STRATEGY FOR COMPOST MARKET DEVELOPMENT IN FLORIDA

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INTRODUCTION

Generation of various wastes continue to grow nationwide. America may lead the world in waste generation per capita, as with municipal solid waste (MSW) generation in the U.S. had increased from 250 tons in 1989 to 307 tons in 1994 and to 340 tons in 1997(Glenn, 1998). These problems with recycling and if necessary disposing are not unique.

Management of municipal wastes, both liquid and solid, continues to be major concerns for governments throughout the U.S. Conventional waste disposal methods have serious environmental problems and are becoming too expensive. For example, in 1994, landfill disposal costs ranged from $36 in Florida to $75 in Minnesota to $125 in long Island, N. Y. (Christopher & Asher, 1994). In response, many states, counties, and local governments in the U.S. passed legislation to reduce the quantities of materials entering landfills and/or implemented alternative methods of waste disposal. This resulted in a positive impact. For example, in 1985, about 83% of MSW was land filled compared with 72% in 1994 (Carra and Cossu, 1990; Christopher & Asher, 1994). The number of landfills reduced from 8,000 in 1988 to 2,514 in 1997 (Glenn, 1998). It is projected that the number of landfills will decrease to 1,200 by the year 2010 (Christopher & Asher, 1994).

Mandatory regulations for a diversion of waste streams from landfills, increasing cost of landfill disposal and public support for resource conservation is causing many communities throughout the U.S. to plan and/or operate composting facilities by the public and private sectors. Composting of organic wastes is increasingly advocated as an environmentally benign, affordable recycling method. As a result, the number of composting facilities has drastically increased during the last decade and the trend is continuing.

In 1992, thirty seven states planned to enact, or had already enacted, legislative bans on land filling yard trimmings in the U.S. Thirty five states had solid waste diversion mandates with deadlines 1991 to 2010 (Glenn, 1992). As a result of legislation banning yard trimmings from landfills, there has been a dramatic proliferation of yard trimming composting facilities throughout the U.S. The number of yard trimming facilities increased from 900 in 1990 to 2,200 facilities in 1992 and to 3,484 facilities by 1997 (Glenn, 1998). This trend is expected to continue in future years.

The number of biosolids operating plants in the U.S. increased from 61 in 1983 (Richard, 1991) to 261 in 1997 (Goldstein and Block, 1997), while the number of MSW composting facilities increased from one in 1983 to 7 in 1989 (Goldstein and Riggle, 1989) and to 14 in 1997 (Glenn, 1997).

Florida is a leader in composting organics with 12 permitted composting facilities in nine counties as of February 1997 (Florida DEP, 1997). This number of composting facilities does not include the exempted composting facilities (i.e., yard trimming composting facilities exempted per FDEP policy, small facilities and normal farming operations). If the exempted facilities are included, the total number would exceed 45 facilities (FDEP, 1996; FDEP, 1997). The number of biosolids composting facilities that include yard trimmings in their operation is 11 (Goldstein and Block, 1997), while MSW composting facilities are two (Glenn, 1997). Some of these composting facilities are among the largest commercial facilities in the U.S. For example, the Enviro-Comp facility in Jacksonville is one of the largest yard trimming composting facilities, Palm Beach Solid Waste Authority operates one of the largest and most successful co-composting facilities (biosolids +yard trimmings), and Sumter County composting facility, with the longest continuous operating experience in MSW composting known to us.

In 1996, about 23 million tons of MSW were collected in Florida (FDEP, 1997). If an organic fraction of this waste stream is biologically decomposed, it is estimated about 5.5 million tons of composts could be generated. This estimate raises a number of questions that need to be addressed:

1. Will the market capacity in Florida be sufficient to utilize the compost produced?
2. What is the present market capacity fro the composted products?
3. How to build markets for composted products?

Battlelle's study (Slivka et al., 1992) on the practical potential applications for compost in Florida found that as much as 42 million tons of compost could be used annually within a 50-mile radius of urban centers with populations more than 100,000. Agriculture alone could use more than 20 million tons each year. The distance constraint was added because of the perceived limit on the economic viability of shipping further.

