits to the research fields and plots as well as lots of opportunity for discussion. There'll be an informal tone to our event – please dress for the field visits as well as the weather.

Date:	**Wednesday September 2, 2015**
Time:	10am – 3pm
Location:	AAFC Potato Research Centre 850 Lincoln Road Fredericton NB E3B 4Z7
COST:	**Everyone Welcome** - No Charge for Members of The Compost Council of Canada - $30 for Other Guests of our Great Day

The Plan for the Day:

1. Discussions on various projects using compost in potato production systems
2. Lunch – generously sponsored by **ENVIREM ORGANICS**
3. Field Plot Visits

Please dress for the field as well as the weather, rain or shine.

Please **REGISTER IN ADVANCE**, sending back by fax (416 536 9892) or email (info@compost.org):

NAME: ____

AFFILIATION: ____

ADDRESS: ____

CITY: ________________________PROV: ____________POSTAL CODE: ______________

TELEPHONE: ________________________FAX: ______________________________

EMAIL: ____

REGISTRATION FEES

❑ Members of the CCC : NO CHARGE. Thank you for your support!   ❑ Guests : $30 each (includes GST)

GST Registration #R136167533

METHOD OF PAYMENT

PLEASE PRINT CLEARLY:

❑ Please charge $______________ to my VISA or MasterCard

Account Number: ______________________________Expiry Date: __________________

Card Holder's Name (please print): ____

Card Holder's Signature: ____

Conseil canadien du COMPOST Council of Canada

Growth Matters ! COMPOST in Action

ALLIANCE DE LA QUALITÉ COMPOST QUALITY ALLIANCE

Come and be outstanding in our fields of compost research & plant growth!

Wednesday September 2, 2015 • AAFC Potato Research Centre • Fredericton NB

About AAFC's Potato Research Centre

The Potato Research Centre (PRC) is one of Agriculture and Agri-Food Canada's network of 19 research centres. The Centre is located in Fredericton, New Brunswick, on the south bank of the St. John River. Potato research is the Centre's main focus as the province of New Brunswick is a recognized world leader in potato production.

The forces driving the agriculture sector have become more complex and are changing even more quickly in recent years. Market demands, social preferences, global trade, energy costs, water availability, environmental health, and changes in risks associated with crop production (e.g., new pests) due to climatic variation place pressure on the industry for innovative solutions to challenges.

The PRC is custodian of the Canadian Potato Genetic Resources. It is not only comprised of the main centre in Fredericton but also the Benton Ridge sub-station which supports germplasm enhancement activities.

The main focus of research conducted at the centre is in three areas:

- Potato germplasm enhancement
- Crop protection
- Enhancing the environmental performance of potato production systems

Areas of Research

The Centre's areas of core research are aligned with national priorities to help the sector adapt and remain competitive in domestic and global markets. Greater participation in research networks and industry-led partnerships expands the Centre's innovation capacity.

Agri-based Science Solutions for the Environment

- Investigating the nutrient and mineral properties of crops and soils
- Conducting research, in the laboratory. field scale, and watershed scale, on the production of greenhouse gases, soil quality and erosion, and water quality
- Assessing chemical and non-chemical methods for controlling insect pests
- Finding new methods to reduce the use of agri-chemicals (pesticides and fertilizers) to lower production costs and environmental risks

Leading Edge Research for Better Products

- Developing new varieties of potatoes with superior traits for Canada's potato industry using traditional and leading edge technologies
- Developing new methodologies for early detection of viruses in seed potatoes
- Accelerating advanced scientific ways to improve or modify potato plants to protect them from diseases and pests, and preserve their nutritional properties during processing
- Gene mapping of traits and cloning of potato plants with important characteristics needed for processing, disease and pest resistance
- Using gene analysis technologies to identify potato varieties





What are Farmers looking for in Composts and other Organic Residuals?

Lise LeBlanc & Misty Croney

LP Consulting





What are we applying on farmers fields?

Wood Ash

Biosolid amended products

Gypsum

Wood waste

Compost

Whey products

Digestate

Fish waste

??????

Do you need a permit - NAOW?

Know the Agricultural Market in Your Area

Western – calcareous, optimum-high pH, very high pH – issues with P availability, Alberta – good K levels, Sask – low K levels. Mainly cash crops (grain) and high density livestock farms (Beef). Typically low OM on prairie soils.

Average farm size – 1168 acres Farm debt increasing

Ontario– calcareous soils, low-high pH levels, improving soil nutrients. 52,000 farms

32% of farms are 10-69 acres (14,000)

Average farm size – 244 acres

30% grains (grow 90% of Canada's soybeans)

13% Beef, 8% Dairy 5% are fruit/veg

Gross-increasing/Net- decreasing





Know the Agricultural Market in Your Area

Quebec – 30,675 farms, average size 279 acres.

Dairy -37% of all dairy cows in Canada

Hogs, beef, sweet corn, maple, blueberries.

35% of farmers have off-farm jobs

95.4% - field crops and hay

4.1% - fruits and vegetables

Atlantic – noncalcareous soils, low pH, low nutrient levels, good OM.

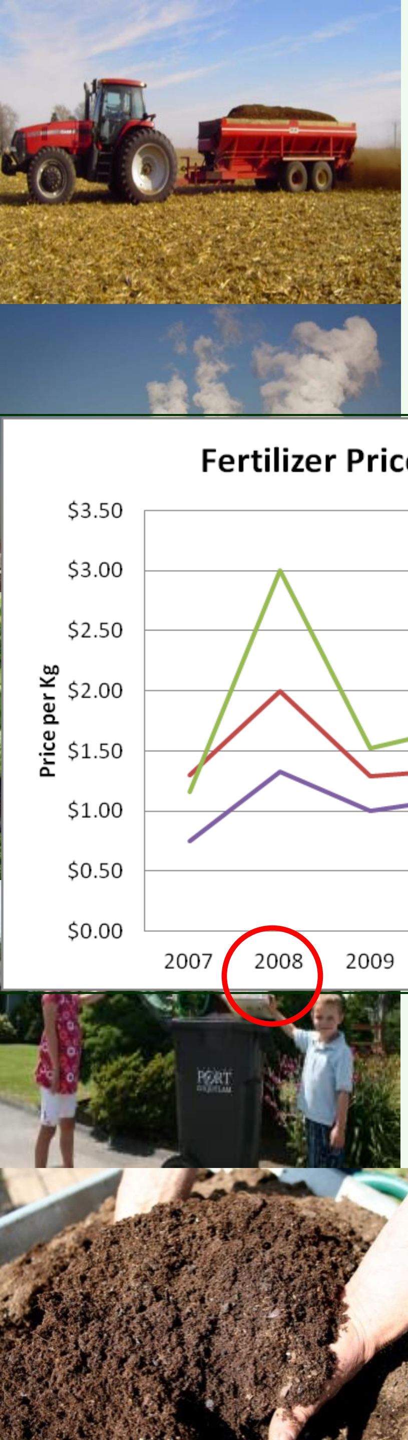
Key nutrients – N, K, S and B.

