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Identifying Opportunities for Waste Conversion within the Ontario Tree Nursery Sector

March 2021

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Introduction

Our understanding of the use of organic amendments in field production is centered on the individual and combined uses of manures, composts and mulch. Although the majority of Ontario field tree producers surveyed identified soil organic matter (SOM) as the most important soil characteristic influencing tree growth and productivity, approximately 40% of growers indicated that they do not use any organic amendments in the field. Cost and availability of organic amendments were the primary factors limiting their widespread use in field production (**Table 1**). Availability was simultaneously identified as the top contributing factor influencing use of organic amendments amongst the 60% of tree producers who do currently apply organic amendments across their field operations. Where increasing organic amendments is one of the central mechanisms by which tree nurseries can build soil health at the field level, integrative strategies are needed to increase availability and access to affordable organic amendments throughout the industry.

Does not use organic amendments	11	39%
There is limited availability of product	8	73%
Product is not cost effective	6	55%
Other	5	45%
Product is not reliable	3	27%
Uses organic amendments	17	61%
Availability	16	94%
Cost effectiveness	5	29%
Reliable production benefits	5	29%
Few reliable alternatives	1	6%

Table 1. What factors contribute to the use or non-use of organicamendments in field production?

*Results correspond to the responses provided by 29 nursery producers who were asked to identify their reasoning for using or not using organic amendments in the field.

Compost and livestock manure are the top two organic amendments used in field production (**Figure 1**). In contrast, mulch is not readily applied throughout the industry; only 18% of nurseries surveyed actively use mulch as part of their field management practices with the purpose of moderating soil temperature and suppressing weeds during production (**Table 2**). The remaining 82% of Ontario tree producers do not use mulch as part of their field practices on account of high cost, limited availability, uncertainty surrounding the efficacy of the product and concerns related to the transmission and spread of pests and diseases.



Table 2. What factors contribute to the use or non-use ofmulch in field production?				
Does not use mulch	23	82%		
Cost	11	48%		
Limited access/availability	8	35%		
Ineffective product	7	30%		
Vector for disease	4	17%		
Uses mulch	5	18%		
Moderate soil temperature	4	80%		
Weed suppression	4	80%		
Build soil organic matter	0	0%		
Build soil fertility	0	0%		

*Results correspond to the responses provided by 29 nursery producers who were asked to identify their reasoning for using or not using mulch in the field.

Figure 1. Overview of the types of organic amendments used in field production.

Although compost is one of the more widely used organic amendments, the application of compost is by no means prevalent amongst field nursery producers. Of the 29 tree producers surveyed, 57% indicated that they do not currently apply compost, nor do they intend to apply compost in the future. The 43% of tree producers who identified compost as part of their current management practices, indicated using nursery produced compost, purchased compost or some combination of the two. Where cost and availability were again the primary limiting factors affecting the use of compost to help build soil physical, chemical and biological function, on-farm composting presents an opportunity for some growers to incorporate compost into their standard management practices.

Candidate Opportunities

On-farm composting within the Ontario tree nursery sector is fundamentally driven by the need to manage waste material generated during production. Composting is however, only one of four identified strategies for managing relevant waste materials resulting from standard nursery operations. In consultation with nursery producers, four waste management opportunities were identified and the benefits and limitations of each were discussed (see **Tables 7 and 8** for full discussion notes). **Table 3** outlines the four central strategies available to nurseries for managing the various waste products generated during production. Discussion with nursery producers revealed that of the four options, 'using' waste materials via on-farm composting is the only reliable waste conversion opportunity that sufficiently minimizes risk while providing notable value to the nursery. Although the 'sell' option was presented for discussion, it was readily dismissed as a distraction and a generally non-viable business opportunity for producers, who are reluctant to consider selling converted waste material given the associated quality assurance, regulations and financial as well as ecological risks.