If the total production of compost is estimated to be approximately 5.5 million tons a year, this study shows that the potential use for composted products in Florida is more than 7.5 times the production of composts each year. Therefore, what we have is a market development challenge, not a lack of a market.

Since the growth of composting in the U.S. is not driven by demand for compost products in marketplace, communities developing composting facilities will have to devote a great deal of attention to compost market development . Product quality, safety of compost and benefits for users must be demonstrated once the facility is operating.

For any type of compost to be marketable, regardless of origin, it must pass the minimum product standards for protection of public health, safety, and the environment. And, the quality of compost should meet the market specifications and requirements for end-user(s). Passing the minimum product standards and having a high quality does not always secure a market for a compost product. Although this is a big step, effective market development strategies are required to secure markets.

The long-term feasibility of composting depends largely upon building a market for the compost by demonstrating the safe use and establishing the values associated with the benefits of compost application. Definitive information needs to be generated about the safety and potential benefits of compost utilization. Once the information is generated, effective methods should be employed to disseminate the findings to end-users. Effective methods of information dissemination for developing ongoing working relationship with end-users include, but is not limited to: media outreach to grower and trade associations, the Farm Bureau, and local newspapers; workshops, and field days to demonstration findings and newsletters to regional audiences. A comprehensive compost market development program conducted by a group of researchers, and Extension educators at the University of Florida is an example of this strategy. This program, managed by the Center for Biomass Program received support from the Florida Department of Environmental Protection through the Center for Solid and Hazardous Waste. It consisted of 6 projects--two projects to address compost safety, three projects for the demonstration of compost benefits, and one project for the establishment of management and outreach programs.

A. DEMONSTRATION OF COMPOST SAFETY

To remove barriers to compost acceptance, two projects were designed to: 1) demonstrate the biological and chemical remediation of pesticides during composting and 2) evaluate compost maturity/stability measures important to N and toxic metal availability and accumulation in crop parts. Composts from various facilities in Florida were used for pesticides assays.

1. DEMONSTRATION OF THE BIOLOGICAL AND CHEMICAL REMEDIATION OF PESTICIDES DURING COMPOSTING - The objective of this project was to evaluate the remediation of several commonly used pesticides applied to yard foliage and other organics composted in Florida. Commercial compost was evaluated for pesticides. These sites included two municipal solid waste sites, one cow manure site, one mushroom site, and two yard trimmings sites. A Quality Assurance (QA), Quality Control (QC) testing protocol was established for pesticide (endrin, lindane, methoxychlor, toxaphene) and herbicide (2,4-D, silvex) detection in compost. Samples tested have confirmed the hypothesis that pesticides are not present in mature/stable composts. This is either from not being present to begin with or from remediation of the chemicals through the composting operation. To date, no herbicides or toxaphene was found in the samples tested this far. Thus, based on the sites sample so far, commercial composts are free of harmful pesticide levels.

Air-tide composters were designed to study the bioremediation when composts are "spiked" with known quantities of a pesticide. Radio-labeled atrizine was the model herbicide chosen. This project is being continued to also include analysis of heavy metals not previously assayed (E.I. arsenic, etc.)

2. COMPOST MATURITY/STABILITY MEASURES IMPORTANT TO NITROGEN AND TOXIC METAL AVAILABILITY AND ACCUMULATION IN CROP PARTS - Feedstocks and composts at different grades of maturity, from three compost facilities, Palm Beach County Solid Waste Authority, Enviro-Comp in Jacksonville, and Bedminister Bioconversion Corporation (Sevierville County, TN) were studied. Several methodologies were utilized to measure the maturity/stability of the compost products. These methods include total C/N ratio, water-extractable organic C and N and also its ratio, optical density of the water-extract, and a short-term (3 days), easy and low cost respiratory study based on CO_2 evolution. The most reliable and clear indicator for compost maturity/stability was determined to be the respiratory procedure.

Although the total nutrient and heavy metals quantity varied in different composts, in all cases the levels were far lower than the limits established by the Department of Environmental Protection (DEP) regulations. Water-extractable metals were also low verifying that the bioavailability of metals from these materials do not pose serious risks.

B. DEMONSTRATION OF COMPOST BENEFITS

A set of projects was designed to demonstrate the benefits of compost applications to:

1) sandy soils used for vegetable crop production,
2) compost applied to landscape beds to enhance establishment of woody ornamentals, and
3) turfgrass soils to determine effect on nitrogen release and on leaching of nutrients and organic compounds.