Beef (24%), fruit (14%) and Dairy (11.5%)

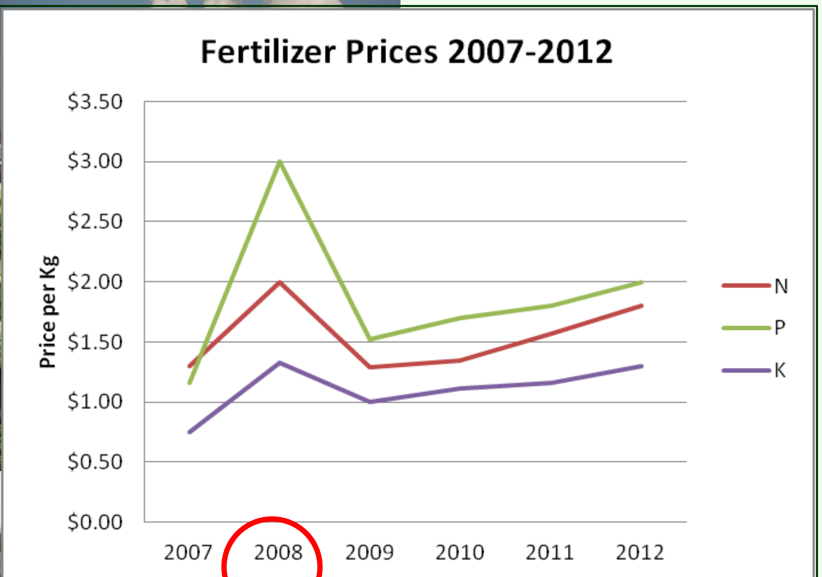
Average farm size – 287 acres

75% of farms gross less than $100,000

Inorganic Fertilizers



World demand on fertilizers increase as populations increase which will continue to increase fertilizer prices.



Prices in 2008 doubled – high demand for biofuels and increased Ag production in China and Brazil. Farmers cut their use of fertilizers.

2009 – fertilize prices decreased the economic recession – steadily increasing since.

Concern about future availability of Phosphorus

Impt to access local renewable nutrient sources for a sustainable future

Importance of Residuals for Agriculture

- Improve soil condition – tilth, aeration, drainage, water holding capacity, reduces hard pan
- Adds organic matter
- Stimulates microbial activity for a healthy soil environment.
- Reduction in manure availability
- Reduce reliance of costly fossil fuel fertilizers
- Limited availability of phosphorus

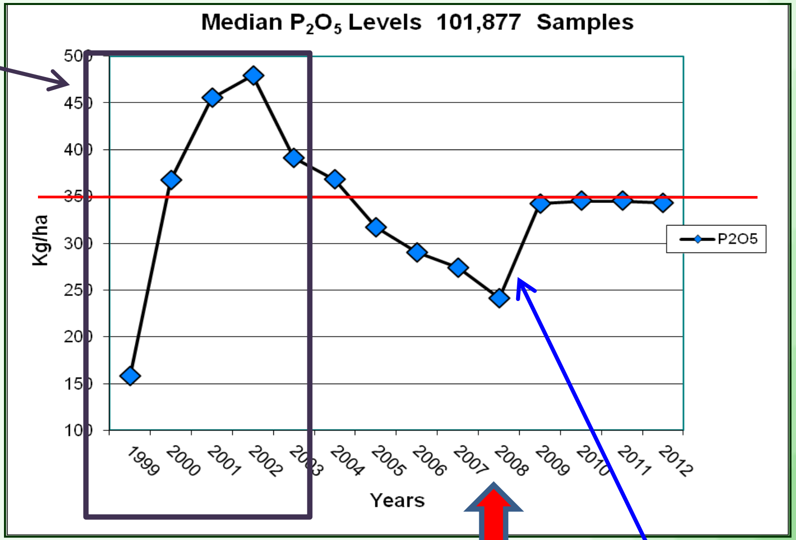
Waste to Resources

Fertilizer Buying Trends VS Soil Nutrient Levels

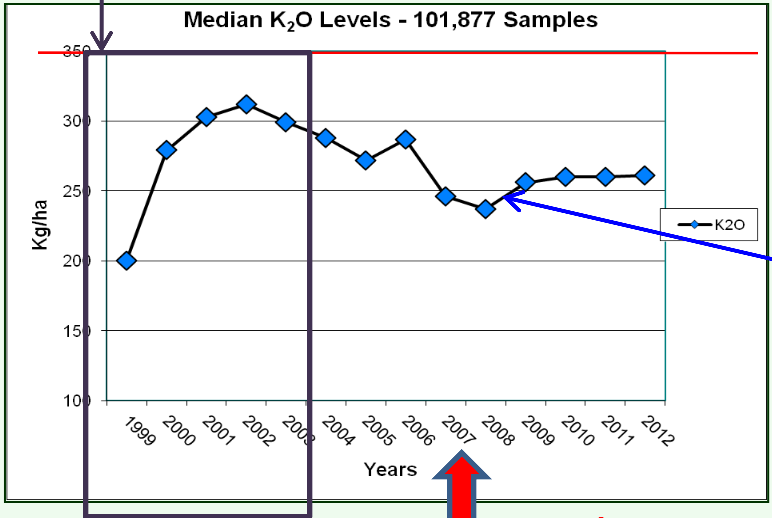




Cheap fertilizers



High $



Increased use of Ash and N-Viro

High $

LP Consulting Solutions





Criteria Residuals Must Meet to be Successful?

- Does it require a **provincial permit**??
- Residual must have **higher value** than the final delivered cost
- **Proven** to increase/maintain crop yields - $
- **Equipment** readily available for application
- **Application rates** must be reasonable for nutrient availability
- Delivery must be **timely** based on cropping production practices
- Must be **contaminate free "Key"**
- Target agricultural leaders first
- Solid relationship with the farming community - **"TRUST"**




Wood Ash (0-1-3)

