Utilization and Marketing Potential for Waste Compost in Nursery and Container Production

Calvin Chong
Professor
University of Guelph, Department of Plant Agriculture-Vineland
4890 Victoria Ave. N., Box 7000
Vineland Station, ON L0R 2E0
Tel: (905)562-4141 ext.101   Fax: (905)562-3413
E-mail: cchong@uoguelph.ca
Utilization and Marketing Potential for Waste Compost

in Nursery and Container Production

Calvin Chong
University of Guelph, Department of Plant Agriculture-Vineland, ON
E-mail: cchong@uoguelph.ca

There has been increasing interest in recycling and reuse of organic wastes and composts in agriculture. Researchers all over the world have demonstrated that these can be effectively used as soil and potting amendments, or substituted for animal manures, bark, and peat moss (Oshins 1995; Shiralipour et al. 1994; Warman and Taylor 2000).

Since the mid-1980s, the Ornamental Nursery Research Program at the Horticultural Research Institute of Ontario, Vineland Station (now part of the University of Guelph), has been conducting research to identify and develop economically viable and environmentally friendly, alternative production systems for the nursery/landscape industry, with emphasis on container production. This type of production has increased rapidly and represents about 35% of Canadian-grown nursery stock. It is intensive, specialized agriculture, utilizing large amounts of bark, peat, composts and other potting amendments.

Over the years, our research demonstrated the benefits of container growing using potting mixes blended with a wide variety or combinations of composted or raw by-products.

The first part of this presentation examines the marketing potential for waste compost and highlights constraints and challenges facing both the composter and the compost user in this industry. The second part provides an overview of my research dealing with a variety of waste compost.

Marketing Potentials and Challenges

Triggered by legislation in the mid-1990s, municipalities across Ontario and other provinces began to produce municipal waste compost from leaf and yard waste and household garbage, all coming on stream about the same time and with little knowledge on how to market it.

As large amounts of compost piled up in certain jurisdictions, early efforts to market it at a reasonable price, or even to give it away to the public, have had variable -
sometimes successful but often frustrating - results (Chong 1995). Today, many municipalities have become better at marketing municipal composts but there still seems to be a lot of it out there (Antler 2001).

**Farm Use - Limited Potential**

Common sense suggests that most farms would use it. After all, composts have been successfully used in agriculture since ancient times. And even if this were possible in today’s modern agriculture, farmers may not be able to afford the costs for the compost, or associated costs such as for transportation and spreading (Chong 1995; 1996). Would society underwrite these costs as part of the garbage disposal process? And do we have the needed scientific information required to recommend to the farmer how to properly use waste composts?

At the first (1995) Compost Marketing Workshop, sponsored by various organisations including the Association of Municipalities Recycling Council (AMRC) and The Canada Composting Council (CCC), John Schleihauf (then with the Ontario Ministry of Agriculture, Food and Rural Affairs) indicated that waste such as paper and sewage sludges can be applied to agricultural land provided it is beneficial to agriculture and not simply dumping. Only “quality composts and wastes with minimum standards for heavy metals, organic chemicals and debri such as plastic and glass” are acceptable for use.

He predicted that most farmers will have little interest to use off-farm composts since they still struggle to use all of their manure. Ironically, there is even less interest today. In the wake of the recent Walkerton tainted water incident which left half the town’s 5,000 people sick and several dead due to *E. coli* from manure, the Ontario government has enacted stricter legislation for use and management of manures. During the past five years, there continued to be negative public concerns about the spreading of sewage and paper mill biosolids in Ontario. In the U.S., there has been increasing concerns over contaminants such as plastics in municipal composts.

**Horticulture - the Driving Force**

Schleihauf also anticipated that demand for waste compost will be driven primarily by end-users in horticulture and related specialty markets and not necessarily by compost producers such as municipalities. This prediction remains largely true today in Canada, as also in the U.S. (Logan et al. 1997).

Horticulture is distinctly different from general agriculture. It is a more intensive type of culture and includes fruits, vegetables, and ornamentals. Horticultural markets are more specialised, diverse and smaller, but the value of the crops are greater, especially the ornamentals. These crops include: greenhouse-grown floricultural crops such as cut flowers, holiday pot plants, foliage plants for interior use, and bedding plants for outdoor use; field and container nursery stock such as trees, shrubs, ground covers,
and vines; and sod and turf. Allied activities and services include bagging and soil amendments, landscaping, garden maintenance, garden centres, and gardening.