Several compost types materials were utilized in these projects. These included yard trimming compost obtained from Enviro-Comp (Jacksonville, FL), biosolids composted with yard trimmings from Palm Beach Solid Waste Authority (Palm Beach, FL), municipal solid waste (MSW) composted with biosolids from Bedminster Bioconversion, and MSW compost from Sumter County, FL.

1. BENEFITS OF COMPOST APPLICATIONS TO SANDY SOILS USED FOR VEGETABLE PRODUCTION - This project was initiated to build upon the base knowledge obtained in 1992 and 1993. Compost was applied to tomatoes planted in rotation with bell peppers. The experimental design was a 4 x 4 x 2 factorial in a randomized complete block, split-plot design with four replications. The main plot factor was cropping system, either fall tomatoes followed by spring watermelons, or fall bell pepper followed by spring watermelons. The subplot factor was application schedule, either a full rate applied once at the beginning of experiment to last 2 years, or a half rate applied twice, at the beginning of each year. The sub-plot factor was compost source, either none, Bedminster, Enviro-Comp, or Palm Beach Solid Waste Authority compost (SWA). The Bedminster and Enviro-Comp 2-year application rate was 40 dry tons per real estate acre (80 tons per treated acre). The SWA compost application rate was 13.3 dry tons per real estate acre (26.6 tons per treated acre). The soil series at the field site was pomello fine sand, which contained about 1% organic matter.

Compost application resulted in yield increase and improved fruit quality of bell pepper and tomato plants. Extra-large tomato yield was significantly greater where Enviro-Comp compost was applied compared to unamended soil. Marketable yield in 25-lb cartons per acre was 1158 for Enviro-Comp in comparison to 939 for the unamended soil. The unamended treatment produced the largest yield of medium tomatoes (410 cartons in comparison to 325, 370, and 337 cartons for Bedminster, Palm Beach County, and Enviro-Comp, respectively), had the highest percentage of fruit with "Yellow shoulder" (28% in comparison to 9%, 16%, and 7% for Bedminster, Palm Beach County, and Enviro-Comp, respectively), and produced the firmest tomatoes.

'Fancy' bell pepper yield was greatest in the Bedminster compost treatment compared to the other treatments. The

Envio-Comp treatment produced the firmest peppers, and the unamended treatment produced the softest. There was no difference between treatments in terms of fruit color or post-harvest variables measured. Yield was significantly greater where Palm Beach compost was applied to watermelon compared to unamended soil. The yield difference was attributed to larger individual fruit weight rather than more melons harvested per acre. Watermelon grown with PBC compost was also "sweeter" compared to fruits grown in the other treatments as measured by the brix of a fruit extract.

2. COMPOST APPLIED TO LANDSCAPE BEDS TO ENHANCE ESTABLISHMENT OF WOODY ORNAMENTALS - The objectives of this project was to determine if composts incorporated in landscape soils hastens establishment of container grown woody shrubs and the causes for the improvement in root growth and other measures.

Two types of compost were evaluated. One was a yard waste and biosolid co-compost produced and marketed by West Palm Beach Solid Waste (WPB). The other was a municipal solid waste compost (MSW) produced and marketed by Bedminister Bioconversion.

The experiment was designed as a split plot, with two irrigation frequencies as the main plot and 4 levels of compost and the control soil constituting the sub-plot. Irrigation frequencies were initially set at 0.5 inch daily (High) or 0.75 inch on alternate days (Low). After 5 weeks, irrigation frequency was reduced to alternate days (High) and every third day (Low). Four months after transplanting, frequencies were reduced to twice or once weekly, for High and Low, respectively; and the application rate was increased to 0.75 inches per event for the High frequency. Soil treatments consisted of 1 and 3 inches of MSW compost, 2 and 4 inches of WPB compost, and an unamended control (0 inches).