Wood ash applied to agricultural fields for decades

Alberta –180,000 tonnes/yr

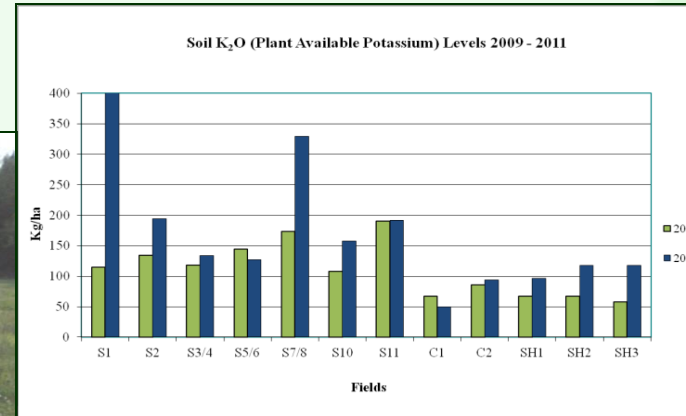
Quebec –80,000 tonnes/yr

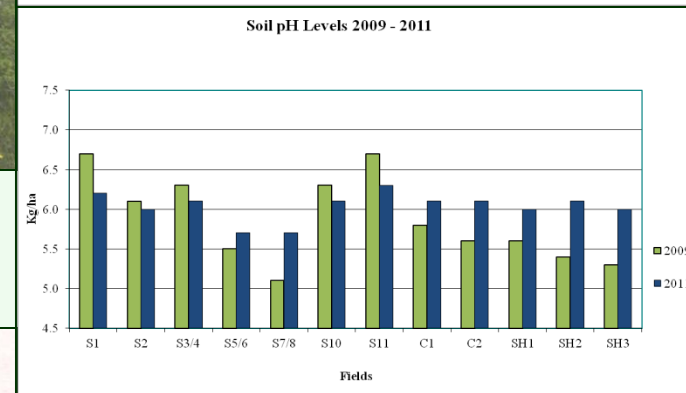
Atlantic Canada (2007) – 50,000 tonnes/yr
***booked several years in advance – Irving, BP, NSP**
***although booked, still keep up marketing! IMPT**

Increase ash tonnages as cogeneration programs for power increases.

How did we achieve success?

Large scale research demonstrations





Tours and Media

Forage field day covers a lot of ground

by George Fullerton

By lunch time on June 28, event-organizer Nadine Simpson was happy to see about 60 farmers attending the Kings County Soils and Crops Association annual forage field day in New Brunswick.

"It is always a gamble scheduling this field day, because you never know what the weather will bring and you never know how far advanced farmers are with their own forage harvesting and if they can afford a day away," Simpson said. "It was especially concerning that the field day was beautiful and the forecast for the following day was for rain, so anyone with hay on the ground was focused on getting it done up."

In addition to static and active demos of shiny new power and forage equipment from Arbing Equipment (Case, Kuhn), Green Diamond (John Deere), and Hall Brothers (Massey Ferguson), the field day also featured a wood ash mini-seminar and spreading demo with support from LP Consulting. Todd Beyers with the New Brunswick Department of Agriculture and Aquaculture was also on hand fielding questions about forage and agriculture.

The Kings County Soils and Crops Association held its annual forage field day on June 28 in New Brunswick. There were demonstrations of mowing and displays of the ash farmers are using as a soil amendment.

How did we achieve success?

Publications and Ads

New Brunswick

Agricultural

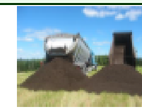
Wood Ash

Program

IRVING

J.D. IRVING, LIMITED

LISE A. LEBLANC, M.SC., P.AG. & MISTY CRONEY, B.SC., A.AG.
LP CONSULTING LTD. AGRICULTURAL CONSULTANTS



Agriculture Wood Ash Program

Wood ash is an excellent source of nutrients such as phosphorus, potassium (potash), boron and other micronutrients and it increases soil pH. **Wood ash = lime plus fertilizer!** All in one pass!

Farmers in the Maritimes have used over 70,000 tonnes of ash on agricultural lands. We have seen improvements in crop quality and yield for field, vegetable and berry crops as well as pastures! **If you are interested in ash research studies on various crops, please call our office for a copy.**

Irving NB Wood Ash has a CFIA (Canadian Food Inspection Agency) Label. This means that the ash has to meet all metal testing similar to other agricultural products such as fertilizers and lime. Ash has very low levels of metals and are well below government guidelines

Applying ash at 7.5 tonnes/ha is similar to applying 21-6-18 at 1000 lb/acre but without the nitrogen (21). There is no nitrogen in ash. **There is no cost for the wood ash, only the trucking. Contact Misty for rates to your farm.**

Suggestions for Using Wood Ash in your Farm Program

Spring

- **Forages** - for 1st cut. 3 tonnes/acre will replace the phosphorus and potassium that is removed with 1 cut of forage. Also provides sulfur and boron needed by legumes.
- **New seeded crops** - important to increase pH and provide nutrients. 3-4 tonnes/acre
- **Vegetables** - 3-4 tonnes/acre. Many vegetables especially root (carrots, onions, beets, etc) and cole (cabbage, cauliflower, broccoli) crops need a lot of potassium and boron. Potassium is important for growth, disease resistance, taste and color. Optimum pH levels for vegetables are between 6.5-7.0.
- **Pastures** – 3 tonnes/acre for good production. More nutrients = better rate of animal weight gain.
- **New cleared land** – 5 tonnes/acre. In rease the soil pH in 2-4 weeks and provide nutrients to low nutrient soils.

Summer

- **Forage** – apply after 1st cut to feed 2nd cut. 2 cuts of forage removes a lot of nutrients!
- **Pastures** – apply to increase the length of growing season Increase nutrient value of pasture.

Fall

- **Legume forages** (alfalfa/clover) – apply 3 tonnes/acre to increase pH and feed potassium to crop for following season, increase longevity and help over-winter crops (works like anti-freeze!).
- **Grass forages** – provide nutrients for next springs 1st cut.
- **Pasture** – to increase length of grazing season.
- **New cleared land** – in preparation for fall seeding or for next spring season.

Fall is an excellent time to provide nutrients for the crop next spring. It can be difficult to get a 30 tonne truck on the field in the spring due to wet conditions. Roads are closed from March-May when ash is needed. More application time in the fall as compared to spring rush.

NS & NB Agricultural Wood Ash Programs

Wood ash is an excellent source of nutrients and will increase pH levels in 3-4 weeks. There has been over 30 years of research in Canada and the US that shows that ash can significantly increase crop yields and quality.

Wood ash provides phosphorus, potash and micronutrients such as boron and zinc that is essential for crop growth. Wood ash will increase soil pH and feed your crop at a fraction of the cost of lime + fertilizer!

Call us to discuss how wood ash can become an important part of your crop production program.

Wood Ash Locations

2 locations in Nova Scotia:
Brooklyn Power Corp., Liverpool,
NewPage Corp., Pt. Hawkesbury

1 location in New Brunswick:
Irving Pulp and Paper (Saint John)
more NB locations coming soon.