**The High-End Market**
During the past 20 years, ornamental horticulture, also referred to as the “high-end market”, has been one of Canada’s fastest growing agricultural sector. Typically, every compost producer or soil amendment business initially aims for this market. This market has the greatest potential for utilizing and paying higher prices for composts (Logan et al. 1997). Greenhouses, although concentrated mostly in or near urban centres, are the least likely to use substantial amounts of compost since most grow plants hydroponically using large quantities of artificial substrate materials such as rockwool.

Recent industry-gathered statistics show current farm gate contributions to the Canadian economy of $787 million for floriculture and $355 million for nursery stock and sod. Consumers spent an estimated $4 billion in annual landscape upgrades. Ontario’s share of all these contributions is about 55%.

However, we have no “hard” statistics on the amount of topsoil, bark, peat, composts and other soil or potting amendments required by this market. “Guesstimates” from leaders in this area suggests that Ontario needs annually about 3 million tonnes (4 million cubic yards) of topsoil, 300,000 tonnes (1 million cubic yards) of peat, 100,000 tonnes (300,000 cubic yards) of bark, and 100,000 tonnes (300,000 cubic yards) of mulch.

For compost, the “guesstimate” is even cruder. Assuming substitute use for one-third of all the above, there may be a market potential for about 1.2 million tonnes of compost in Ontario, including about 135,000 tonnes of spent mushroom compost. Also assuming that the rest of Canada could perhaps use another 1.2 million tonnes of compost, total demand by the high-end market could be about 2.4 million tonnes across Canada. For comparison, statistics published by the CCC indicated that in 1998 Canada produced 845,000 tonnes of finished compost, of which 33% or 278,000 tonnes were produced in Ontario.

**Difficult Market - Needs Assurances**
Quite often potentially large sales to nurseries are not realized because the composter is unable to provide satisfactory answers to questions such as:

- Can you supply me with large quantities of this compost with consistent quality year after year?
- Do you know the technical qualities of your compost (chemical, physical, and biological properties)? Does it have disease suppressing properties?
- Is it free of dioxins, PCB’s, and plastics?
- Will my crops respond well to it?
- How much of it can I use in my mixture?
• Is your price competitive?

The high-end horticultural market for waste compost is very difficult to penetrate and maintain a hold in. Typically, only the highest quality composts are acceptable. Considering use of a waste compost in container culture because it is less expensive than the traditionally-used bark or peat moss is not sufficient motive by itself for a nursery producer to make this substitution. His crops are high-valued. He requires assurance that the compost is not hazardous or that it will benefit some aspect of culture such as increased growth or disease resistance. Container crops and other high-end crops are produced under exacting requirements. Nursery producers are well aware of common misconceptions such as “if it’s compost, or if it meets Ontario compost guidelines, it’s gotta be good”.

Composts are produced under widely varying circumstances (seasons of the year, source and mix of feedstock materials, turning frequencies, and other production variables). Thus, all composts are not the same and not all composts are good. Not all composts - in fact only relatively few - have been proven to suppress plant diseases.

During composting, urban or farm wastes (“fresh” or “unstable” organic matter) are broken down with the aid of bacteria and other microbes to produce humus (“stable” organic matter). There is a fresh earthy smell to compost even in the early or active phase. When properly done there is no foul odour - a common and obnoxious complaint. As a rule, if it smells, it’s not good compost.

Since I became involved with composting research and extension, I have seen a lot of poor quality composts - and good ones also - intended for use in the nursery, turf, landscape, and gardening sectors of our industry, as well as in greenhouse operations. The results have sometimes been disappointing. Little wonder that there remains a lot of concern and scepticism about compost usage.

From my experience, a waste compost often may meet existing guidelines such as those published in Ontario, Quebec, and other provinces but do not measure up to the exacting standards required by the high-end user. Besides odour and inconsistent quality, the other two major complaints are excessive soluble salts and high pH values. Problems such as these make it difficult to market the compost, or to use it effectively in horticulture. Composts with higher standards, or targeted to a specific crop use based on their quality, would assist in ensuring that the right compost is sold for the right use.