	Use	Hold	Transfer	Sell
Opportunities	• Waste materials can be managed and used on site as an organic amendment (compost or mulch)	• Waste materials can be stockpiled and held on site with minimal management for extended periods of time	• Waste materials can be transferred to supplement third party waste management	• Waste materials can be sold for profit to commercial entities for processing or consumers for use
Benefits	 Generating a product for use that would otherwise be purchased Management of large volumes waste materials is necessary for larger operations 	• No cost and/or no or low management effort required	 Contribution to sustainability objectives Does not require allocated space to hold materials for long-term 	• Potential for revenue generation
Limitations	• Substantial land, resource and time allocation required to set up and manage waste conversion	Loss of land where space is allocated to hold waste materials	 Tipping fees and costs associated with transferring material off-site Quality assurance and regulatory requirements 	 Lack of potential buyers in current market Quality assurance and regulatory requirements Potential vector for transmission and spread of pests/disease

Table 3. Overview of strategies for managing waste materials generated at Ontario nurseries

Nursery Size as a Factor in Waste Conversion Efforts

The implementation of any of the four aforementioned waste management strategies is largely contingent upon the scale of a nursery's field operation. Results of the 2020 *Soil Management Survey for Nursery Growers* suggest that operation size is likely one of the key factors driving current perspectives on compost use and production within the nursery sector. Use of compost is most prevalent amongst large-scale tree producers with more than 500 acres in field production. Mid-size operations with 300 to 500 acres, demonstrate the lowest rate of compost use ranging from 29-33%, and only 36% of smaller nurseries with less than 100 acres in field production currently use compost within their operation.

		llses	Doe	es Not Use Comp	oost
Size of Field	# of	Compost	Interested in	No Plans to Use	Intends to
Production	Nurseries	compose	Producing Compost	Compost	Purchase Compost
0-100 acres	14	36%	29%	29%	7%
100-300 acres	7	29%	0%	43%	29%
300-500 acres	3	33%	0%	67%	0%
> 500 acres	5	100%	0%	0%	0%

Table 4. How does the size of the nursery operation influence opportunities for composting?



Figure 2. Opportunities for composting according to size of nursery field operations.

Small Nurseries (0 to 100 acres)

Ontario nurseries with less than 100 acres in field production present the most diverse range of perspectives on compost use and production. Smaller nurseries are likely to produce a lower volume of 'waste products' in the form of culled trees, root balls and potting media and may require several years of production to amass sufficient feedstocks required for a single round of on-farm compost production. Where the volume of waste is limited by the scale of the operation, nurseries with less than 100 acres in the field may be more inclined to minimize waste rather than characterize and identify streams for waste conversion. The demonstrated interest in compost and compost production amongst smaller nurseries is likely representative of individual interest and opportunistic on-farm experimentation, intended to create efficiencies and make use of resources where available; a strategy which is more prevalent in smaller nurseries than in mid or large scale operations.

Mid-sized Nurseries (100 to 500 acres)

Mid-sized nurseries with 100 to 500 acres in field production are limited by scale in both quantities of 'waste products' and ability to allocate field space, time and resources toward setting up and managing an on-farm compost operation. Where the operational demands of field production and management may be greater than that of nurseries with fewer acres in production, these mid-sized nurseries appear to be limited in their capacity for on farm experimentation, accounting for the lack of further interest in generating and using compost at this scale.

Large Nurseries (>500 acres)

All nurseries with large acreage for field production (> 500 acres) currently use compost. Larger nurseries are likely to produce sufficient quantities of 'waste products' in the form of culled trees, root balls and potting media to generate compost without needing to source additional feedstocks. These larger nurseries are also more readily able to allocate field space (typically fallow or resting fields), time and resources toward setting up and managing a long-term on-farm composting operation.

Nursery Size and Compost Use

Small Nurseries (0 to 100 acres)

Smaller nurseries that are already using compost within their field operations, are either generating or purchasing compost. In these smaller nurseries, the volume of organic feedstocks required to amend fields may not be sufficiently supplied by the waste that is generated though pruning, culls, weeding and other production related activities. Nursery producers of this scale reported generating roughly 1500 yards of waste and between 800 and 1000 yards of compost annually. Roughly, 150 to 250 yards of compost is needed to amend one acre of field production (assuming a 15-25% incorporation rate). For nurseries of this scale, on-farm composting occurs over multiple growing seasons, as it may take several year to accumulate the waste required to generate sufficient feedstocks for composting. Producers are still required to manage waste, however the resulting volume of compost produced is likely inadequate to service all of their application needs.

Mid-sized Nurseries (100 to 500 acres)

Mid-size nurseries that are already using compost are predominantly generating compost, suggesting some capacity for on-farm use and waste conversion. Opportunities for mid-sized nurseries are explored in greater detail with respect to the barriers to on-farm compost use outlined in the following section. These mid-sized nurseries appear the least interested in generating on-farm compost, although they are inherently aware of the benefits that compost can bring to soil health (i.e. 29% intend to purchase compost; **Table 4**). More information on the logistical or operational barriers to on-farm composting is needed to better understand the opportunity for waste conversion at this scale.