Call to find out the trucking cost to your farm

Lise LeBlanc and Misty Croney
LP Consulting Ltd.
(902) 792-2636
lise.leblanc@ns.sympatico.ca
mistycroney@ns.sympatico.ca

Hauling Ash – Farm Focus

Showed Farmers the Value of Wood Ash – proved it with ongoing Lab results

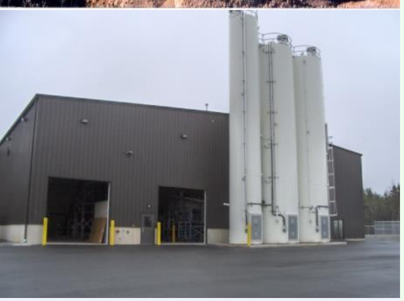
	NS Power (15,000 T)		Irving (15,000 T)		St. Leonard (1500 T)	
Nutrient	Kg per tonne	Value$	Kg per tonne	Kg per tonne	Kg per tonne	Value$
P205	12	$17.50	7	$10.15	31	$45.00
K20	22	$22.00	22	$22.00	44	$44.00
Lime		$12.00		$12.00		$27.00
Mg	10	$68.00	9	$46.24	18	$122.40
B	0.2	$2.40	0.1	$1.20	0.3	$3.60
Zn	1	$4.50	0.7	$3.50	0.9	$40.50
S	1.0%	$9.00	3%	$27.00	1%	$9.00
Total Value per Tonne		**$135.40**		**$122.09**		**$291.50**

Trucking costs are from $12 (50 km) - $45 per tonne (350 km)

High value of ash enables larger market distance

2009 – Problems with Contaminants at one of the Plants

- **Company quickly owned the mistakes**
- **They fixed them and demonstrated how the problems were fixed**
- **Worked to regain trust (still not all back). You only have 1 chance!**



Biosolid Amended Products – 2 Examples

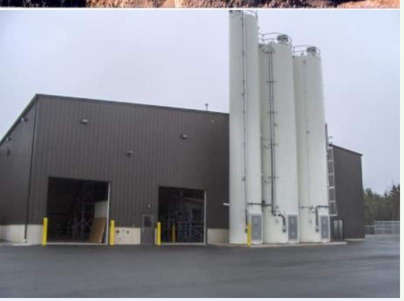
N-Viro – Alkaline Stabilized biosolids

Ontario (4 plants), Nova Scotia (1), PEI (1), Banff National Park (1)

- **Treated biosolids mixed with cement kiln dust, heated and cured.**
- **Has significant neutralizing value and nutrients.**
- **Canadian Food Inspection Agency (CFIA) approved – no restrictions**

Composted Biosolids –Moncton Garderner's Gold

- **Treated biosolids mixed with forestry bi-products, yard waste and/or straw and hay.**
- **Composted in windrows to create a Class A compost which can be used without restrictions.**



Biosolid Amended Products

Challenges

- Public perceptions and credibility
- Odor
- Contaminants in biosolid compost mixes
- Management – poor communication planning

Can't communicate yourself out of problems – too late!

MISTAKES ARE COSTLY

How you manage your program – affects if farmers are willing to use biosolid amended products.

They live in their communities

Successful Programs

- **Create a demand in the market** – marketing programs, demonstrations, tours, build relationships.
- **Focused communication plan** – focused on benefits rather than risks.
- **Respect** public and farmer concerns.
- All levels of the Company need to learn their **communication responsibilities.**
- Prepare **alternative programs** before you have a problem.
- Always take **responsibility** if something happens

A biosolid idea?

by Neal Ozano

Greg Webster has a lot to say about what is being used to fertilize the farmland in Kings County, Nova Scotia. For eight generations, his family has been farming a large spread near Cambridge, where, with spring in full swing, he is getting ready for another season of fruits and vegetables. One of Webster's most pressing concerns this year is the buzzword in the barns and council chambers of Kings County: biosolids. That is, treated sewage as fertilizer.

Webster is not an organic farmer. "Don't even get me started on organics," he warns, minutes into our phone call. So in other words, he is not the sort to oppose industrial farming techniques. On his farm Webster uses conventional petroleum-based fertilizers, and, as he puts it, appropriate pesticides in appropriate doses at appropriate times. But, nonetheless, he says biosolids, which for some are an attractive alternative to conventional fertilizers, are not to be trusted and do not belong on farmland in Kings County.

Matter-of-factly, he says, "To my mind, it's not worth the risk."

Biosolids, in a general sense, are a residue of sewage treatment. They are the material that is left over when you take all the water out of everything a city or town flushes down its toilets and drains. In Halifax's case that is a lot of wastewater from homes, hospitals, university labs, streets, and industrial parks.

Before biosolids can go on fields they are, essentially, cleaned. This is how it works: Once Halifax's waste runs through the municipality's three sewage treatment plants the process of transforming it into a fertilizer can begin. First cement kiln dust is added. This is a lime-like residue from the production of cement that lowers the pH of soil, an important part of soil treatment in a province with acidic soils. The mix of dust and treated sewage then goes into a rotating drum where it is heated to kill off bacteria and other pathogens found in the sludge. Sterilized, the once-sewage (now fertilizer) is ready to go. Processed, bagged and sold by N-Viro Canada LP, in Nova Scotia the waste-based fertilizer can then be used anywhere conventional fertilizers are permitted.

Lise LeBlanc, a consultant working for N-Viro Canada, holds that company's treated sewage fertilizer.
(Neal Ozano photo)

RISKY?

Most environmental groups and opponents agree on one thing when it comes to biosolids: the risk is that there just is not enough information available on the potential contaminants they think are lurking in N-Viro's product. Both the Nova Scotia Environmental Network (NSEN) and Halifax's Ecology Action Centre (EAC) have put forward positions on the use of biosolids; both agree they should not be used until their effects, and more simply, their contents, are better known.

"It's less about the human waste itself," says Marla MacLeod, the EAC's food miles committee coordinator, over the phone from her office. "If it were being done in a closed system using a composting toilet, it wouldn't really be such a scary thing, because the concept of using waste as fertilizer is not a bad idea. What really concerned us was everything else attached to that."

The "everything else" she refers to is a potential soup of pharmaceuticals, fire retardants, cleaning products, and other potentially harmful contaminants that might be dumped down the drain in the Halifax Regional Municipality (HRM) and inadvertently left behind in the sludge N-Viro uses.

The Chair of NSEN's Biosolids and Waste Water Caucus, Marilyn Cameron, who is also a Kentville-based veterinarian, agrees with MacLeod that it is the unknowns about biosolids that are scaring farmers, consumers, and Kings County councilors.

Cameron, along with fellow NSEN member Fred Blois, gave a presentation to Kings County council in November of last year informing the Council there is not enough research on what potentially harmful substances – also known as emerging constituents (EC) – are in biosolids.

"While there is some documentation of (emerging constituents) in biosolids, no focused study has been completed yet on an inventory of ECs in Canadian biosolids," says a scientific review commissioned and released by the Canadian Council of Environment Ministers (CCME) in late

APRIL 2010 RURAL DELIVERY PAGE 35

- Produce a **clean, consistent, quality product.**

http://www.loopforyoursoil.com

INFINITELY RENEWABLE

BRANDING BIOSOLIDS CLOSES THE "LOOP"

About 15 percent of Loop® g
forestland application (abov
percent is used for applicati
agricultural crops.

King County, Washington is addressing consequences of misinformation about biosolids by creating a brand to help communicate the facts in a consistent w

Katrina Mendrey

DRIVE East on I-90 from Seattle, and you may end up following one of King County, Washington's colorful Loop® trucks. Decked out with scenes of flowers in bloom, Washington forests, or wheat fields, these trucks are filled with Loop, Class B biosolids produced at treatment plants operated by the King County Wastewater Treatment Division (KCWTD). King County provides wastewater treatment services to the Seattle metropolitan area. About 10 trucks per day make the trip, each carrying about 31 wet tons of Loop.