Research Overview

Spent Mushroom Compost
Spent mushroom compost has been used for a long time to “enrich” garden soils. Researchers throughout the world have suggested the potential for its use in the culture of many types of crops, but information has been variable, limited, or inconclusive (Wuest et al. 1995). Concern for its use is primarily due to its high salt content and potential for “burning” plants.
In early trials at Vineland, spent compost analysed from five representative farms across southern Ontario were shown to have physical properties such as aeration porosity (31-45%) and moisture retention (41-55%) that were at least comparable to those of bark (aeration porosity, 36; moisture retention, 40%) (Chong and Rinker 1994). All spent composts, however, had elevated pH (8.0-8.2) and undesirably high concentrations of soluble salts (expressed in terms of electrical conductivity, 4.5-8.5 dS m⁻¹, 1:2 by vol substrate:water extracts; ≤ 1.0 dS m⁻¹ considered desirable) due primarily to excessive concentrations (mg L⁻¹) of chloride (895-1825), potassium (>999), sulfates (800), calcium (465-790), and sodium (244-460).

Growth of a wide assortment of container-grown (2-gallon size) woody nursery species was good to excellent in media amended with spent compost (Chong and Rinker 1994). There was little difference when freshly spent (high salt level), leached (low salt level), or aged (intermediate salt level) composts were used. Most species grew more as the proportion of compost was increased in the media, in some cases, up to 100% by volume. The key to our successful results was that the salts leached quickly from the small nursery containers with normal irrigation practices, declining to values that were benign to plants within days after potting.

Growers often report successful use of spent mushroom compost under both container and field growing conditions, but some have reported salt damage. We recommend that (a) the salt level in the spent compost mix be monitored, particularly during the first several to 14 days after potting when hazard level is highest; (b) the mix should never be allowed to dry out since this increases the hazard level; (c) no more than 50% of the mix should be spent compost due to excessive substrate shrinkage at these or higher levels; and (d) use only with smaller containers since salts leach slowly from large containers.

Paper Mill Wastes
In the U.S., research on use of paper mill wastes began in the 1950s in land reclamation, forestry, and agriculture (NCASI 1959).

Since the 1980s, paper mills across Ontario have been distributing paper mill biosolids to Ontario farms and rehabilitation sites (Bellamy et al. 1990). According to one Niagara farmer who has successfully used this by-product to grow landscape trees and shrubs, “We couldn’t farm without it. Tile drainage on this heavy soil has been disappointing.” The waste is distributed over the field and ploughed under several times. The fields are planted for one or two years to a rye cover crop which is worked into the soil. Nursery trees and shrubs are then planted and grown into the amended field soil which has a consistency similar to that attained after adding peat moss.

Raw sludge mixed with soil, bark or other ingredients can be used effectively for container growing. As a rule, we recommended no more than one-third of the mix as sludge (Bellamy et al. 1995), although, in some cases depending on the sludge, up to
two-thirds of the mix can be comprised of sludge. However, any amount of a good sludge-derived compost can be used. Plant growth was little affected by immature or aged sludge-derived compost.

In a recent trial, field-grown nursery trees thrived equally well regardless of rates of paper mill sludge incorporated up to 250 tonnes/ha (unpublished). More recently we demonstrated an alternative use of the sludge as rooting medium amendment in summer propagation, and also as amendment in soil and substrates for growing selected greenhouse flowering crops.

Obnoxious odour continues to be a major deterrent to use of raw paper mill sludge in agriculture. Recently Environmental Systems, a new company in St. Catharines, Ontario, began to compost the raw sludge by letting it stand for about six months in windrows with occasional turning. The composted product is odourless and seems to be at least as effective as a container amendment as the raw product.

Notwithstanding these successes, the use of paper mill sludge in Ontario agriculture has produced variable and sometimes detrimental results, due in part to insufficient agronomic and research knowledge about its use. Different sources of sludge, or even batches of the same sludge, vary in chemical and physical characteristics. Agronomic responses are not always similar at different locations or in different years, or when another sludge other than the one tested is used.