Incorporation of compost in landscape beds prior to transplanting generally increased both root and shoot growth compared to transplanting into unamended soils. Bulk densities decreased with compost amendments as the 2-inch WPB and 3-inch MSW compost treatments increased air porosity. Changes in the soil physical properties did not adequately explain differences in root or shoot growth measured in the faster growing species. Irrigation frequency had no effect on leaf areas for any species nor shoot dry mass for all species except ligustrum. For the faster-growing species of virburnum and ligustrum, irrigation frequency had a significant impact of overall canopy size, with greater growth occurring at the higher frequency. Overall, the largest canopy growth occurred in soils amended with 4 inches of WPB compost under high irrigation. For the larger growing species, incorporation of 2 inches of WPB compost produced the best hedge.

Analysis of data suggests that canopy effects are opposite to those measured in the roots. Plants grown in highest levels of compost appear to have larger canopies, smaller roots and higher levels of tissue nitrogen. High nitrogen levels in the tissue my explain what appears to be lower root:shoot ratios. All compost amendments appear to have completely substituted for fertilization requirements.

3. EFFECT OF COMPOST IN TURFGRASS SOILS ON NITROGEN RELEASE AND ON LEACHING OF NUTRIENTS- The objectives of this projects were to determine the rate of nitrogen mineralization in three composts (yard trimmings, biosolids/yard trimmings, MSW) and identify laboratory indices related to the mineralization.

Field, greenhouse, and laboratory studies were conducted to evaluate N release from three compost sources. Three compost sources were used: Enviro-Comp, Palm Beach Solid Waste Authority, and Bedminster Bioconversion. In the field, the composts were incorporated into a sandy soil and sodded with St. Augustinegrass. At periodic intervals, the St. Augustinegrass turf was rated visually, and clipping samples were collected and analyzed for N to gauge N mineralization from the compost. The same compost sources were used in a companion study in the greenhouse that utilized N uptake by Bermudagrass as a measure of N mineralization from the compost. In the laboratory, a study was conducted to evaluate the effect of temperature on N mineralization of the three composts used in the field and greenhouse studies. Columns of compost-soil mixes were leached monthly by 0.01M $CaCl_2$, and the leachates were analyzed for N. $CaCl_2$ extracts from the compost-topsoil mixes in the temperature chambers, and those of topsoil alone, were analyzed for volatile and semi-volatile organic compounds. On several dates, surface tension was determined in the $CaCl_2$ leachates.

The Palm Beach source containing the biosolids had the highest content of N, and the Enviro-Comp compost comprised of just yard debris had both the lowest content of N and the highest C/N ratio of the sources used in the studies. In the field study, visual appearance ratings and clipping weights of grass generally were highest for the Palm Beach source, followed rather closely by the Bedminster source. Enviro-Comp source produced poorer results. These data are consistent with the N content data. The greenhouse data are generally consistent with the field data in terms of clipping weights, except that results from the Enviro-Comp source are relatively closer to the other two sources. No volatile or semi-volatile organics were found in the $CaCl_2$ extracts from the compost-topsoil mixes. However, surface tension was found to be lower, though inconsistently so, in leachates from certain soil-compost mixes, as compared to unamended soil, indicating the presence of materials with surfactant properties.

C. PROGRAM MANAGEMENT AND OUTREACH TO ENHANCE COMPOST MARKETING

The objective of this project was to develop effective reporting, interactive communications among all participants in compost research and demonstration programs to end-users and expand outreach to enhance marketing among compost producers, distributors, users and regulators.

All project sites were visited and discussions were held with the researchers to gain a thorough understanding of their experiments and the results being obtained. Photographs and reports on the field and laboratory experiments were compiled for use in outreach materials. An informational video and fact sheet on the projects were produced and distributed among the compost users, producers and regulators. The 10.5-minute video entitled, "Composted Organic Wastes Show Their Market Potential" was produced featuring the sites where compost was being produced and the research sites which were part of this project. Other related activities included arranging field days for various compost projects. The results of the projects have been and will be published in appropriate journals. These materials are being used to inform about and promote the use of compost materials, thus enhancing their markets.

The research projects presented here are addressing several important compost parameters and utilization opportunities. These projects revealed that application of a compost pose no serious threats and if mature, compost is safe and can result in benefits to plant production.

There are several other ongoing research projects by the UF scientists at various locations in Florida. These are designed to further establish markets for composted products by demonstrating the benefits and showing the safe use of composts when used in various utilization schemes.

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