Most of the trucks head toward two of King County's largest biosolids customers, Boulder Park, Inc. and Natural Selections Farms. About 80 percent of the Class B product is then distributed and applied by these farmer-owned companies to agricultural crops on the east side of the Cascade mountains. Approximately 15 percent goes to commercial forestland managed by Hancock Natural Resource Group and the Washington State Department of Natural Resources. Up to 5 percent is used by a local composter, GroCo, Inc., which manufactures the only publicly available product containing Loop. GroCo makes a Class A product consisting of biosolids composted with sawdust.

King County biosolids transport trucks promote Loop, featuring scenes of flowers in bloom, Washington forests or wheat fields.

So why develop a brand if you already have a market for your product? "One of the goals of this project is to inform the public of the good work we're doing at King County, and what a great resource biosolids are," explains Kate Kurtz, Biosolids Project Manager at KCWTD. "If you've never heard of biosolids before you're more likely to believe misinformation from noncredible sources. Correcting and dealing with the consequences of misinformation is one of our greatest business challenges. Creating a brand helps us to get in front of the message by communicating the truth about our product in a consistent way."

She adds that the Loop brand images on the trucks spark peoples' curiosity. "They see the logo and want to know what's inside and where the trucks are going," notes Kurtz. And this curiosity presents an opportunity for education.

BRANDING PROCESS

But the trucks are just one piece of the larger branding project King County recently launched to bring new awareness to its Class B biosolids product. The initiative included a new name, messages,

GARDENING WITH LOOP® BIOSOLIDS – IT'S LIKE MAGIC

Gardener and soil scientist, Kate Kurtz, discusses why she chooses GroCo compost made with Loop® biosolids in her home vegetable garden. For Kate, it's a choice of environmental ethics and she k

Everyone has a story. Our friends share what they find inspirational about Loop.

WHY CARE ABOUT HEALTHY SOIL AND BIOSOLIDS?

Who uses Loop® and why? Farmers, foresters, gardeners, and environmental educators all use Loop® because it works to create healthier, more productive, and more sustainable soils.

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Compost

Not all compost is created equal!

Farmers will compare compost with other residuals for the highest nutrient value for the lowest price.

As Is	Poultry Compost kg/tonne	Mink Compost kg/tonne	SSO Compost kg/tonne	Biosolid Compost Kg/tonne
Total N	50	21	14	10
Total P2O5	43	39	7	12
Total K2O	21	5	7	19

Application Comparison

Goal: 100 kg/ha of nitrogen for corn PPI

Product	1st Yr Nutrient Availability - Incorporated (kg/tonne)	Value/tonne (N-P-K only) *2014 prices	Application Rate Tonnes/ha	Nutrients
Poultry Compost	20-25-19	$64	5	100-125-95
Mink Compost	13-15-5	$46	8	104-120-40
SSO Compost	4-3-7	$17	25	100-75-175
N-Viro (HFX)	10-10-15	$43*	10	100-100-150
Composted Biosolids	2-5-17	$27	50	100-250-850
Chicken Pellets	40-10-20	$80	2.5	100-25-50

* NViro also has a liming value -increases the value of the product to $78 (if add mac/micros $125 in HFX). *Value added product

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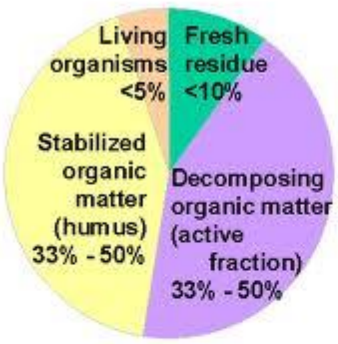
Organic Matter

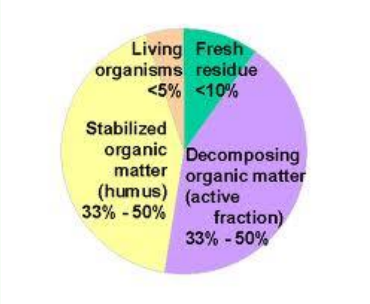


- Organic matter is important for soil and plant health, soil tilth and nutrient and water holding capacity.
- Soil organic matter across Canada ranges between **2 – 15 %.**
- Most soil amendments have similar organic matter content.

	O.M. %
Poultry Compost	30
Mink Compost	25-40
Composted Biosolids	34
N-Viro	30
SSO Compost	20-35

OM is not a distinguishable selling feature

Increasing Soil Organic Matter



Product: 30% O.M, 70% Solids

Application Rate: 10 tonnes/acre

Typical compost, applied at 10 tonnes/acre would take 9 years to increase soil organic matter by 1%! (no tillage)

Organic matter is very important, but it's not going to sell the product to most of the Agriculture industry.

HM Corn Profit – Compost Vs Conventional

Ongoing research project shows an increase in yield from 4-7.5% if apply compost to meet ¾ of crop N need. Is this profitable?

Conventional HM Corn Input Costs/Acre	
Seed	$110.00
Combine	$50.00
Planting	$30.00
Herbicide	$40.00
Herb App	$15.00
Fungicide & App	$30.00
Tillage/Drying	$17.00
Fertilizer	$200.00
Fert App	$8.00
Total Costs	**$500.00**
Avg Yield and Price (500 ac)	**3.5 T x $180/T = $630**
NET PROFIT	**$130 ($65,000)**

Compost HM Corn Input Costs	
Seed	$110.00
Combine	$50.00
Planting	$30.00
Herbicide	$40.00
Herb App	$15.00
Fungicide & App	$30.00
Tillage/Drying	$17.00
Compost	**$50.00**
Compost App	**$50.00**
Trucking - within 50 km - $11.50/t	**$115.00**
Supplement Fert	$75.00
Fert App	$8.00
Total Costs	**$590.00**
NET PROFIT	**$40 ($20,000)**

Research Increased Yield - Net Profit	
4%	$65 ($32,500)
7.50%	$87 ($43,500)

Time Factor in Sp

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Digestate from Anaerobic Digestion

Digestate from anaerobic digestion as a renewable nutrient source for the agricultural industry.

- **Waste from animal industry**
- **Waste from residential and commercial sources**

Nutrient value is based on feedstock

Location is key to reducing trucking costs to the agricultural market.

Average digestate "value"	**$0.05/gallon**
6000 gallon liquid tanker "value"	**$300**

Farms within 100 km ($600 per load) $0.10/gallon

Application cost $0.02/gallon

ENERGY is the $

Waste Wallboard and Wood fiber

Alternative Dairy Bedding

Over 50,000 tonnes of wallboard and 100,000 tonnes of wood fiber sent to the landfill each year

2 Uses – (1) Animal Bedding (2) Soil Amendment

RRFB
NOVA SCOTIA

Quality Milk Management
Atlantic Vet College
C&D Recycling

Testing to ensure there is a market to farmers

Contaminants of Concern – Heavy metals, flame retardants, asbestos, Dixons, Furans, insecticides, hydrogen sulfide and formaldehyde gases.