**Waxed Corrugated Cardboard**
Chemical analysis indicates that waxed corrugated cardboard is low or lacking in nutrients and, in this respect, desirable as an amendment for container production (Chong and Hamersma 1995).

Our first study in the 1990s showed that certain substrates consisting of 25% or 50% by volume of uncomposted waxed corrugated cardboard mixed with spent mushroom compost and/or sawdust supported growth of container-grown nursery species equal to a bark control medium or a commercial nursery mix. In growth trials, with 12 different combinations of spent mushroom compost, wood wastes, corrugated cardboard, and various nitrogen-rich wastes, these substrates suppressed seed germination and growth of greenhouse-grown bedding plants due to the high salt content, but two of three container-grown nursery crops grew better in them than in control nursery substrates (Raymond et al. 1998).

**Municipal Waste Composts**
In Canada, as in other countries across the world, composting is considered a key to the management and reduction of municipal wastes (Shiralipour et al. 1992; Warman and Taylor 2000). Thus, in the future, municipalities will be the major source of composts.
An early trial at Vineland in the mid-1980s, showed that various container nursery crops grew more with increasing amounts of composted municipal residential waste in the media up to 100% by volume (Chong et al. 1990).

Since 1995, we have routinely and successfully used waste compost from Metro Toronto Solid Waste Division, Keele Valley Landfill, and more recently composts from the cities of Guelph and Waterloo, in our experimental container mixes. Nursery plants typically grow well in these substrates mixed with paper mill waste, bark and/or other ingredients. Other trials also indicate that municipal waste composts make good rooting substrates, as long as the substrates are leached to reduce salt levels to ≤ 0.2 dS/m, the threshold value considered to be desirable for rooting nursery cuttings.

Excess salts, high pH, presence of plastic and glass residues, and variability in quality are major deterrents against use of municipal composts in nursery propagation and plant culture.

Other Wastes and Composts
We have also investigated other types of waste by-products in container nursery cropping systems including: turkey litter compost, softwood tree barks; apple pomace; industrial waste by-products from the manufacturing of polyvinyl chloride resins and compounds; organic fertilizers manufactured from animal wastes and meat by-products; wood chips from pallets and furniture and demolition wastes; food wastes; various animal manures; and pulverized broken glass. More recently we began to recycle nutrient-rich compost leachates and run-off water in container growing of nursery crops (Chong 2001).

Conclusion and Recommendations

During the past 10 years, we have demonstrated that our ability to produce composts far exceeds our ability to utilize it. In our consumer-oriented society, garbage will continue to increase. Significantly more of it must be composted to meet near-term government targets for waste reduction or we may fall more and more behind. Note that Ontario fell short of its waste reduction target of 50% by year 2000, achieving only 30%.

Information and knowledge on use of waste compost in modern horticultural growing systems is lacking, fractious, or uncertain. My research, and that of other scientists across the world, is providing new knowledge on how we can effectively use more and more of it in crop production systems. But until our confidence in using it improves substantially, there is little chance that the horticulture industry will fully accept and use them in routine growing practices. In this regard, I recommend that the composting industry:

• adopt improved standards, labelling and grading of comports
• conduct a bona fide marketing survey of compost markets
• increase agronomic and research knowledge on compost usage
• as composters, make sure you really know your compost - its benefits and
  limitations
• promote more use to specific target groups.

The pundits predict that by year 2030, 90% of all wastes will be recycled or
diverted from landfills into composting and manufacture of new products. Until then,
there is a lot of work to be done to make this happen.

References


Wastewater Treatment and 2nd Workshop on Drinking Water, Montreal, QC.


Pages 36-42 in R. Khana and M. Stager eds. Ground Works ’96 Proceedings. The
Evergreen Foundation, Toronto, ON.

Chong, C. 1999. Experiences with the utilization of wastes in nursery potting mixes


Chong, C., Hamersma, B., and Cline, R.A. 1990. Recycled municipal waste shows


Logan, T.J., Lindsay, B.L., and Titko, S. 1997. Characteristics and standards for
processed biosolids in the manufacture and marketing of horticultural fertilizers and soil