Large Nurseries (>500 acres)

Most nurseries with large-scale field production are generating their own compost. 60% of tree producers with large-scale field operations are purchasing compost to supplement on-farm compost production. Only one producer with more than 500 acres in field production indicated that they exclusively purchase compost for field application. For nurseries with greater field production, purchasing compost for use as an organic amendment is limited by the size of the operation, where amendment of extensive acreage using commercially produced composts is likely to be cost prohibitive at this scale.



	Uses Compost		
Size of Field Production	Generating Compost On- Farm	Both Generating and Purchasing Compost	Purchasing Compost
0-100 acres	2	0	2
100-300 acres	1	0	1
300-500 acres	0	1	0
> 500 acres	1	3	1

Table 5. How does the size of the nursery operation influence compost sourcing?

Barriers to On-farm Compost Use

The central barriers to on-farm composting as identified by Ontario tree nursery producers are (1) composting set up and logistics, (2) information on compost quality parameters for trees and (3) information to support monitoring and maintenance of a composting operation.

Table 6. How does the size of the nursery operation relate to perceived barriers to on-farm composting?

	0-100 acres	100-300 acres	300-500 acres	> 500 acres
Information on compost quality parameters for trees	36%	43%	0%	40%
Shortage of feed stocks	14%	14%	0%	60%
Set up and logistics	43%	57%	67%	0%
Monitoring and maintaining the operation	43%	43%	33%	0%

These barriers when considered within the context of scale, once again demonstrate that challenges vary according to the size of a nursery's field operation (**Table 6**). Larger nurseries with greater acreage (> 500 acres) appear generally less constrained by logistical concerns related to the setup, maintenance and monitoring of a compost operation (Figure 3). These nurseries, which are more readily able to allocate field space, time and resources toward composting, identify their primary challenge as being centered on sustained access to quality feedstocks; presumably to supplement composting of waste materials that are generated on site. Alternatively, the smaller and mid-size field operations are largely limited by logistics associated with on-farm composting and may require specified guidelines and strategies that allow for more periodic waste management.



Figure 3. Perceived barriers to on-farm composting according to size of nursery field operations.

The need for information on compost quality parameters for trees was found to be relevant across the industry, suggesting technical guidelines and comprehensive resources are required to inform the production, management and use of nursery-produced compost throughout the field nursery sector. Where perspectives on compost use and production are generally dependent on the scale of a nursery's field operation, resources should be designed in a way that is cognizant of these various scales of production.

Conclusions

Although composting accounts for only one of four identified strategies for managing relevant waste materials resulting from standard nursery operations (use, hold, transfer, and sell; **Table 3**), it is the only waste conversion option that provides value to the nursery. Waste conversion opportunities for the nursery sector in Ontario are very dependent on the size of the nursery's field operation. For large nurseries, on-farm composting appears to be the best overall waste conversion opportunity. For mid-sized and smaller nurseries, on-farm composting in conjunction with holding material until volumes of waste are sufficient to convert to compost is likely to be the most reliable and valuable opportunity. For mid-sized and small nurseries, low levels of investment and space are required to make this opportunity attractive. Additionally, providing nurseries with access to the resources needed to allow them to use on-farm composting to their advantage, where appropriate, is integral to the value of this opportunity in the extended term.