Agricultural value, mastitis bacteria, cow comfort

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Success!

Determined what the market needed, tested for farmer concerns, provide clean product, address problems that arise, target key Ag leaders, marketing, tours, articles. Utilized trust in the Ag community.

Cost-efficient alternative

Nova Scotia agronomist researches using waste drywall materials to develop innovative bedding solutions

A new research project is analyzing using discarded drywall mixed with waste wood fiber as a cost-efficient alternative to traditional cow bedding.

Lise LeBlanc, an agronomist with LP Consulting in Newport, Nova Scotia, along with Don Anderson, a research project partner and udder health specialist with Quality Milk Management in Sussex, New Brunswick, and the Atlantic Veterinary College have been working on this project since May 2012. They are testing several components of the alternative bedding on two farms—Bovidae Farms, run by Bob Wilson, Falmouth, N.S. and Folkerstma Farms, owned by Jack Folkerstma, Milford, N.S.

LeBlanc got the idea for the alternative bedding research project after hearing dairy farmers complain about their difficulties obtaining sawdust for bedding.

She wanted to determine the feasibility of grinding up discarded drywall and mixing it with waste wood fiber for bedding. The used bedding, which contains gypsum, could also be used for soil amendment to lime the field where it is applied.

LeBlanc partnered with Halifax Construction & Demolition Recycling, a recycling and composting company. It ships up to 50,000 tonnes of waste drywall and 100,000 tonnes of waste wood fiber annually to a landfill. "We hope to be able to divert most of this if the project proves successful," says LeBlanc.

Before pulverizing the scrap wood into fiber, Halifax C&D sorts it and removes wood that is painted, treated with preservatives or creosote, or contains any metal, such as nails. It is then sorted and screened "so it won't be a problem for farmers and won't leach contaminants into the field," says Paul Longobardi, C&D Recy-

Bob Wilson, owner of Bovidae Farms in Falmouth, Nova Scotia, says the waste wood fiber-drywall mixture he uses for bedding as shown in the photo works well in his barn. His cows like to lie on it because it's a dry surface.

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How do you sell to the Agricultural Community?

• What does your local market need?
Nutrients, Lime, Timing?

• Can you make a product to meet
that need? At what cost to the farmer?
How are you making your $, tipping fees
or do you need to make high sales?

• Is your location near the market or
will transportation costs too much? Do you
that can haul a minimum of 30 tonnes?
Relationship with truckers?
Manage trucking in a timely manner.

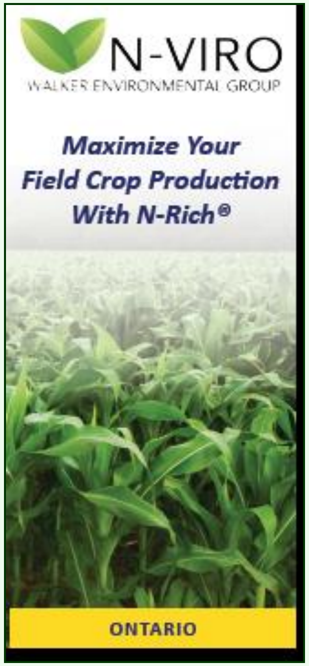
How do you sell to the Agricultural Community?

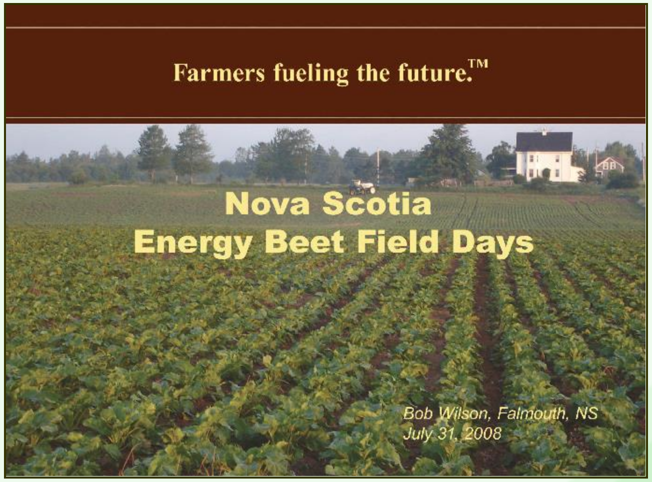
- Do you have a relationship with the farming community?

*its more than just learning "farm speak"

If you don't, develop a relationship with Agrologists who have a good farmer clientele (listen to them)

- Develop a good marketing program





Are you connecting with the Agriculture Market?

Lise LeBlanc: lise.leblanc@eastlink.ca

Misty Croney: mistycroney@eastlink.ca

LP Consulting 902-256-2636

APPENDIX XI

Compost in Agriculture – Compost Producers Meeting

Date: Wednesday November 18, 2015 – 10:00 am – 4:00 pm
Location: Region of Peel, 2 Copper Rd, Brampton, ON L6T 4W5

Attendees:

Lise LeBlanc – LP Consulting
Larry Conrad – Region of Peel
Merissa Bokla – Region of Peel
Terry DiNatale – Region of Peel
Ian McLachlan – A&L Labs
Jon Durzi – Miller Compost
Mike Kopansky – Miller Compost
Andrew Drury – All Treat Farms
Greg Mariotti – Orgaworld
Mike Lishman – Arlington Farms
Benoit Lamarche – EnGlobe
Jon Gingrich – Schlegel Poultry Compost
Rebecca Bell – MOE
Michael Richardson – OMAFRA
Christine Brown – OMAFRA
Peter Gorrie – Writer
Susan Antler – Compost Council of Canada
Mitch Banks – Compost Council of Canada

What Can be Applied

- NASM causing issues for application of compost
    - Compost being classified as non-agriculture sourced under NASM
    - CFIA will not register compost or compost standards A classification
    - If producers can find a way of increasing sulphur in their product by mixing it with something else – will help as farmers are wanting more sulphur in their land

Challenges Working with Agriculture

1. Leased Land
    - growers don't want to put money into leased land
    - 40% of agricultural land in Ontario is leased land
    - Usually 1-3 year terms
    - Farmers fear putting product on that will not provide them with short term gain due to short rental terms
    - Many rental arrangements are unwritten
    - Leased land poorer quality soil
    - To make a case for leased land – recommend showing farmers the economics of soil health with or without the use of an amendment product
    - Developers do not want their land to be a high producing agricultural crop because they will not be able to re-zone it for development purposes
    - Farmers need to negotiate with land owners (as many land owners do not understand soil health and agriculture) – negotiate a cheaper lease with the insurance of improving the soil health over the term of the lease
        - Tell land owners what and how much will be put into the soil
        - Educate the land owner regarding soil health and the return on investment (ie: higher rent for more valuable soil)
2. Tough to compete with biosolids market where product given away for free
3. Large distrust in scientists
4. MOE policy limiting use of compost outside of garden application

    - NASM 3 rating for compost that just falls outside the criteria for maturity is a harsh category to be in – much more work even though very little difference between product
5. Backlash from fertilizer producers
    - Fertilizer producers would say compost's salt content too high etc so farmers keep using fertilizer product
    - Fear competition from compost industry
6. Used to be a landfilled product
    - Greenbin material used to be landfilled which a tipping fee was charged for vs farmer wanting a tipping fee for disposing product on their land
    - This is especially if poor compost quality
    - If you make a mistake early on, its very hard to find forgiveness later on

Know the Agriculture Market

- most compost producers are not agrologists
- get connected with a local agrologist
    - show them there is value in compost product
- importance of OMAFRA to be involved

Ontario Soils and Markets

- products that increase pH are valued
- 52,000 farms in Ontario
- 32% are 10-69 acres (14,000 farms)
- Average farm size is 244 acres
- 90% of farms in Ontario are soybeans
    - Soybeans need small amounts of N and more potash and potassium
    - Compost would be a great value to soybean crops
- Compost has been shown to reduce nematodes in soil
- Prices dictate what amendments farmers will buy - cost of the amendment + return on yield are factors indication which amendments
- Drive of fertilizer industry and crop prices dictates what farmers will spend/have available to spend on amendments for their soil
- The prices change yearly – based on weather, fertilizer costs, farm land rental fees etc.
- Agriculture is not a movement
    - Cannot make a sale based on emotion rather than economics
    - Save the planet vs save the farm
    - Farmers want to see the numbers – doing the right thing will not sell your product

Future of Fertilizer

- 2008 prices spiked in fertilizer
- Economy crashed and farmers cut their use of fertilizer
- 2015 loonie is impacting prices
- Phosphorus is a concern in its use in fertilizer – it is a non-renewable resource
    - Key for many crop processes
    - Phosphorus is coming from outside of Canada
- Using compost in agriculture does the public good as well – good for recycling phosphorus
- With terrorism on rise – will create more concerns with ammonia in fertilizer also

Why does the compost industry think compost is important for Agriculture

- Organic matter
  - Not a selling feature
  - Not the first thing to use to sell compost product
  - Put a $ value on organic matter – make it more valuable
- Soil health
- Increased yields
- Micronutrients
- Safe application – stays where you put it
- Healthier crop
- Sustainable nutrients
- Stimulate microbial activity
- Good alternative to manure since reduction in manure availability
- Limited phosphorus availability

What the Agricultural Industry Values in Inputs

- Talk about your product – have other farmers talk to farmers about the successes of compost
- Go to the farmer – bring other farmers to the farmer to talk about it and demonstrate successes

What's Important to Farmers

- N P K
- Micronutrients
- Nitrogen
  - Know requirements of the crops you are selling it to/targeting
  - Different crops require different amounts
  - Nitrogen is dependent on many factors – can be all over the board
  - Cannot market compost on nitrogen alone because its not consistent
  - Your increasing mineralizable nitrogen not available nitrogen
- Phosphorus
  - Compost doesn't contain a lot of phosphorus
  - Phosphorus is going to be very important in the future
  - Partnering with someone who has available phosphorus would be ideal
- Potassium
  - Sales of potassium have sky rocketed
  - Becoming just as important as nitrogen
  - Compost can provide a lot of potassium – big selling factor
  - Soybeans – require potassium – have found that it can increase pods and increase yield
    - This is where an agrologist relationship is key
  - Potassium is key in plant defense against pests and disease
- Micronutrients
  - Less manure available to provide micronutrients
  - Micronutrients very important for plant development
  - Like a multi-vitamin for the soil

Agrologists discuss with Farmers

- Soil health
  - New discussion just starting to take place more frequently
  - Need OMAFRA to be discussing importance of soil health

- Crop nutrients
- Economics of production
    - o You can cut back on nutrients but what will it cost in the future to put back what has been depleted
- Investment vs cost
    - o Compost is an investment
        - How will it have a significant impact on the farmer
    - o New compost regulations will make it even more difficult and take longer to prove the investment is worthwhile especially with the new regulation forcing the maturity of the product
    - o Getting a 5-6 stability/maturing rating would be ideal in the agricultural industry but with the new regulations it would not be able to be sold

Economics of Crop Productions

- Making the best decisions for profitability on the farm
    - o Feeding crop/building soil reserve
    - o How does fertility = profit
    - o Alternatives to provide nutrients for less cost

Successful Programs

- Create a demand in the market
- Building relationships with agriculture industry – takes time, not easy to break into
- Focused communication plan – get in the news in a good way
- Truckers delivering your product are the face of your company
- Have an alternative plan before you have a problem
- Take responsibility if something happens
- Keep your product clean and consistent
    - o Will lose relationship with farmer if he doesn't like your product or if its not consistent
    - o Visual differences in product even if paperwork says it's the same will hurt
    - o Keep contaminants as minimal as possible
    - o New regulations for compost will force consistency
- Need to complete the loop showing success on the farm to encourage residents to participant in their greenbin programs and keep it clean and contaminant free
- Who is responsible for education of residents
    - o Miller compost working with local municipality going out to schools and community events
- Biggest challenge: it starts at the front end – this can be a limiting factor and can kill certain markets (ie: ag industry if full of plastic contaminants) – new regulations have helped by tightening up contamination levels
- Put a program together with an agrologist on how to use the product
- Visual impact on soil tests are a huge help in moving the product forward
- Pictures – pre and post pictures show successful results

Distribution

- Location of facilities is key to reduce trucking costs to the agricultural market
- Pricing needs to be consistent from farm to farm
- Trucking is done based on zones to keep it fair and consistent

- Give trucker pamphlets with info and contact information to avoid relay of improper information
- Truckers not used to delivering to agriculture is an issue
    - Getting stuck
    - Small spaces for turning around
    - To avoid this, find drivers that work and request them
- Biggest complaint has been drivers getting stuck, wrecking soil etc.
- Appropriate trailers are also key for certain farms/tight spaces
- Also need to have big enough trailers to move the product – being cost effective
- Application can be faster than trucking
    - Trucking can hold up application of compost
    - Need to get it to the farm when requested or they will go somewhere else
- If you want to sell in the agricultural market sell it in weight (kg or tonnes, what they are used to working with)
    - It's a completely different market than landscaping – they don't work in cubic yards

Economics

- One of the biggest challenges is cost
- Compost vs conventional ways
    - Is a 4-5% yield increase profitable?
        - Yes but not as much as conventional means increase in yields
    - Difficult news is that they could also do it the conventional way for less time and more money but it doesn't represent soil health in successive years
    - Harder to sell on going soil vs promoting it to poor soil
- Nitrogen in compost used to assist in breakdown of corn residue (carbon) leftover from harvest
    - better option of spreading compost on top than tilling before winter
    - spreading 2 tonnes of compost in March allows for ease in the spring for field work – release of nitrogen minimal and won't affect the crop with high nitrogen release later in growing season
    - could be used as a tool rather than a piece of equipment
- farmers want to see significant difference between cost and value
    - need to get farmers to shift to compost product
- Best customers are livestock farmers that are no longer selling livestock because they know the value of manure and understand their land