		Nursery no. 1	Nursery no. 2	Nursery no. 3	Nursery no. 4	Nursery no. 5
1	Can you estimate the volume of waste (pruned branches, culls, etc.) that result from your operation?	In 2020, 1900 yards.	Roughly 1500 yards per year.	Roughly 100 yards per season	Roughly, 500-600 yards per year.	1000 yards of wood grinds (ground culled trees piled until the end of a season), 6000 yards ground root balls/potting media. 7000 yards total.
2	What volume of compost do you produce?	Typically 1000 yards. In 2020, the compost pile was ~ 200ft long, 25ft wide and 8ft tall.	Typically, 800-1000 yards per year.	No additional processing for compost, same as waste material from digging/containers (100 yards per season)	Roughly, 250-300 yards per year.	8000-10 000 yards/ year for the past two years (since bringing in additional feedstocks to supplement nursery waste). In previous years compost production was roughly 4000 yards per year.
3	What feedstocks do you use to supplement your compost beyond the waste materials generated on farm?	Arborist wood chips (maybe ~ 500 yards), cow manure (2020 was the first year they brought in much livestock manure, 20 dump trucks, ~20 yards/truck) and poultry manure (50 dump trucks, ~20 yards/truck). Sometimes they will throw unusable fertilizer into the compost pile to avoid having to dispose of the damaged bags.	Turkey manure (locally sourced, paid to bring in), hoping to source more cow manure moving forward. Ease of access to turkey manure given the abundance of farms in the area means it's likely he'll continue to use predominantly turkey manure for the compost to avoid cost of trucking other feedstocks in from further away	Typically source manure (both horse and composted cow manure). Material is not incorporated into "compost" or used for composting. Manure spread separately, often in conjunction with the compost.	Previously used manure (small amounts of a mixture of chicken, llama, sheep; all from neighboring farm). Access to pile of well-composted horse manure. Cow manure will typically go straight onto the fields and not in the compost. They intend to start using unpasteurized mushroom compost and woodchips in their composting.	Vegetable waste, composted and uncomposted horse manure, mushroom compost (different sources to supplement lack of in house compost).
4	How do you source additional feedstocks?	Local chicken farm, local manure wholesale. Local, pre-existing relationships.	Locally, via word of mouth. Priority is to source materials as close to the nursery as possible to minimize trucking cost.	Locally, via word of mouth.	Locally, via word of mouth.	Material obtained via a variety of longstanding local sources. Mushroom compost purchased from GroBark.

Table 7. Waste Conversion Opportunity Mapping- Tree Nursery Sector

 Table 8. Understanding On Farm Composting in the Nursery Sector

		Nursery no. 2	Nursery no. 5
1	When did you start composting at the nursery? How have things changed since you started?	Going in to year 3 of composting at the nursery (completed two full seasons of composting). Initially started composting in the winter, transitioned to setting up and composting windrows in late summer. Moved the location of the windrows to avoid areas subject to flooding (to minimize risk of oversaturation/anaerobic compost). Started composting turning windrows with a bucket, purchased Sittler compost turner this past year.	Composting for 20+ years using the "old style" (ad hoc) approach to composting. Compost generated on the fallow land only (no designated composting site). Produced roughly 60-100 yards/ acre from mixed woodchips, mushroom compost, horse compost and screened root balls. In the last 2 years they have been doing more active, involved composting. Now have (and are gaining) a greater understanding of compost quality, prioritizing composting and allocating time to composting to ensure they are maximizing quality and function of the compost.
2	What do you see as being the minimum requirement for composting in a nursery setting?	Space, basic materials, any equipment to begin moving and turning material.	Space , roughly 1 acre per 1000 yards.
3	What are your goals for composting at the nursery?	Field amendment.	Primarily field amendment. Beginning to discuss the possibility of creating and generating their own container mixes (likely well down the road, required much greater understanding of the composting process). Other major goals include waste conversion/ waste management, reducing synthetic fertilizer use (in combination with cover crop) and supplementing soil loss.
4	Would you advise other growers to generate their own organic amendments for field production? Why or Why not?	Yes.	Yes.
5	What do you see as being the primary benefit to on farm composting?	Making use of waste material. Minimize cost of bringing in/trucking other amendments.	Part of a sustainable system. You know what you are getting when you generate the compost on site.
6	Would selling compost/mulch generated using nursery materials be a reasonable option for your nursery? Would there be interest in creating continuity between amendments used during production and those used for planting?	They have considered collecting and selling compost/mulch from the farm. Largely limited by restrictions (OMAFRA/MOE) and not wanting to invite complications into the operation. At this scale, the compost/mulch generated on site is more valuable to them (field production, cash crop they have got going on nearby) than it would be to sell. In his opinion, not worth putting all that time and effort into something that they won't make up value by selling. Also limited by feedstock, currently they have plenty to make use of internally but not enough to justify time and resource nor to make selling it worthwhile. Hesitant to bring material in given risk of disease, not just in the compost/mulch product but mostly the risk of having these things on site. Smaller operations are less likely to be able to have sufficient separation between their compost operation and their crop to justify bringing potentially compromised material in.	

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