Creating Demand in Agriculture

- Compost lacking presence at conferences and tradeshows etc
    - Be persistent and consistent – attend shows year round – not just as a booth but with presentations etc.
- Make a face in the agriculture community
- Agromart farm days – ideal to attend or provide a talk
    - Develop a relationship with a dealer to assist on getting your name/product out there
- Target farm related magazines and papers with articles
    - Need numbers and information to back it
- Certified crop advisors have a conference in January
- Fruit and vegetable growers have a conference in February – a section will be on using compost

- Barrier: change in legislation has created a barrier to continue supplying the agricultural market – need assistance from OMAFRA and MOECC to overcome this barrier

Incentives

- To encourage use of compost – key to getting it on the farm
- Transportation subsidy
- Subsidies to compost operators
- Grants
- Tax breaks – give farmers a deduction for using compost
- Carbon credits
- Nova Scotia trucking subsidy
  - Use the trucking subsidy for lime
  - Presented paper on societal good affecting water and soil quality
  - 75% cost of trucking is now paid
  - Government removed criteria
- Need some kind of subsidy/incentive to get farmers using the product – get them hooked on it and want it without a subsidy
- Mindset of trucking subsidies and paying for the product makes a difference rather than giving product away for free – shows you have a valuable product
- GLASI program could fall into the incentive/building healthy soils – focus on reduction of phosphorus use, increase holding capacity to prevent run off
- To lobby the government – use language the government uses to help get assistance – ie: healthy soils, higher organic matter which is on the government's radar right now
- Transportation subsidy is a good incentive – as transportation can be a sticking point/barrier
- CALRecycle in California has a good incentive based program occurring
- Farmers want compost 2x per year and won't wait for compost if its not available
  - Spring and fall applications
  - Producers need to have storage availability to meet the spring and fall demand periods for agriculture market

Government Programs of Impact to Marketing Compost in Agriculture

Great Lakes Agricultural Stewardship Initiative

The Great Lakes Agricultural Stewardship Initiative (GLASI) is an incentive based program funded by Agriculture and Agri-Food Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs to improve soil health, water quality and pollinator health in agricultural regions in the watersheds of Lake Erie, Lake St. Clair and southeastern shores of Lake Huron.

The program focuses on Best Management Practices (BMPs) in agriculture through the Farmland Health Check-up. The GLASI program is a great fit with the Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost as two of the BMPs encourage use of compost in agriculture.

GLASI gives farmers the opportunity to work with a certified crop advisor (CCA) to review their farming operations and develop BMPs identified by GLASI that would be best suited for their needs and operations. The main focus of GLASI and the farmland health check-up is to focus on the soil health as this can have a great impact on the watersheds leading into the Great Lakes. CCAs will work with farmers to conduct a review of selected fields for their soil type, nutrient levels, risk of erosion and land management practices as outlined in the GLASI information package. Financial support is provided based on the BMPs agreed upon between the CCA and the farmer.

Two of the best management practices outlined in the information package specifically relate to the use of compost. Best Management Practice #2 – Adding Organic Amendments encourages adding organic soil amendments (livestock manure, approved bio-solids, non-agricultural source materials). Compost can be used on fields that have not used an organic amendment in 5 years. Reimbursement for a portion of the costs includes the purchase of the amendment, transportation and application.

BMP 2 assists in all areas of encouraging the use of compost in agriculture and breakdown some of the barriers preventing farmers from using compost on their fields. Through the Improving Organic Waste Diversion through a Field Test of Greenbin-Derived Compost the barriers identified through the trials focused on costs, specifically to purchase the product, transport and apply the compost. This allows farmers to get exposure, familiarity of the product and how it will interact with their crops for up to 50% of the cost.

Best Management Practice #3 – Crop Nutrient Plan also supports the use of compost through the creation of a five year plan supporting crop rotation, cover crops, organic amendments, tillage. The basis of BMP 3 is to encourage conservative fertilizer use and increase the health of the soil. A certified crop advisor assists in the creation of the crop nutrient plan.

Government Programs of Impact to Marketing Compost in Agriculture

THE IMPACT OF NASM

A new issue in Ontario is embedded in regulations that came into effect on July 1, 2015. Compost now can be used without restriction (“unrestricted use”) on farmland only if it is deemed to be fully mature. To achieve that classification, it must be cured for at least 21 days, contain minimal contaminants and, more significant for this discussion, maintain at least 40 per cent moisture content while it cures.

The aim, according to the Ontario Ministry of Environment and Climate Change, is to create a top designation for compost that “exhibits limited biological activity, and which has degraded to the point where it can be stored and used without risk of odour and adverse effects, such as risk to plants from residual phytotoxic compounds.”

Material that doesn’t comply with this standard is considered Non-Agricultural Source Material, or NASM. There are three NASM categories: Less mature compost is in the most restricted, known as NASM 3, which imposes a heavy burden of tests and paperwork before it can be used, and significant restrictions on where it can be applied.

It is contended by some compost producers that fully mature compost is too expensive for the agriculture market with less mature compost providing more immediate impact to crop yields. The stability of fully mature compost makes it ideal for horticulture and home gardening but reduces its ability to supply nutrients and attack pathogens. Less mature compost provides those benefits as it completes its decomposition on the field. It is also easier, and therefore cheaper, to spread.

According to a March 2015 report on the Ontario study, the less mature compost is, terms of logistics, the most economical compost product for cash-crop farms and gives the best nutrient value when applied, as in the field tests, once per rotation ahead of corn.

The report also explains the potential negative financial impact of the NASM 3 classification. The added costs and time involved in completing the NASM process is substantial and adds a critical barrier to advance broader uptake by agriculture as well as potentially limit existing use.

It cites a typical farm where green bin compost is applied at five tonnes per acre, or 12 tonnes per hectare. The compost costs $35 per acre, or $86.50 per hectare, including purchase, transportation and application. Its nutrient value is calculated as $145 per acre, or $348 per hectare. The difference between cost and value is strongly positive.

But complying with NASM 3, including conducting soil tests and creating a NASM plan, adds $127 per acre or $226.50 per hectare. This bumps total costs to $162 per acre or $313 per hectare. Now, with the NASM 3 expenses, costs exceed the compost’s nutrient value.

Adjusting the NASM category for less mature compost would be one solution to address both environmental and economic considerations. Another possible solution is to create a new category for less mature compost – not referring to the product as a compost at all. Another term needs to be created, perhaps something similar to digestate or “Farm Soil Builder” for agricultural use.

A full review of this overall situation is being recommended by The Compost Council of Canada, requiring the involvement of both the Ministries of Agriculture, Food & Rural Affairs as well as Environment and Climate Change along with the organics recycling industry.